THEORETICAL ESSAYS ON TRADE POLICIES, MERGERS AND FOREIGN DIRECT INVESTMENT

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ABSTRACT

This thesis is a collection of theoretical essays in the area of trade policies, mergers and foreign direct investment. We employ partial equilibrium analysis to investigate various issues concerning the above topic.

In the first chapter we review theoretical works that investigate the links between trade policy and merger activity. We focus our attention on Falvey (1998) which analyses the effects of tariff policy on mergers and reaches the conclusion that tariffs tend to encourage mergers involving small firms based in the restricting country but discourage mergers involving small firms based in the non-restricting country.

In the second chapter we extend Falvey (1998) to include the effects of the quotas on merger profitability. The quotas tend to discourage mergers involving small firms from both restricting and non restricting countries. When a ranking of the tariff and the quota regimes can be made, mergers gains are larger under the equivalent quota regime.

In the third chapter we investigate tariff and quota equivalence when firms have the option of direct investment. High tariffs induce a foreign firm to switch from trade to investing directly in the home country. Restrictive quotas, however, induce a foreign firm to engage in direct foreign investment in addition to trade. The two regimes are not always equivalent especially in terms of the level of imports.

In the fourth chapter we use game theory to investigate the interaction between welfare maximising home government and a foreign firm capable of choosing the direct foreign investment option. If the foreign firm move first, it may pre-empt the home government by committing to the direct investment option if the optimal tariff is expected to be high. If the home government move first, it may need to set the tariff below the optimal level so that direct foreign investment is not induced.

INTRODUCTION

This thesis is a collection of theoretical essays on the effects of trade policies on mergers and foreign direct investment. We investigate the effects of tariff and quota policies on mergers in the first two chapters. In the third chapter we investigate the tariff-quota equivalence when foreign direct investment is possible. Finally we investigate the interaction between the foreign firm who has a choice of direct investment and the welfare maximising home government.

The methodology used in this thesis is the partial equilibrium analysis. The base model which we use throughout the thesis is the international Cournot oligopoly model. We choose oligopoly because we believe that world production is increasingly dominated by international oligopolies, while the Cournot model appealed to us because it provides reasonable and intuitive economic implications for pricing in oligopolistic markets and it is easily tractable. We also assume linear demand and linear marginal costs, these assumptions simplify the analysis greatly and help us to obtain some explicit solutions which are necessary for most of our analysis. In the final chapter we also apply the game theoretical technique to investigate the strategic interaction between the home government and the foreign firm.

On the topic of trade policies and mergers, we begin in chapter 1 by reviewing theoretical works that investigate the link between trade policies and mergers. A common approach to examine this issue is to model a merger as an exogenous reduction in the number of firms and see how this affects the welfare and what the optimal trade policy response should be. However this approach ignores the fact that a merger is a private decision and only occurs if it is profitable to do so. There is an alternative approach which models a merger explicitly in the open economy context. This can be done by incorporating a range of models available in the general merger literature. One of the theoretical works using this alternative approach is Falvey (1998). Falvey employs a model of international Cournot oligopoly with linear demand, constant marginal cost and segmented markets. Potential mergers between large and small firms, which will result in the closure of the high cost (small) firm, are considered. We find that the condition for profitable merger depends on the relative size of the merger participants. When the home country imposes a tariff on imports, the pre-merger sales of home firms rise while the sales of foreign firms fall. As a result the tariff decreases the profitability of marginal mergers that involve the inefficient home firm but it increases the profitability of marginal mergers that involve the inefficient foreign firm.

In chapter 2, we extend Falvey's (1998) model to include the analysis of quota policy and merger profitability. We consider the case where the home government imposes a quota on imports, with quota rights allocated in proportion of free trade sales. We find that the quota, which increases the sales of the home firms, discourages the potential (national and international) mergers that involve the inefficient home firm, at the margin. The national merger between two foreign firms will lead to the transfer of the high cost firm's quota to the remaining low cost foreign firm. Then the quota discourages this merger if the quota constraint is binding on the merged firm. If the quota constraint is not binding, the quota may increase the profitability of this merger. The merger between the large home firm and the small foreign firm is also discouraged by the quota at the margin. Comparison between the tariff and the quota regimes shows that the gains from national mergers between the high cost and the low cost firm are higher under the equivalent quota regime, while the results from international mergers are ambiguous.

In chapter 3, we investigate the issue of tariff-quota equivalence when the foreign firms have the option of direct investment. We consider the model of international Cournot oligopoly with linear demand, constant marginal cost and where all consumption of the good in question occurs in the protected home market alone. We then focus on the decisions of two asymmetric foreign firms who have the option of direct foreign investment (DFI) so that they can produce goods inside the home market albeit at higher marginal costs than the export option. Under the tariff regime the foreign firm will switch from the usual export option to the DFI option once the margin from the DFI option is larger than the margin from the export option which is subjected to a specific tariff. Under the quota regime the foreign firms always supply the home market by trade, however the foreign firm will also engage in the DFI once the margin from the DFI option is larger than the permitted export volume. On the comparison of the two trade regimes, we cannot always find the equivalent regimes that lead to the same price and same imports in the home market. We can always find tariffs and quotas that lead the same price, but for some range of quotas there would not be import equivalent tariffs.

In chapter 4, we investigate the interaction between the welfare maximising home government and the foreign firm which has the option of direct investment. We use a simple sequential game to find the outcomes of this interaction. We first consider a game which sees the foreign firm move to choose between export and direct investment before the home government sets the optimal tariff after which the foreign firm will choose the level of production. A rational foreign firm will foresee the level of the optimal tariff that the home firm will set, and this will help the foreign firm to decide the home market entry choice. The foreign firm will pre-empt the home government by choosing the direct investment option if it anticipates the optimal tariff to be high. For the home government, it cannot always set the tariff optimally because the foreign firm can avoid high trade cost by choosing the direct investment option. If the home government moves first and provided that the direct investment contribute nothing to the home welfare, we may see the government set the tariff just below the switch-over level to prevent the foreign firm from choosing the direct investment option.

CHAPTER 1

TRADE POLICIES AND MERGERS

A Literature Review

1.1 Introduction

In the last few decades we have witnessed a significant reduction in trade barriers. This is resulted from among other things, successions of multilateral trade negotiations (mostly via the GATT and the creation of the World Trade Organization) and the creation of many preferential trading areas. Falling trade barriers together with declining foreign investment restrictions and on going deregulation have brought significant changes in business strategies. One prominent corporate development observed in the wake of this freer trade environment has been a merger wave of unprecedented scale.[1] There is now a considerable literature which offers a theoretical account of the link between trade policies and mergers. The objective of this chapter is to review some of the recent advances in this topic especially on the issue of the effects of tariff on mergers.

The policy relevance of this topic is very significant, especially for its implication on competition policy. The insight into this topic is important to our understanding of how the competition policy should be designed in the wake of freer trade environment. If the reduction in trade barriers induces

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[1] For example a recent figure shows that the value of completed (cross-border) mergers worldwide rose from the total of $200 billion in 1995 to more than $500 billion in 1999 (Evenett et al, 2000). While earlier observation by Long and Vousden (1995) implicates that the lowering of trade barriers within Europe has been followed by a spate of domestic and

increased merger activity, it is suggested that we need to have a strong competition policy to counter the increased market concentration. Then this policy implication contradicts a conventional belief that trade liberalisation can be substituted for a stricter competition policy.[2] The understanding of the link between trade policies and merger activity will also help us to assess the concern that some governments are now substituting the increasingly limited trade policies with the competition policies to pursue the undesirable goal of beggar-thy-neighbour.[3]

In order to understand the link between trade policy and merger activity we need to know whether the reduction in trade barriers stimulates merger activity and if so what type of merger activity. A substantial number of works investigating this topic model mergers as a choice of the number of identical domestic firms chosen by the government. This approach may simplify the analysis greatly, but it ignores the fact that a merger is the decision of private firms and only occurs if it is profitable to do so. There is an alternative approach to model mergers explicitly and this can be done by incorporating general (domestic) merger models into open economies context.

In this chapter and the next we will investigate the link between trade policies and horizontal mergers under Cournot competition. In this chapter we begin by reviewing theories on horizontal merger in the closed economy. Then

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cross-national mergers and the same phenomenon has also been observed in Canada in the wake of Canada-US free trade deal.

[2] One may expect the scaling down of trade barriers to raise domestic and international competition, and hence leading lower prices and higher efficiency. However if market is not perfectly competitive, we might not achieved increased competition following the reduction of trade barriers.

[3] This concern has led to increasing attention from international organizations, such as WTO and OECD, traditionally concerned with trade policies.

we look at the recent development of theories of mergers in open economies. We will focus our attention on the works that investigate the effects of tariff reduction on merger profitability. The literature review in this chapter will give us a firm foundation for the development of the original analysis of quota policy and merger activity in chapter 2. The organisation of this chapter is as follows: Section 1.2 presents the literature review on domestic horizontal mergers. Section 1.3 presents the theoretical review on mergers in open economies. Section 1.4 we investigate the effects of tariff on merger incentives. Conclusion remarks are given in section 1.5.

1.2 Domestic Horizontal Merger

The foundations of the analysis in this chapter and the next are theories of domestic horizontal mergers and theories of mergers in open economies. There exist a large number of theoretical works on domestic horizontal mergers. The general concerns of the literature in this area are the profitability of horizontal mergers and their welfare effects. The early development by Stigler (1950) points out that the new merged firm typically produces less than the combined, pre-merger production of its constituent firms. Unless there is large cost saving from a merger, the reduction in quantity normally increases the industry price. The non-merging firms will benefit from this merger externality and expand their production. On welfare implications of a merger, Williamson (1968) shows that the net social welfare effect of a merger is given by the sum of cost saving gains and additional profits to the remaining firms minus the lost of consumer's surplus (as a result of the higher price).

In the past few decades substantial numbers of formal analysis on domestic horizontal mergers have emerged. One of the prominent works in this field is the paper by Farrell and Shapiro (1990). In their work, Farrell and Shapiro propose a simple condition for a welfare-improving merger, in a context of Cournot oligopoly with general demand and cost functions. Since the main analysis of this chapter and the next are set in the context of Cournot oligopoly, we will look at Farrell and Shapiro (1990) in detail.[4]

Consider a closed economy in which n firms produce a homogeneous product. Assume that the inverse demand for this good is given by $p = p(H)$ where H is the industry output and $p'(H) < 0$. Firm i produces h_i unit of output and faces a cost function $c_i(h_i)$. Competition in this market is assumed to be Cournot and new entry is not permitted. Firm i's profit function is given by

$$\pi_i = p(H) \cdot h_i - c_i(h_i) \tag{1}$$

Taking $\dfrac{\partial H}{\partial h_i} = 1$, the best response of firm i to the output decision of all other firms, H_{-i}, is the unique solution to the first order condition:

$$p(h_i + H_{-i}) + h_i \cdot p'(h_i + H_{-i}) - c_i'(h_i) = 0 \tag{2}$$

To ensure the existence of Cournot equilibrium and the continuous reaction functions we assume that the decreasing marginal revenue property ($p' + h_i p'' \leq 0$) holds, and the cost functions are smooth and $c_i'' - p' > 0$. Together with the previous assumption about the inverse demand ($p' < 0$),

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[4] The Cournot model provides simple yet reasonable and intuitive economic implications for

these conditions ensure that the profit function (1) is concave in h_i.[5] Then we have a negative second order condition[6]:

$$2p' + h_i p'' - c_i'' < 0$$

The slope of firm i's reaction function is obtained by differentiating (2), which gives

$$R_i' \equiv \frac{dh_i}{dH_{-i}} = -\frac{p' + h_i p''}{2p' + h_i p'' - c''} \tag{3}$$

By the second order condition, the denominator of the fraction on the far right-hand side in (3) is negative. The numerator is negative from downward-sloping marginal condition. Thus the slope of the reaction function is negative ($R_i' < 0$), which implies that an increase in the output of all other firms will lead to the contraction of firm i's output. And from (3), we can write $dh_i \cdot (1 + R_i') = R_i' \cdot (dh_i + dH_{-i}) = R_i' \cdot dH$, or

$$dh_i = -\lambda_i \cdot dH \tag{4}$$

where $\lambda_i = -\frac{R_i'}{1 + R_i'} = \frac{p' + h_i p''}{p' - c_i''} > 0$ as $p' + h_i p'' \leq 0$ and $c_i'' - p' > 0$. Since $dh_i = -\lambda_i dH$ and $dH_{-i} = \sum_{j \neq i} dh_j = -(\sum_{j \neq i} \lambda_j) \cdot dH$, then

$$dH = dh_i + dH_{-i} = dh_i - (\sum_{j \neq i} \lambda_j) \cdot dH$$

from which we have

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pricing in oligopolistic markets. Another reason that we employ the Cournot model is its tractability.

[5] See Vives (1999) and Collie (1992) for discussions of several types of existence results which may apply to the Cournot model.

[6] This follows since $\frac{\partial^2 \pi_i}{(\partial h_i)^2} = p' + h_i p'' + p' - c_i'' < 0$ as $p' + h_i p'' \leq 0$ and $c_i'' - p' > 0$.

$$\frac{dH}{dh_i} = \frac{1}{(1+\sum_{i \neq j} \lambda_i)} \tag{5}$$

Because the λ_i coefficients are positive, then $0 < \frac{dH}{dh_i} < 1$. This result implies that if firm *i* changes its output, and all other firms adjust output along their reaction curves, the aggregate output will change in the same direction as firm *i*'s output, but by less. With this result we can see the price effects of the domestic horizontal merger by simply concentrating on the change in output of the merger participants.

Suppose that the first *m* firms (of the total *n* firms) merge into a single firm. Let the pre-merger output of the first *m* firms be $H_m = \sum_{i=1}^{m} h_i$. At the pre-merger output, the marginal revenue of the merged firm is given by $p(H) + p'(H) \cdot H_m$. The merged firm will reduce output if and only if its post-merger marginal cost, c'_M, exceeds marginal revenue at the pre-merger output level, or

$$c'_M > p + H_m p' \quad \Leftrightarrow \quad -H_m p' > p - c'_M \tag{6}$$

From the merged firm's reaction function (2), we can write,

$$-p'H_m = \sum_{i=1}^{m} [p - c'_i]$$

Thus the merged firm will reduce output (from the pre-merger level) if and only if it's post-merger mark-up is less than the sum of the pre-merger mark-ups of its constituent firms, i.e. if and only if

$$\sum_{i=1}^{m} [p - c'_i] > p - c'_M \tag{7}$$

The above condition must hold if $c'_m \geq \min\{c'_i\}$, since $p \geq c'_i$, $\forall i$ (so that each firm produces positive output). In other words, the merger will lead to the reduction in output of the merged firm (from the pre-merger level) unless the marginal cost of the newly merged firm is lower than the pre-merger marginal cost of the most efficient merger participant. If the merged firm output is reduced from the pre-merger level, then it follows immediately that the new aggregate output will also be reduced (from equation 5), and the price will rise.

In a simple two-firm merger between firm *1* and firm *n* (with $c'_1 < c'_2 < ... < c'_n$), the price will fall if and only if $p - c'_M > (p - c'_1) + (p - c'_n)$, or equivalently

$$c'_n - c'_M > p - c'_1 \tag{8}$$

If a merger generates no synergies, i.e. the new merged firm's production possibilities are no different from those of the merger participants (jointly) before the merger, then the merger raises domestic price. With no synergies, c'_M is normally the marginal cost of the most efficient firm that participates in the merger. In the above two-firm merger case, the post-merger production possibility is equivalent to c'_1. It is now easy to show that condition (8) is reduced to $c'_n > p$, which cannot be true. Thus this merger will lead to an increase in price. Farrell and Shapiro (1990) also show that condition (8) can be expressed in terms of pre-merger variables as[7]

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[7] From (8), we have $c'_m < -p + c'_1 + c'_n$. Then we can rewrite the inequality as $c'_m < p - [(p - c'_1) + (p - c'_n)]$, or equivalently $c'_m < p + p'[h_1 + h_n]$. Finally we have $c'_m < p + p\left[\frac{p'H}{p}\right]\left[\frac{h_1 + h_n}{H}\right] \Leftrightarrow c'_m < p - p\left[\frac{h_1 + h_n}{\varepsilon H}\right]$.

$$c'_M < p\left[1 - \frac{s_1 + s_n}{\varepsilon}\right] \tag{9}$$

where s_i is firm i's pre-merger market share and $\varepsilon = -\frac{p}{p'H}$ is the elasticity of demand. Condition (9) shows how much less than the current price the merged firm's marginal cost must be, if price is to fall.

Next we turn our attention to the profitability of the merger. A merger will not actually happen unless it is profitable. Consider the general case where the first m firms are merging. We can define the gain (G) from this merger as

$$G = \hat{\pi}_m - \sum_{i=1}^{m} \pi_i$$

where $\hat{\pi}_m$ is the post-merger profit of the merged firm, and the second term on the right hand side is the sum of pre-merger profits of all merger participants. For a merger to be profitable, we need $G > 0$. Before the merger, firm i produces $h_i = -\frac{p - c_i}{p'}$, with a profit function given by $\pi_i = ph_i - c_i(h_i)$. After the merger, each remaining firm j produces $\hat{h}_j = -\frac{\hat{p} - c_j}{p'}$, with a profit of $\hat{\pi}_j = \hat{p}\hat{h}_j - c_j(\hat{h}_j)$. The gain from merger is given by

$$G = \left[\hat{p}\hat{h}_m - mp\sum_{i=1}^{m} h_i\right] + \left[\sum_{i=1}^{m} c_i(h_i) - c_m(\hat{h}_m)\right] \tag{10}$$

Thus the condition for a privately profitable merger among the first m firms is

$$\left[\sum_{i=1}^{m} c_i(h_i) - c_m(\hat{h}_m)\right] > \left[(mp\sum_{i=1}^{m} h_i) - \hat{h}_m\hat{p}\right] \tag{11}$$

The left-hand side of the above inequality is the potential cost saving from the merger, while the right-hand side reflects the potential losses in revenue.

However with general demand and general cost specifications, it is difficult to analyse the above condition explicitly.[8] Since the main analysis in this chapter and the next concern the effects of trade policies on merger incentive, we need to examine the issue of merger profitability explicitly. So let now consider other horizontal merger models that relax the assumptions of general demand and general cost functions.

Salant, Switzer, and Reynolds (1983) analyse a horizontal merger in a context of Cournot oligopoly with a linear demand and identical firms. In this model we assume a linear demand given by $D = A - p$, where A is a positive constant. There are n identical firms and each firm has an identical constant marginal cost of c, and a profit function given by $\pi = (p-c)h$. By solving the profit maximisation problems, we get the equilibrium price, each firm's optimal output, and each firm's profit as

$$p = \frac{A+nc}{n+1};\ h_i = p - c = \frac{A-c}{n+1};\ \pi = (h)^2 = \left[\frac{A-c}{n+1}\right]^2 \tag{12}$$

Next consider a simple merger between two firms, firm *1* and firm *n*. We assume that a merger does not generate cost synergies, and simply leads to a shutting down of one of the merger participants (and suppose that firm n will be shut down). Then the market equilibrium price is simply that which would obtain in the absence of firm n. Thus the post-merger price ($\hat{p}$) is

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[8] Farrel and Shapiro (1990) model focuses mainly on the welfare implication of a merger. Their model give a simple condition for a net positive welfare effect of a privately profitable merger on outsiders (non-participating firms) and consumers as $\sum_{i \in O} \lambda_i s_i > s_I$, where s_i, $i \in O$ is a market share of each outsider firm, s_I is a market share of the insider and λ_i is defined above in equation (4).

$$\hat{p} = \frac{A+(n-1)c}{n} \tag{13}$$

It follows immediately that the changes in price, output for each remaining firm, and industry output, as a result of this merger are given by[9]

$$\Delta p = \hat{p} - p = \frac{h}{n}\,;\ \Delta h_j = \Delta p = \frac{h}{n},\ j = 1,\ldots,n-1\,;\ \Delta H = \Delta D = -\frac{h}{n} \tag{14}$$

It is clear from the above results that a merger will lead to the increase in price as the total industry output falls, but each remaining firm will produce more output. The post-merger profit of the remaining firm j ($j \neq n$) is given by $\left[\frac{A-c}{n}\right]^2$. Then the increase in profit for each remaining firm is

$$\Delta \pi_j = \hat{\pi}_j - \pi_j = \left[\frac{A-c}{n}\right]^2 - \left[\frac{A-c}{n+1}\right]^2 = \frac{(2n+1)(A-c)^2}{n^2(n+1)^2} > 0 \tag{15}$$

The above result shows that the merger between two identical firms will lead to the increase in profit for each remaining firm. Thus each of the non-participant firms will definitely benefit from the merger. But for the merger participants (firm *1* and n), the merger gain (G) is the difference between the increased profit of firm *1* and the forgone pre-merger profit of firm n, that is

$$G = \Delta\Pi_1 - \Pi_n = \frac{(2n+1)(A-c)^2}{n^2(n+1)^2} - \frac{(A-c)^2}{(n+1)^2} = \frac{(2n+1-n^2)(A-c)^2}{n^2(n+1)^2} \tag{16}$$

The above equation implies that a merger will be profitable if $n < 3$.[10] That is in Salant et al (1983) model, symmetric firms have no incentive to merge (two-

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[9] $\hat{p} - p = \frac{A-nc}{n+1} - \frac{A-(n-1)c}{n} = \frac{A-c}{n(n+1)} = \frac{h}{n}$; $\hat{h}_j - h_j = (\hat{p}-c) - (p-c) = \Delta p$;
$\hat{H} - H = (n-1)\Delta h - h = (n-1)\frac{h}{n} - h = -\frac{h}{n}$.

firm merger) unless there are initially 2 firms and the two merge into a monopoly. This result is not surprising, since the merger in this model offers only the increased profit from the anti-competitive effect without any efficiency gain. In addition the merged firm has to share any gain from the anti-competitive effect equally with the non-participating firms. In most case, this gain from the anti-competitive effect is too small to offset the loss from the pre-merger profit of the closed down firm.

A similar result also arises in the multi-firm merger case. Now suppose that that firms *1* through m (for $m<n$) merge into a single firm. In this case the post-merger equilibrium price is[11]

$$\hat{p}=\frac{A+(n-m+1)c}{n-m+2} \tag{17}$$

The post-merger profit for each remaining firm is $(\hat{p}-c)^2=\left[\frac{A-c}{n-m+2}\right]^2$. Then the merger gain in this case is

$$G=\left[\frac{A-c}{n-m+2}\right]^2-m\left[\frac{A-c}{n+1}\right]^2 \tag{18}$$

The above equation implies that the merger gain will be positive if $(n-1)^2>m(n-m+2)^2$. By using numerical examination, Salant et al show that if there are six or fewer firms, a profitable merger must include all the firms in the industry. If $7\geq n\geq 11$, at most one firm can be excluded from a merger if it to be profitable for the participants. Again this result demonstrates that the condition for a profitable merger is very restrictive and this sort of

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[10] From equation (16), the merger gain will be positive if $2n+1-n^2>0$, and this condition will be met if $n<3$.

combination (which leads to a profitable merger) is unlikely in real world mergers.

However if a merger leads to a large fixed cost saving, a normal merger of symmetric Cournot firms may be profitable. Recall the two-firm merger case in the industry that there are at least 3 firms. Then a merger between firm *1* and firm *n* will result in a loss of L ($L = G < 0$).[12] Now assume further each firm faces a positive fixed cost of F in addition to the identical constant marginal cost. The inclusion of the fixed cost assumption does not affect the equilibrium price and outputs, but the pre-merger profit of each firm will be $\pi_i = \left[\frac{A-c}{n+1}\right]^2 - F$.[13] A merger between firm *1* and firm *n* will lead to a closure of one of the merging partners (again suppose it is firm *n*). Then the profit of the merged firm is given by $\hat{\pi}_1 = \left[\frac{A-c}{n}\right]^2 - F$. The gain from this merger is

$$G_F = \hat{\pi}_1 - \pi_1 - \pi_n = L + F \qquad (19)$$

Then this merger will be profitable if, *F*, the fixed cost saved by shutting down a firm is bigger than *L*. In this case, a merger of identical firms could be profitable if the fixed cost saving is large enough.

Perry and Porter (1985) consider a merger of asymmetric firms. In their analysis, firms are assumed to be endowed with different capital base, and a merger involves the taking over of capital assets of a target firm. In this model

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[11] This price is simply that which would obtain in the case where *m*-1 firms depart the market.

[12] Since $L = \frac{(2n+1-n^2)(A-c)^2}{n^2(n+1)^2}$, then $L < 0$ for $n \geq 3$.

the expansion of the capital base of a merged firm will lead to the reduction of its marginal cost. This can be done specify a marginal cost function of firm *i* as $MC_i = d + \frac{h_i}{s_i}$, where *d* denotes the intercept of the marginal cost function, and $s_i \le 1$ denotes the share of capital endowment available to firm *i*. A merger of two firms will lead to the addition of capital stocks of the two parties involved. With the above marginal cost formulation, the merged firm will have lower cost function as its capital base expands.[14] Thus a merger in this model not only has the anti-competitive benefit to the merged firm, but also the efficiency gain as a result of the reduction in its marginal cost. Unlike Salant et al. (1983) result, firms in this case will often have an incentive to merge.[15]

1.3 Horizon Mergers in Open Economies

The second foundation of our main analysis comes from the literature on mergers in open economies. Recently there have been several works that study the effects of trade liberalisation (in the light of success of negotiations under GATT and WTO) on mergers. The main concern in this research area is whether freer trade should be accompanied by more lenient competition

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[13] The inclusion of a fixed does not change the first order conditions of the profit maximization problems. Hence the post-merger equilibrium price and outputs will be the same for any value of F.

[14] For example, if firm *1* and firm *n* merge, the new share of capital endowment of the merged firm will be $s_1 + s_n$. Then a marginal cost function of a merged firm is $MC_m = d + \frac{h_m}{s_1 + s_n}$, and this function has a lower gradient than both pre-merger marginal cost functions of the two parties.

[15] There are also other approaches which show similar result that firms often have incentive to merge. For examples in Deneckere and Davidson (1985) which assumes Bertrand competition with differentiated products, and in McElroy (1991) which allows conjectures variation in the post-merger stage.

(especially merger) policy. The literature that discuss this issue includes Dixit (1984), Ross (1987), Long and Vousden (1995), Collie (1997), Falvey (1998) and Horn and Levinsohn (2000).[16] We will begin with Dixit (1984) and Collie (1997), which examine the links between mergers and trade policies in an international oligopoly model.

We consider a model where there are two countries – home and foreign (where variables are denoted with asterisk). Each country has a small number of firms (n domestic firms and n^* foreign firms) producing a homogeneous product and the entry of new firms is not possible. The firms compete in Cournot oligopoly fashion in the domestic market, and for simplicity it is assumed that all consumption of this product occurs in the home country.[17] It is also assumed that each domestic firm has a constant marginal cost c and a fixed cost F. Similarly each foreign firms has a constant marginal cost c^* and a fixed cost F^*. On the supply side, home firms each sell h units and foreign firms each sell h^* units of output in the domestic market; hence, domestic production is $H = nh$, foreign exports (domestic imports) are $H^* = n^*h^*$, and total sales are $X = H + H^*$. On the demand side, the inverse demand function is given by $p = p(X)$, and it is assumed that $p'(X) < 0$. The home government maximises national welfare by using a specific tariff t and a production subsidy s, while the foreign government is assumed to be passive.

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[16] Other works in this area include Fracois and Horn (2000), which looks at different competition policies in the open economy framework, while Richardson (1999) analyses trade and competition policies in a framework of free trade area. Barros and Cabral (1994), Head and Ries (1997), and Kabiraj and Chaudhuri (1999) all focus on the welfare effects of mergers in open economies.

[17] This is similar to considering one of two segmented markets.

A horizontal merger will be modelled as an exogenous reduction in the number of firms.

We begin the analysis by considering profit functions of domestic and foreign firms which are given by

$$\pi_i = (p-c+s)h - F; \ \pi_i^* = (p-c^*-t)h^* - F^*$$

Assume that the marginal revenues are strictly decreasing, $p' + hp'' < 0$ and $p' + h^* p'' < 0$.[18] This assumption together with the decreasing demand function ($p'(X) < 0$) and a constant marginal cost ($c' = c^{*\prime} = 0$) ensure that the profit functions have negative second order conditions and thus are concave in h and h^*.[19] With concave profit functions we can find the unique Cournot solutions by solving the first order conditions:

$$\frac{\partial \pi}{\partial h} = p + hp' - c + s \tag{20a}$$

$$\frac{\partial \pi^*}{\partial h^*} = p + h^* p' - c^* - t \tag{20b}$$

By equating the above two first order conditions to zero, we can solve for the initial equilibriums of domestic price, home firms' and foreign firms' outputs. However we are more interested in the effects of trade policy variables (t and s) on mergers (in this case the reduction in number of symmetric firms), then

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[18] Collie (1997) assumes less restrictive conditions of $(n+1)p' + Hp'' < 0$ and $(n^*+1)p' + H^* p'' < 0$, which ensures the 'global' concavity of the profit functions. These conditions allow the firms' output to be strategic substitutes or complements whereas the usual conditions assumed above imply that firms' output are strategic substitutes.

[19] The SOCs are $\dfrac{\partial^2 \pi}{(\partial h)^2} = p' + hp'' + p' < 0$ and $\dfrac{\partial^2 \pi^*}{(\partial h^*)^2} = p' + h^* p'' + p' < 0$.

we must carry out the comparative static analysis of the system (20a) and (20b). Totally differentiate the first order conditions (20a) and (20b) to obtain

$$\begin{bmatrix} n\phi + p' & n^*\phi \\ n\phi^* & n^*\phi^* + p' \end{bmatrix} \begin{bmatrix} dh \\ dh^* \end{bmatrix} = \begin{bmatrix} -1 & 0 & -\phi h & -\phi h^* \\ 0 & 1 & -\phi^* h & -\phi^* h^* \end{bmatrix} \begin{bmatrix} ds \\ dt \\ dn \\ dn^* \end{bmatrix} \tag{21}$$

where $\phi = p' + hp'' < 0$ and $\phi^* = p' + h^* p'' < 0$. The determinant of the matrix on the left hand side of system (21) is $\Omega = (n\phi + n^*\phi^* + p')p'$ which is positive.[20] Then the solution of the system (21) yields the comparative static results for effects of trade policy variables, number of home and foreign firms on the Cournot output of domestic and foreign firms:

$$\begin{bmatrix} dh \\ dh^* \end{bmatrix} = \frac{1}{\Omega} \begin{bmatrix} n^*\phi^* + p' & -n^*\phi \\ -n\phi^* & n\phi + p' \end{bmatrix} \begin{bmatrix} -1 & 0 & -\phi h & -\phi h^* \\ 0 & 1 & -\phi^* h & -\phi^* h^* \end{bmatrix} \begin{bmatrix} ds \\ dt \\ dn \\ dn^* \end{bmatrix}$$

or

$$\begin{bmatrix} dh \\ dh^* \end{bmatrix} = \frac{1}{\Omega} \begin{bmatrix} -(n^*\phi^* + p') & -n^*\phi & -\phi hp' & -\phi h^* p' \\ n\phi^* & n\phi + p' & -\phi^* hp' & -\phi^* h^* p' \end{bmatrix} \begin{bmatrix} ds \\ dt \\ dn \\ dn^* \end{bmatrix} \tag{22}$$

And for the industry output by home firms $H = nh$, and the total output by foreign firms $H^* = n^* h^*$, the comparative results are obtained by totally differentiate H and H^* ($dH = ndh + hdn$ and $dH^* = n^* dh^* + h^* dn^*$), which gives

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[20] Since ϕ, ϕ^*, and p' are all negative, thus the sum of the terms in the brackets is negative and this makes the product of the whole terms positive in sign.

$$\begin{bmatrix} dH \\ dH^* \end{bmatrix} = \frac{1}{\Omega} \begin{bmatrix} -n(n^*\phi^* + p') & -nn^*\phi & hp'(n^*\phi^* + p') & -n\phi h^* p' \\ nn^*\phi^* & n^*(n\phi + p') & -n^*\phi^* hp' & h^* p'(n\phi + p') \end{bmatrix} \begin{bmatrix} ds \\ dt \\ dn \\ dn^* \end{bmatrix}$$

(23)

Finally we will look into the effects on the total output (home and foreign) and its price. Recall that $X = H + H^*$ and $dp = p' \cdot dX$, then comparative static results for the effects on total output and on price are

$$\begin{bmatrix} dX \\ dp \end{bmatrix} = \frac{p'}{\Omega} \begin{bmatrix} -n & n^* & hp' & h^* p' \\ -np' & n^* p' & h(p')^2 & h^*(p')^2 \end{bmatrix} \begin{bmatrix} ds \\ dt \\ dn \\ dn^* \end{bmatrix} \qquad (24)$$

The above comparative static results (22) – (24) show the effects on output and on price as a result of the changes in home government policies and the number of firms. A subsidy increases the production of home firms, while it decreases the production of foreign firms. A tariff, on the other hand, reduces the production of foreign firms but it increases home firms' production. At the aggregate level, an increase in subsidy raises the total output of the good and hence reduces the price. An increase in tariff reduces the total output and therefore increases the price. For the effects of mergers we consider the effects of an exogenous reduction in the number of firms. As the number of home firms changes, we find a national merger in a home country ($dn < 0$) and a national merger in a foreign country ($dn^* < 0$) each raises the output of every surviving firm in each market, but the total output in each market declines and the price goes up.

With this model, Collie (1997) shows that we can analyse the welfare effect of the changes in number of home and foreign firms when domestic government employs optimal trade policies. The domestic welfare measure is given by the sum of consumer surplus, producer surplus and the net government revenue:

$$W = V(p) + n\pi + (tH^* - sH) = V(p) + (p-c)H - nF + tH^* \qquad (25)$$

where $V(p)$ is the aggregate indirect utility function. Then we can find optimal tariff and subsidy rates for the home government by maximising domestic welfare (25) with respect to t and s. By taking the optimal trade policy variables into consideration, Collie shows that the overall effects of domestic and foreign merger are given by

$$\frac{dW}{dn} = \frac{\partial W}{\partial n} + \frac{\partial W}{\partial t}\frac{dt^O}{dn} + \frac{\partial W}{\partial s}\frac{ds^O}{dn}$$

and

$$\frac{dW}{dm} = \frac{\partial W}{\partial m} + \frac{\partial W}{\partial t}\frac{dt^O}{dm} + \frac{\partial W}{\partial s}\frac{ds^O}{dm}$$

By examining the comparative static results (obtained by totally differentiating the first order conditions) of the domestic welfare maximisation problem together with the results previously obtained, Collie (1997) finds that when the domestic country pursues an optimal trade policy, it will always worse off as a result of a foreign merger. The optimal response of the domestic country to a foreign merger is to decrease (increase) the tariff, if demand is concave (convex), and to increase its production subsidy. The optimal response to a domestic merger is to leave the tariff unchanged and to increase the production subsidy so that the domestic industry output remains unchanged.

The above approach by Dixit (1984) and Collie (1997) shows how the changes in trade policies variables and the number of firms affect the Cournot equilibrium. More importantly this approach can give the implications for optimal trade policies in the light of mergers.[21] However by modelling a merger as an exogenous reduction in the number of firms, we cannot examine the direct effects of trade policy on mergers.[22] Moreover by assuming asymmetric firms, the above model also fails to tackle the issues of merger incentives. Although the above model shows that national mergers (both in home and foreign countries) lead to increased profits for the remaining firms (as both the price and the output of each surviving firm increase as a result of a reduction in a number of firms), it does not mean that mergers are profitable to the group of merging firms. We have demonstrated in the domestic merger review section (Salant et al. 1983) that a merger of identical firms in oligopolistic competition is unprofitable unless firms are merging into a monopoly or there is a very large fixed cost saving. Since the issue of merger profitability is essential to the main analysis we will now turn our attention to the approach that models merger explicitly. This can be done by incorporating the conventional merger literature into the open economies context.

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[21] Horn and Levinsohn (2000) also use similar approach to examine the links between trade policies and the optimal domestic concentration level via the analysis of a reduced form welfare formula.

[22] In a similar setting of international Cournot model with symmetric home firms and symmetric foreign firms, Ross (1988) examines the indirect effect of a change in tariff policy on a merger. This is done by taking the view that a change in tariff will lead to a change in foreign firms' marginal cost. Then we can find out how a reduction in foreign firms' marginal cost (as a result of tariff reduction) changes the effect of a merger (a reduction of number of firms) on price by examining the terms $\frac{d^2p}{dndc^*}$ and $\frac{d^2p}{dn^*dc^*}$.

In Barros and Cabral (1994), the domestic merger model of Farrell and Shapiro's (1990) is extended to the open economies context. This analysis focuses on the external welfare effect of mergers and the rule for approving a merger in open economies. However there is little emphasis on merger incentive in Barros and Cabral's model. Gaudet and Kanouni (2000) examine how the removing of a tariff (at different levels) affects the profitability of a domestic merger of symmetric firms that saves a fixed cost. However in this model, a small trade liberalisation will have a limited impact on merger incentive. In Neven and Seabright (1997), a simple version of Perry and Potter's (1985) model is applied to the open economies context. They focus on a cross-border merger of two asymmetric firms that results in a lower cost for a merging firm as the two parties combine their capital assets together.[23] It appears that there are some incentives to undertake a cross-border merger when trade costs (as a result of a tariff) are high. However the cross-border merger will be less profitable as trade costs are reduced.

In a simpler way of modelling a merger of asymmetric firms in open economies, Long and Vousden (1995) focus on firms with different technologies (and hence with different marginal costs). It is assumed that there are $n+2$ domestic firms and m foreign firms competing in Cournot fashion to supply a good to two segmented markets (home and foreign). For domestic firms, there are n identical firms but the other two firms have different constant marginal costs. For foreign firms, all m firms are identical. A merger will result in the adopting of technology of the lower cost firm, i.e. the

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[23] Recall that in this type of model, there is a direct link between the size of capital base and the

participant with higher cost will be closed down. With linear demand a merger of two firms will be profitable if the cost-reduction effect (which depends on the difference in marginal costs of the two firms) is sufficiently high. Long and Vousden then examine the effects of tariff liberalisation on a domestic merger of the two asymmetric firms and on a cross-border merger. A change in tariff will change a range of cost differences that make mergers profitable. It turns out that the unilateral tariff reduction will encourage domestic mergers which primarily concentrate market power (mergers with low cost-reduction effects). However the equal bilateral tariff reductions will encourage domestic mergers which primarily reduce cost (mergers with high cost-reduction effects). On cross-border mergers, Long and Vousden consider two types of merger. The first type is a cross-border merger which supplies each national market from a local plant, and this type of merger will be discouraged by both unilateral and bilateral tariff reductions. The second type of cross-border merger that Long and Vousden consider is a merger which leads to a closed down of a home firm's plant (higher marginal cost). Unilateral tariff reduction will encourage type II cross-border mergers which have lower cost saving effects, while bilateral tariff reductions will encourage type II cross-border merger which have large cost-saving effects.

Falvey (1998) also considers mergers among firms with different technologies from both domestic and foreign countries. This model focuses on mergers of a low cost firm and a high cost firm (which will result in a closed down of the high cost firm) from the same or different countries. Set in a

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marginal cost.

context of linear demand, constant marginal cost, and Cournot competition, Falvey's model gives relatively simple outcomes of several types of mergers under a tariff regime (which is imposed by the domestic country). As our original analysis of mergers and quota policy in chapter 2 is the extension of Falvey's model, we will examine this model in more details in the next section.

1.4 The Effects of Tariff on Mergers

We consider a model of international oligopoly comprised of two countries: home and foreign. Each country has a small number (n, $n^* \geq 3$) of firms producing a homogeneous product supplying both home and foreign markets and entry of new firms is not possible.[24] Competitions in both markets are assumed to be Cournot. Each firm faces constant unit cost and no fixed costs.[25] Unit costs differ across firms with $c_k > c_i$ if $k > i$. The home government can impose a small specific tariff of t per unit, which implies that the cost of firm i^* of selling in the home market will be $c_i^* + t$. It is also assumed that there are no transport costs. As demonstrated by Falvey (1998), we can make two alternative assumptions about the linkages between the two national markets: an integrated world market, and segmented markets. In the case of integrated world market, arbitrage between markets is possible (if the difference in prices in the two markets exceeds the relevant tariff) and it will link the prices between the two countries. A change in tariff will affect the

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[24] To ensure that after the merger we do not end up with a monopolist.

[25] As previously discussed, the equilibrium price and outputs will be same for any value of a fixed cost. However a fixed cost will affect firms' profits and hence the potential gains from mergers.

equilibrium in both markets.[26] In the case of segmented markets, on the other hand, we can treat the two markets independently. And the change in tariff will only affect the equilibrium in the home market. We will focus our attention only on the segmented markets case as this will simplify the extension of this model in chapter 2 to include the examination of quota policy on mergers.

Let h_i, f_i (h_i^*, f_i^*) denote the sales of each home (foreign) firm in the home and foreign markets respectively. Assume that demands for home and foreign markets are linear and given by

$$D = A - p;\ D^* = A^* - p^* \tag{26}$$

where A and A^* are positive constants, and p and p^* are domestic and foreign prices respectively. Market clearing requires that

$$D = H + H^*;\ D^* = F + F^* \tag{27}$$

where $H = \sum_{i=1}^{n} h_i$, $H^* = \sum_{i^*=1}^{n^*} h_i^*$, $F = \sum_{i=1}^{n} f_i$, and $F^* = \sum_{i^*=1}^{n^*} f_i^*$.

Let first consider the case of free trade equilibrium (i.e. $t = 0$). Then domestic and foreign firm profit maximization problems are

$$\underset{h_i, f_i}{Max} \quad (p - c_i)h_i + (p^* - c_i)f_i\ ; \quad \underset{h_i^*, f_i^*}{Max} \quad (p - c_i^*)h_i^* + (p^* - c_i^*)f_i^* \tag{28}$$

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[26] In this case of integrated market, we would model a two-stage game. In the first stage, firms choose their outputs in each market, taking each other firm's outputs as given. In the second stage, arbitrage activity occurs if the first stage results in a price differential between the two markets that exceeds the relevant tariff.

Taking $\frac{dp}{dh_i}=\frac{dp}{dh_i^*}=\frac{dp^*}{df_i}=\frac{dp^*}{df_i^*}=-1$ (this reflects the assumption that firms choose the quantities to produce independently in the Cournot model), we can find each firm optimal output by solving $FOC=0$, this gives[27]

$$h_i = p-c_i;\ f_i = p^* - c_i;\ h_i^* = p - c_i^*;\ f_i^* = p^* - c_i^* \tag{29}$$

The equilibrium profits for home and foreign firms are

$$\pi_i = (h_i)^2 + (f_i)^2;\ \pi_i^* = (h_i^*)^2 + (f_i^*)^2 \tag{30}$$

Substituting the optimal outputs into the demand functions (26), gives the equilibrium domestic and foreign prices:

$$p=\frac{A+C+C^*}{N+1};\ p^* = \frac{A^*+C+C^*}{N+1} \tag{31}$$

where $C=\sum_{i=1}^{n} c_i$, $C^* = \sum_{i^*=1}^{n^*} c_i^*$, and $N=n+n^*+1$. Noting that the difference between the two free trade equilibrium prices is

$$\alpha = p^* - p = \frac{A^*-A}{N+1}$$

Then this term, α, also represents the difference in sales between the two markets by each firm.[28]

Next consider a two-firm merger case. Again assume that the merger does not generate cost synergies. Then cost minimization by the new merged firm implies the abandonment of the relatively inefficient participant's technology.

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[27] We can confirm that the solutions of the first order conditions are the unique Cournot equilibriums since the second order conditions are negative, $\frac{\partial^2\pi_i}{(\partial h_i)^2}=\frac{\partial^2\pi_i}{(\partial f_i)^2}=\frac{\partial^2\pi_i^*}{(\partial h_i^*)^2}=\frac{\partial^2\pi_i^*}{(\partial f_i^*)^2}=-2$.

[28] Given the definition of α, we can write $f_i = h_i + \alpha$ and $f_i^* = h_i^* + \alpha$.

With this lock-up merger, the post-merger equilibrium is that which obtains with the closure of one of the merger participants.

A National Merger in the Home Country under Free Trade Regime

To illustrate, consider the merger between firm *1* and firm *n*. As it will become clear later, this merger is likely to be the most profitable of the potential mergers. The merger results in the departure of firm *n*, then the post-merger equilibrium outputs of $n-1$ home firms and n^* foreign firms are given by

$$\hat{h}_j = \hat{p} - c_j,\ \hat{f}_j = \hat{p}^* - c_j,\ j \neq n;\ \hat{h}_i^* = \hat{p} - c_i^*,\ f_i^* = \hat{p}^* - c_i^*$$

where $\hat{x}$ denotes the post-merger equilibrium value of variable x. Summing these optimal outputs and then substituting into the demand functions, we get the post-merger prices:

$$\hat{p} = \frac{A + C + C^* - c_n}{N};\ \hat{p}^* = \frac{A^* + C + C^* - c_n}{N}$$

Then the effects of a merger on equilibrium outputs and prices are[29]

$$\Delta h_j = \Delta h_i^* = \Delta p, j \neq n;\ \Delta p = \frac{h_n}{N};\ \Delta f_j = \Delta f_i^* = \Delta p^*, j \neq n;\ \Delta p^* = \frac{f_n}{N} \quad (32)$$

where $\Delta x = \hat{x} - x$ indicates the discrete change in the equilibrium value of variable x as a result of merger. This merger results in the increase in sales (in both markets) of each of the remaining (*N*-1) firms. The sales of each firm rise

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[29] It follows that $\Delta h_j = (\hat{p} - c_j) - (p - c_j) = \Delta \hat{p}, j \neq n$;
$\Delta h_i^* = (\hat{p} - c_i^* - t) - (p - c_i^* - t) = \Delta \hat{p}$;

by one *N*th of the departing firm's original sales. Then it follows immediately that the total outputs fall (as there are only *N*-1 firms left) and prices rise.

Next we investigate the effect of this merger on firms' profits. The change in profit of the home firm j ($j \neq n$) is given by[30]

$$\Delta \pi_j = \Delta p h_j + [\hat{p} - c_j]\Delta h_j + \Delta p^* f_j + [\hat{p}^* - c_j]\Delta f_j$$

Since equilibrium prices and firm's optimal outputs increase as a result of a merger, then it is clear that firm *j*'s profits will be increased as a result of a merger between firm *1* and firm *n*.[31] The expression for the change in profit for each foreign firm is also derived similarly. After substituting the expressions for Δh_j, Δp, Δf_j, and Δp^*, we can derive simple expressions for $\Delta \pi_j$ and $\Delta \pi_i^*$ as

$$\Delta \pi_j = \Delta p[2h_j + \Delta p] + \Delta p^*[2f_j + \Delta p^*];$$

$$\Delta \pi_i^* = \Delta p[2h_i^* + \Delta p] + \Delta p^*[2f_i^* + \Delta p^*] \qquad (33)$$

Given Δp and Δp^*, which depend only on the initial output of the departing firm, expressions (33) show that the most efficient firm (i.e. the largest firm)

$\Delta p = \dfrac{A+C+C^* - c_n}{N} - \dfrac{A+C+C^*}{N+1} = \dfrac{A+C+C^*}{N(N+1)} - \dfrac{c_n}{N} = \dfrac{h_n}{N}$. And the results for Δf_j, Δf_i^*, and Δp^* are derived similarly.

[30] We can break down the change in firm *j*'s profits from each market into two components. The first component is the change in profits resulting from the change in price on the original output. The second component is the change in profits resulting from the change in output at the new (post-merger) price.

[31] We can rearrange the expression for the change in firm *j*'s profits to get

$$\Delta \pi_j = \left[\Delta p \hat{h}_j + [p - c_n]\frac{h_n}{n} + [c_n - c_j]\frac{h_n}{n}\right] + \left[\Delta p^* \hat{f}_j + [p^* - c_n]\frac{f_n}{n} + [c_n - c_j]\frac{f_n}{n}\right]$$

With this expression we can investigate the sources of firm *j*'s increased profits. For each market, the increased profits are coming from a transfer form consumers' surplus, a transfer of profits of the departing firm, and a relative efficiency gain from shutting down firm *n*.

has the largest potential profits and hence the greatest incentive to initiate this merger.

For the merger between firm *1* and firm *n* to happen, a merger gain (*G*) must be positive. We define the merger gain as the increased profits of a remaining participant less the loss profits of a departing participant. In this case $G = \Delta\pi_1 - \pi_n$, or

$$G(1,n) = \Delta p[2h_1 + \Delta p] + \Delta p^*[2f_1 + \Delta p^*] - [(h_n)^2 + (f_n)^2]$$

$$= \frac{2h_n}{N}[h_1 - h_n \cdot g(N)] + \frac{2f_n}{N}[f_1 - f_n \cdot g(N)]$$

$$G(1,n) = 2\Delta p R(1,n) + 2\Delta p^* R^*(1,n) \qquad (34)$$

where $R(1,n) = h_1 - h_n g(N)$; $R^*(1,n) = f_1 - f_n g(N)$; $g(N) = [\frac{N}{2} - \frac{1}{2N}] > 1$; $g'(N) > 0$. The merger gain consists of domestic and foreign gains. Considering the terms $R(1,n)$ and $R^*(1,n)$, we can show that

$$R(1,n) - R^*(1,n) = \alpha[g(N) - 1]$$

This result implies that the gain from merger is more likely in the smaller marker, in the sense that if merger would make neither a profit nor a loss in the larger market it will generate profit in the smaller market.[32] Since determining the influence of differences in market size is not the main objective, we will henceforth assume that the two markets are approximately equal in size ($A \approx A^*$) and thus the merger gains from the two markets (under free trade) are equal.

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[32] But the merger induces larger price increase in the larger market, so that the magnitude of any gain could be larger there. We can show that $sign\{2\Delta p R(1,n) - 2\Delta p^* R^*(1,n)\} = sign\{\alpha[g(N)[h_n + f_n] - [h_n + f_1]]\}$.

Equation (34) provides a condition on the relative firm sizes for a profitable merger (for example a positive merger gain in the domestic market requires $\frac{h_1}{h_n} > g(N)$). Given the initial outputs of the discontinuing partner, the larger the required initial output of the continuing partner if the merger is to yield a net gain. Therefore we expect this type of merger to involve large and small firms; the largest and the smallest firms in particular. To expand on this point we can look at the conditions on firms' sizes which will yield a maximum merger gain. Since the two markets are symmetric we need to consider only the effects of the merger in the home market. Given h_n, the optimal merger partner for firm *n* is the most efficient firm, firm *1*.[33] But given h_1, the optimal partner for firm *1* needs to have an output of $\frac{h_1}{2g(N)}$.[34] Thus a sufficient condition for a merger to involve the largest and smallest firms is that $h_n \geq \frac{h_1}{2g(N)}$. And a merger between firm *1* and firm *n* with $h_1 = 2h_n g(N)$ is the best merger (i.e. this will lead to the maximum merger gain).

<u>Initial Equilibrium under Tariff Regime</u>

Next we consider the situation where the home government impose a small specific tariff of *t* per unit on imports. With the assumptions of segmented

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[33] This is because. $\frac{dG}{dh_1} = \frac{2h_n}{N} > 0$.

[34] Since $\frac{dG}{dh_n} = \frac{2[h_1 - 2h_n \cdot g(N)]}{N}$, and $\frac{d^2G}{(dh_n)^2} = -\frac{4 \cdot g(N)}{N} < 0$, then $h_n = \frac{h_1}{2 \cdot g(N)}$ will give the maximum merger gain for a given h_1.

markets and constant marginal costs, the tariff set by the home government will affect only domestic price and outputs. The tariff acts as a unit cost increase for foreign firms supplying the home market, and the new equilibrium price in the home market is given by

$$\bar{p} = \frac{A + C + C^{*} + n^{*}t}{N+1} = p + \frac{n^{*}t}{N+1} \qquad (35)$$

Then the effects of the change in tariff on domestic price, firm outputs and profits are given by

$$0 < \frac{d\bar{p}}{dt} = \frac{n^{*}}{N+1} < 1; \ \frac{d\bar{h}_i}{dt} = \frac{d\bar{p}}{dt} > 0; \ \frac{d\bar{h}_i^{*}}{dt} = \frac{d\bar{p}}{dt} - 1 < 0;$$

$$\frac{d\bar{\pi}_i}{dt} = 2\bar{h}_i \cdot \frac{d\bar{p}}{dt} > 0; \text{ and } \frac{d\bar{\pi}_i^{*}}{dt} = 2\bar{h}_i^{*} \cdot [\frac{d\bar{p}}{dt} - 1] < 0 \qquad (36)$$

The above results confirm that a tariff set by the home government will increase a domestic price and domestic sales of each home firm, but it will reduce domestic sales of each foreign firm.[35] And the profits of each domestic firm will increase, while the profits of each foreign firm will decrease as a result of a tariff.

[TA] <u>A National Merger in the Restricting (Home) Country</u>

Now consider a national merger in the restricting country, in particular the merger between firm *1* and firm *n* (which is potentially the most profitable). This merger leads to the closure of the least efficient firm, firm *n*. The effects of this merger on equilibrium outputs and prices are

[35] In this case of linear demand, a tariff increases domestic sales of each home firm by the same amount and decreases domestic sales of each foreign firm by the same amount. In a non-linear demand case Collie (1998) shows that the domestic sales of a larger (smaller) than average

$$\Delta\bar{h}_j = \Delta\bar{h}_i^* = \Delta\bar{p}, j \neq n;\ \Delta\bar{p} = \frac{\bar{h}_n}{N};\ \Delta f_j = \Delta f_i^* = \Delta p^*, j \neq n;\ \Delta p^* = \frac{f_n}{N}$$

This merger case is similar to a domestic merger case under free trade that we have discussed earlier. Then the relevant expression for the merger gain is from (34):

$$\bar{G}(1,n) = \frac{2\bar{h}_n}{N} \cdot \bar{R}(1,n) + \frac{2f_n}{N} \cdot R^*(1,n) \tag{37}$$

where $\bar{R}(1,n) = \bar{h}_1 - \bar{h}_n \cdot g(N)$ and $R^*(1,n) = f_1 - f_n \cdot g(N)$. It is worth noting that the merger gains from the two markets are no longer equal. The tariff affects only the home market, and it increases domestic sale of a smaller firm more proportionately than that of a larger firm (a tariff increases the sale of each firm by the same absolute amount). Thus the merger gain from the home market under the tariff is different from the gain under the free trade, while the merger gain from the foreign market remains unchanged. We can show that

$$\frac{2\bar{h}_n}{N}\bar{R}(1,n) - \frac{2h_n}{N}R(1,n) = \frac{2}{N} \cdot \frac{n^*t}{N+1}\left[[h_1 - h_n g(N)] + [h_n + \frac{n^*t}{N+1}][1 - g(N)]\right]$$

The above result implies that a merger that made neither a profit nor a loss under the free trade is unprofitable under the tariff regime. However if this merger was already profitable under the free trade, the merger gain under the tariff may increase.

Next we investigate the effects of a small discrete change in tariff on the merger profitability. Since the tariff affects only the home market, we focus our attention only on the merger gain from the home market. The result of the

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foreign firm will fall by more than that of the average foreign firm if demand is concave (convex).

finding in the home market should indicate the overall impact of the merger profitability, unless the gains in the two markets are significant in magnitude and opposite in sign. However these circumstances are ruled out by the assumption that the markets are similar in size. We find that

$$\frac{d\overline{G}(1,n)}{dt} = \frac{2}{N}\overline{R}(1,n)\frac{d\overline{p}}{dt} + \frac{2\overline{h}_n}{N}[1-g(N)]\frac{d\overline{p}}{dt} \tag{38}$$

For $\overline{R}(1,n) \leq 0$ which includes all marginal mergers (where $\overline{R}(1,n) = 0$ and hence the gain of this merger is zero initially), a lower tariff increases the merger gain from the domestic market.[36] Because the lower tariff generates the same absolute decrease in outputs of both participating firms, the tariff reduction decreases the pre-merger domestic output of firm *n* more proportionately than the pre-merger output of firm *1*. Hence the condition for a positive merger gain is easier to be met (for the case where the two firms found it unprofitable to merger before the tariff reduction). But if mergers were initially more than marginally profitable (i.e. for which $\overline{R}(1,n) > 0$), then the effect of the tariff reduction on a merger gain from the domestic market is ambiguous. For example, if a merger $(1,n)$ was initially the best merger for the home market i.e. $\overline{h}_1 = 2g(N)\overline{h}_n$, then a lower tariff decreases the gain from this merger.[37]

[TB] <u>A National Merger in the Non-restricting (Foreign) Country</u>

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[36] Since $g(N) > 1$, $\frac{d\overline{p}}{dt} > 0$, and $\overline{R}(1,n) \leq 0$, then we have $\frac{d\overline{G}(1,n)}{dt} < 0$.

[37] In this case we have $\frac{d\overline{G}(1,n)}{dt} = \frac{2\overline{h}_n}{N} \cdot \frac{d\overline{p}}{dt} > 0$ for $h_1 = 2 \cdot g(N) \cdot h_n$.

A national merger in the non-restricting country between firms *1** and *n** will lead to the closure of firm *n**. And the changes in prices and sales of the remaining firms are

$$\Delta\bar{p} = \Delta\bar{h}_i = \Delta\bar{h}_j^* = \frac{\bar{h}_n^*}{N},\ j \neq n;\ \Delta p^* = \Delta f_i = \Delta f_j^* = \frac{f_n^*}{N},\ j \neq n$$

The gain from a merger between firm 1^* and n^* is

$$\bar{G}(1^*, n^*) = \frac{2\bar{h}_n^*}{N}\bar{R}(1^*, n^*) + \frac{2f_n^*}{N}R^*(1^*, n^*) \tag{39}$$

where $\bar{R}(1^*, n^*) = \bar{h}_1^* - \bar{h}_n^* g(N)$ and $R^*(1^*, n^*) = f_1^* - f_n^* g(N)$. And the effect of a change in tariff on this merger gain is given by

$$\frac{d\bar{G}(1^*, n^*)}{dt} = \frac{2}{N}\bar{R}(1^*, n^*)\left[\frac{d\bar{p}}{dt} - 1\right] + \frac{2\bar{h}_n^*}{N}[1 - g(N)]\left[\frac{d\bar{p}}{dt} - 1\right] \tag{40}$$

The above derivative is positive for $\bar{R}(1^*, n^*) \leq 0$. A tariff encourages national mergers in the non-restricting country, provided that those mergers were initially non-profitable in the home market (including marginal mergers). This is because a tariff reduction increases the home market sales for each foreign firm by the same amount. In effect it increases the pre-merger market share (in the home market) of firm n^* more proportionately than those of firm *1**, thus the condition for a profitable merger between the two becomes more difficult to be met after a merger. But the profitability of some already profitable mergers may rise as a result of a tariff reduction; the best merger ($\bar{h}_1^* = 2g(N)\bar{h}_n^*$) for example.[38]

[TC] <u>An International Merger that closes a firm in the Restricting Country</u>

Assume that firm *1** is more efficient than firm *n*, thus firm *n* will be closed down after the merger. The post-merger prices are identical to the case [TA]. The gain from this merger is

$$\overline{G}(1^*,n)=\frac{2\overline{h}_n}{N}\overline{R}(1^*,n)+\frac{2f_n}{N}R^*(1^*,n) \tag{41}$$

where $\overline{R}(1^*,n)=\overline{h}_1^*-\overline{h}_n\,g(N)$ and $R^*(1^*,n)=f_1^*-f_n\,g(N)$. Then

$$\frac{d\overline{G}(1^*,n)}{dt}=\frac{2}{N}\overline{R}(1^*,n)\frac{d\overline{p}}{dt}+\frac{2\overline{h}_n}{N}\left[\left[\frac{d\overline{p}}{dt}-1\right]-\frac{d\overline{p}}{dt}g(N)\right] \tag{42}$$

which is negative for $\overline{R}(1^*,n)\leq 0$, i.e. for those mergers that were initially unprofitable in the home market including a marginal merger case. Thus a marginally unprofitable national merger in a foreign country will become profitable after a tariff reduction. This is because a tariff reduction decreases pre-merger domestic sales of home firm *n*, but it increases pre-merger domestic sales of foreign firm *1**, and thus makes the condition for a positive merger gain easier to be met. Again it is possible that the profitability of some mergers that have already been profitable may reduce as a result of tariff reduction, though it is less likely since here a tariff reduction increases the merger gain of the best merger case ($\overline{h}_1^*=2g(N)\overline{h}_n$).[39]

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[38] With $\overline{h}_1^*=2g(N)\overline{h}_n^*$, we have $\dfrac{d\overline{G}(1^*,n^*)}{dt}=\dfrac{2\overline{h}_n^*}{N}\left[\dfrac{d\overline{p}}{dt}-1\right]<0$.

[39] For $\overline{h}_1^*=2g(N)\overline{h}_n$, we have $\dfrac{d\overline{G}(1^*,n)}{dt}=\dfrac{2}{N}\overline{h}_n\left[\dfrac{d\overline{p}}{dt}-1\right]<0$.

[TD] An International Merger that closes a firm in the Non-restricting Country

For an international merger between firms *1* and n^* that leads to firm n^* being closed down, the post-merger equilibriums are identical to the case [TB]. The merger gain is

$$\overline{G}(1,n^*) = \frac{2\overline{h}_n^*}{N}\overline{R}(1,n^*) + \frac{2f_n^*}{N}R^*(1,n^*) \tag{43}$$

where $\overline{R}(1,n^*) = \overline{h}_1 - \overline{h}_n^* g(N)$ and $R^*(1,n^*) = f_1 - f_n^* g(N)$. Then

$$\frac{d\overline{G}(1,n^*)}{dt} = \frac{2}{N}\overline{R}(1,n^*)\left[\frac{d\overline{p}}{dt} - 1\right] + \frac{2\overline{h}_n^*}{N}\left[\frac{d\overline{p}}{dt} - \left[\frac{d\overline{p}}{dt} - 1\right]g(N)\right] \tag{44}$$

The above derivative is positive for $\overline{R}(1,n^*) \leq 0$ i.e. for those mergers that were initially unprofitable in the home market including a marginal merger case. Thus a marginally profitable merger will become unprofitable as a result of tariff reduction. Some mergers that have been profitable may also find their merger gains decrease as a result of tariff reduction as in a case of the best merger ($\overline{h}_1 = 2g(N)\overline{h}_n^*$).[40]

1.5 Conclusions

In this chapter we have reviewed literature that examine the interactions between mergers and trade policies. A common approach to this topic has been to model a merger as the exogenous reduction in the number of identical firms and to see how this interacts with the trade policies. That approach, for

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[40] $\frac{d\overline{G}(1,n^*)}{dt} = \frac{2}{N}\overline{h}_n^* \frac{d\overline{p}}{dt} > 0$ for $\overline{h}_1 = 2g(N)\overline{h}_n^*$.

example, can show how the mergers affect the welfare of the country that pursues optimal trade policy (Collie 1997) or show how the tariff liberalisation increases or decreases the degree of the price effect of mergers (Ross 1988). However by modelling mergers in that way we ignore the fact that a merger is a private decision which would be taken if it is profitable for the participants. There is an alternative approach which treats a merger explicitly as a decision of private firms. This alternative approach, an example of which is set out in this chapter, is done by employing the range of available models in the general (domestic) merger literature.

By investigating the model of a domestic merger setting in the Cournot framework we can show that identical firms have no incentive to merge unless the participants collectively have a large share of the market, or there is a large fixed cost saving from the merger (Salant et al 1983). However there are greater incentives for asymmetric firms to merge for example if the merger results in the increase in the share of tangible asset which in turn reduces the marginal cost of the merged firm (Perry and Porter 1985). There is a simpler way to model a merger of asymmetric firms by assuming that each firm possesses different technologies reflected in different marginal cost. Long and Vousden (1995) and Falvey (1998, 2001) use this assumption in the open economies context.

Setting in a simple international Cournot model with two segmented markets, linear demand, and constant marginal costs, Falvey (1998) examines the effects of tariff liberalisation on merger profitability and welfare. In this model the conditions for a merger to be profitable to participants depend on the relative size of the merger participants. The tariff makes the relatively inefficient home firms less attractive as a merger partner to other firms. This is because the tariff increases the pre-merger profits of the (potential) departing firm, and the potential losses are likely to outweigh the gains to the surviving partner (via the price increase and the efficiency gain). Thus when the tariff is reduced, it makes the cost of closing down the relatively inefficient home firm cheaper. The tariff has precisely the opposite effect on the relatively inefficient foreign firms, i.e. it reduces the profits of these firms and makes them more attractive as a merger partner. Thus any reduction in tariff will reduce this distortion, and hence decrease the potential gains from merger that closes down the relatively inefficient foreign firms.

CHAPTER 2

QUOTA POLICIES AND MERGERS

2.1 Introduction

In the previous chapter we have reviewed the literature on trade policies and mergers especially on the effects of tariff liberalisation on merger activities. However the reduction in trade barriers in recent year has not confined to tariff liberalisation alone. Other widely used trade barriers that have been encouraged to be reduced (as a result of trade negotiations via GATT and WTO, and various free trade areas) are quantitative restriction policies such as quotas and voluntary export restraints (VERs). The effects of liberalising quantitative restrictions on merger activities remain to be investigated. By extending Falvey's (1998) model of tariffs and mergers, this chapter is set out to investigate the implications of quota liberalisation for merger profitability.

A quota policy imposed by the domestic government directly distorts the volume of foreign imports, and this distortion is likely to affect merger incentives. The analysis in this chapter will help us to understand how a quota policy affects profitability of different merger cases. The results of this finding would contribute to the debate of whether freer trade help or hinder mergers. Moreover we can compare the results of this analysis (quota and mergers) with those of Falvey's model (tariff and mergers). Since the tariff and quota policies are different in nature, it is possible that tariff liberalisation and quota liberalisation may have different effects on profitability of some merger cases.

We employ a simple partial equilibrium model of international Cournot oligopoly competing in two segmented markets with linear demands. Then we consider the effects of a discrete change in quota policy on profitability of several merger cases. We focus our analysis on mergers of a low-cost firm and a high-cost firm. These merger partners can be from the same or different countries. The main analysis is presented in section 2.2. In section 2.3 we compare the merger profitability under the tariff and the quota regimes. Summary and conclusion remarks are presented in section 2.4.

2.2 Quota Policy and Mergers

Here we extend Falvey's (1998) model by introducing a quota policy imposed by the home government. We consider a partial equilibrium model of international Cournot oligopoly previously discussed in section 1.4. Briefly the model consists of two segmented markets: home and foreign. Each country has a small number of firms ($n, n^* \geq 3$) producing a homogeneous product to serve in their own market and export to the other market and the new entry of firm is not possible. Each firm has different technology reflecting by different constant marginal cost. Linear demands in the two markets are given by $D = A - p$ and $D^* = A^* - p^*$, and assume that the two markets are approximately equal in size ($A \approx A^*$). The home government, in this case, imposes a quota on foreign imports. Assume further that any entity through which imports are undertaken in free trade is fully integrated with the foreign producer and thus all the rents from quota restriction are captured by the foreign producers.[1]

In this analysis we model a quota rule based on Article XIII of the GATT.[2] That is either the allocation of trade shares should be agreed by all the suppliers of the product concerned, or the import right should be proportional to the sales during a "previous representative period". For the sake of the analysis of this simple model, we will concentrate solely on the previous representative period rule. Although the term "previous representative period" is not properly defined, in practice a three-year period, during which trade was unrestricted, has generally been taken to be "representative". Here we suppose that the previous representative period is the one under free trade.

Then under the quota system, a foreign firm i^* is allowed to export up to qh_i^*, where q, $0 \leq q \leq 1$, is a quota rate, and h_i^* is the free trade equilibrium domestic sale of firm i^*. Domestic and foreign firm profit maximisation problems in this case are

$$\underset{\widetilde{h}_i, f_i}{Max}\,(\widetilde{p} - c_i)\widetilde{h}_i + (p^* - c_i)f_i \tag{45a}$$

and

$$\underset{\widetilde{h}_i^*, f_i^*}{Max}\;(\widetilde{p} - c_i^*)\widetilde{h}_i^* + (p^* - c_i^*)f_i^* \quad s.t.\;\; \widetilde{h}_i^* \leq qh_i^* \tag{45b}$$

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[1] This avoids the inefficiencies that would arise if a second independent profit maximising entity intervened between home consumers/retailers and the foreign producer.

[2] Briefly, Article XIII requires that all exporters be covered by restriction (paragraph 1), and that the distribution of trade aim at approaching as closely as possible the shares that might be expected to obtain in the absence of the restriction (paragraph 2). The actual allocation of trade shares can be by agreement with all parties having a "substantial interest" in supplying the product concerned or, "where this method is nor reasonably practicable", in proportion to the shares during a previous representative period (paragraph 2(d)).

where $\widetilde{p}$, $\widetilde{h}_i(\widetilde{h}_i^*)$ denote the domestic price and domestic sale of firm i (i*) under the quota regime. Since the two markets are segmented the quota policy does not affect the foreign market equilibrium. For the home market, the optimal response of an unconstrained (domestic) firm is to increase its output in the face of the reduction in sales of foreign firms, and the quota of each foreign firm is proportional to the optimal free trade output, the quota constraint is binding. Then equilibrium sales under quota regime are

$$\widetilde{h}_i = \widetilde{p} - c_i;\ f_i = p^* - c_i;\ \widetilde{h}_i^* = qh_i^*;\ f_i^* = p^* - c_i^*$$

The above results give the home market quota-induced price and the foreign price of

$$\widetilde{p} = \frac{A + C - qH^*}{n+1} = p + \frac{[1-q]H^*}{n+1};\ p^* = \frac{A^* + C + C^*}{N+1} \tag{46}$$

where $p = \dfrac{A + C + C^*}{N+1}$ is the free trade domestic price. Then the effects of a change in quota on the domestic price, sales in the domestic market and the firms' profits are

$$\frac{d\widetilde{p}}{dq} = -\frac{H^*}{n+1} < 0;\ \frac{d\widetilde{h}_i}{dq} = \frac{d\widetilde{p}}{dq} < 0;\ \frac{d\widetilde{h}_i^*}{dq} = h_i^* > 0;\ \frac{d\widetilde{\pi}_i}{dq} = 2\widetilde{h}_i \frac{d\widetilde{p}}{dq} < 0;$$

$$\frac{d\widetilde{\pi}_i^*}{dq} = [\widetilde{p} - c_i^*]h_i^* + qh_i^* \frac{d\widetilde{p}}{dq} \tag{47}$$

By restricting the volume of foreign imports, a quota raises the domestic price. Each domestic firm responds to the restriction of foreign firms' sales in domestic market by increasing its own output. The tightening of a quota then helps to increase the profit of each domestic firm. But for each foreign firm, the effect of a tightening of a quota on the profit is ambiguous. However we can determine a profit-maximising quota (q_i^O) for each foreign firm from (47), which gives

$$q_i^O = \frac{1}{2} + \frac{n+1}{2} \cdot \frac{h_i^*}{H^*} \tag{48}$$

Equation (48) also implies that the larger foreign firm prefers a less restrictive quota.

Next we consider the effects of quota liberalization (i.e. the loosening of the quota) on merger profitability. Again we consider a lock-up merger between two asymmetric firms. As this merger creates no cost synergies, the merged firm adopts superior technology and continues producing at a low cost plant and closes down a high cost palnt. We have demonstrated in section 1.4 that the merger between the largest firm and the smallest firm is likely to generate the largest gain. Hence we will direct our attention to the four merger cases which involve the largest and the smallest firms from the two countries.

[QA] <u>A National Merger in the Restricting Country</u>

Here we consider a merger between the most efficient domestic firm (firm *1*) and the least efficient domestic firm (firm n). In effect, this merger will lead to the departure of firm n. In the domestic market, the post-merger price (denote by superscript m) is

$$\tilde{p}^m = \frac{A + C - qH^* - c_n}{n}$$

Then a change in domestic price as a result of this merger is given by

$$\Delta\tilde{p} = \tilde{p}^m - \tilde{p} = \frac{A + C - qH^*}{n(n+1)} - \frac{c_n}{n} = \frac{\tilde{p} - c_n}{n} = \frac{\tilde{h}_n}{n} \tag{49}$$

Noting that the above domestic price change is larger than the corresponding tariff outcome (which is one *N*th of firm *n*'s domestic pre-merger sale). This is because under the quota regime, the foreign firms are unable to expand their sales in response to the domestic price increase. The post-merger price in the foreign market is given by

$$p^{*m} = \frac{A^* + C + C^*}{N} - \frac{c_n}{N}$$

And the change in foreign price is

$$\Delta p^* = p^{*m} - p^* = \frac{A^* + C + C^*}{N(N+1)} - \frac{c_n}{N} = \frac{p^* - c_n}{N} = \frac{f_n}{N} \tag{50}$$

With results (49) and (50), it is easy to derive the changes in sales of each remaining firm:

$$\Delta\widetilde{h}_j = \Delta\widetilde{p} = \frac{\widetilde{h}_n}{n},\ j \neq n;\ \Delta f_j = \Delta f_i^* = \Delta p^* = \frac{f_n}{N}, j \neq n;\ \Delta\widetilde{h}_i^* = 0$$

The merger does not affect the domestic sales of foreign firms because of the quota restriction.

This merger will be profitable for the participants if the gain, $\widetilde{G}(1,n)$, is positive. As before, the merger gain is defined as the increase in profits to the continuing firm *1* minus the loss in profits of the departed firm *n*. That is

$$\widetilde{G}(1,n) = \Delta\widetilde{\pi}_1 - \widetilde{\pi}_n$$

where $\Delta\widetilde{\pi}_1$ is given by $\Delta\widetilde{p}[\Delta\widetilde{h}_1 + \Delta\widetilde{p}] + \Delta p^*[\Delta f_j + \Delta p^*]$ and $\widetilde{\pi}_n = (\widetilde{h}_n)^2 + (f_n)^2$, then

$$\widetilde{G}(1,n) = \frac{2\widetilde{h}_n}{n}[\widetilde{h}_1 - \widetilde{h}_n g(n)] + \frac{2f_n}{N}[f_1 - f_n g(N)]\text{, or}$$

$$\tilde{G}(1,n) = \frac{2\tilde{h}_n}{n}\tilde{R}(1,n) + \frac{2f_n}{N}R^*(1,n) \quad (51)$$

where $g(n) = \frac{n}{2} - \frac{1}{2n} > 1$, $\tilde{R}(1,n) = \tilde{h}_1 - \tilde{h}_n g(n)$, $R^*(1,n) = f_1 - f_n g(N)$.

Equation (51) implies that the profitability of this merger depends on the relative shares of sales of the two merger participants. The merger gains from the two markets are identical under the free trade (as we assume equal market size), but the two are different under the quota regime as the quota affects only the equilibriums of the home market. However we do not expect a small trade intervention to make the two gains significant in magnitude and opposite in sign. It is also worth noting that for $\tilde{h}_1 = 2\tilde{h}_n g(n)$, the merger will generate the maximum gain from the home market.[3]

Next we examine the effects of quota liberalization on the profitability of this merger. Again we focus our attention on the merger gain from the home market since the quota only affects the home market. Then we have

$$\frac{d\tilde{G}(1,n)}{dq} = \frac{2}{n}\tilde{R}(1,n)\frac{d\tilde{p}}{dq} + \frac{2\tilde{h}_n}{n}[1 - g(n)]\frac{d\tilde{p}}{dq}$$

$$= \frac{2}{n}\left[\tilde{h}_1 + \tilde{h}_n - 2\tilde{h}_n g(n)\right]\frac{d\tilde{p}}{dq} \quad (52)$$

[3] For a given $\tilde{h}_n$, firm *1* is the optimal partner (since $\frac{d\tilde{G}}{d\tilde{h}_1} = \frac{2\tilde{h}_n}{n} > 0$). And for a given $\tilde{h}_1$ we have $\frac{d\tilde{G}}{d\tilde{h}_n} = \frac{2[\tilde{h}_1 - 2\tilde{h}_n g(n)]}{n}$ and $\frac{d^2\tilde{G}}{(d\tilde{h}_n)^2} = -\frac{4g(n)}{n} < 0$. Then $\tilde{h}_n = \frac{\tilde{h}_1}{2g(n)}$ will give the maximum merger gain form the domestic market.

While the sign of the above term is ambiguous in general, it is positive for any mergers that were not initially profitable (i.e. for which $\widetilde{R}(1,n) \leq 0$).[4] Thus the loosening of the quota ($dq > 0$) would increase the profitability (from the home market) of the merger between the most and the least efficient home firms that was just marginally profitable. This is because the loosening of a quota decreases the sale of the least efficient domestic firm more proportionately (the sales of both merger participants decrease by the same absolute amount), and hence makes the size of the continuing partner relatively large enough to turn the merger profitable. But for mergers which were originally more than marginally profitable, the loosening of the quota may lead to a fall in the merger gain; the best merger ($\widetilde{h}_1 = 2\widetilde{h}_n g(n)$) for example.[5] In this case the merger gain in the home market was at the maximum level before the change in the quota. By raising a quota, it reduces the potential merger-induced price increase and the potential increase in domestic sale of the continuing partner and these outweigh the smaller loss in profits of the departing firm.

[QB] <u>A National Merger in the Non-Restricting Country</u>

In this case we consider the merger between the most efficient foreign firm (firm *1**) and the least efficient foreign firm (firm *n**). When this merger takes place, we expect firm n^* to exit both markets and we suppose that the quota

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[4] Recalling that $\frac{d\widetilde{p}}{dq} < 0$ and $g(n) > 1$), then $\frac{d\widetilde{G}(1,n)}{dq} > 0$ for $\widetilde{R}(1,n) \leq 0$.

[5] For $\widetilde{h}_1 = 2\widetilde{h}_n g(n)$, $\frac{d\widetilde{G}(1,n)}{dq} = \frac{2\widetilde{h}_n}{n} \cdot \frac{d\widetilde{p}}{dq} < 0$.

rights (to export to the home market) of both partners pass to the merged firm. Thus after the merger, the merged firm is allowed to serve the home market up to $q(h_1^* + h_n^*)$. With this new quota constraint the profit maximisation problem of the merged firm is

$$\underset{\tilde{h}_1^{*m}, f_1^{*m}}{Max} \quad (\tilde{p}^m - c_1^*)\tilde{h}_1^{*m} + (p^{*m} - c_1^*)f_1^{*m} \quad s.t. \quad \tilde{h}_1^{*m} \le q(h_1^* + h_n^*) \tag{53}$$

where $\tilde{h}_1^{*m}$ and f_1^{*m} are the quota induced domestic sale and the foreign sale of the merged foreign firm.

With the assumption of segmented markets we can treat the profit maximisation problems in the two markets separately. The quota only affects the home market and the corresponding Largrangian for the profit maximisation problem is given by

$$L = [\tilde{p}^m - c_1^*]\tilde{h}_1^{*m} + \lambda[q(h_1^* + h_n^*) - \tilde{h}_1^{*m}] \tag{54}$$

Taking the usual Cournot conjecture $\frac{d\tilde{p}^m}{d\tilde{h}_1^{*m}} = -1$ and ruling out the case where the home market sales of the merged firm are non-positive, we have the following first order conditions:

$$\frac{\partial L}{\partial \tilde{h}_1^{*m}} = (\tilde{p} - c_1^*) - h_1^{*m} - \lambda = 0 \tag{55a}$$

$$\frac{\partial L}{\partial \lambda} = q(h_1^* + h_n^*) - \tilde{h}_1^{*m} \ge 0 \tag{55b}$$

$$\lambda \frac{\partial L}{\partial \lambda} = 0 \tag{55c}$$

If the quota constraint is binding, i.e. $\lambda > 0$, then condition (55b) must hold with strict equality and we have $\tilde{h}_1^{*m} = q(h_1^* + h_n^*)$. Then the total sales in the home market by the foreign firms are unchanged from the pre-merger equilibrium, and so too the post-merger domestic price (i.e. $\tilde{p}^m = \tilde{p}$). Writing $\tilde{p}^m - c_1^* = \tilde{p} - p + p - c_1^*$ and using $p = \frac{A+C-H^*}{n+1}$ and $\tilde{p} = \frac{A+C-qH^*}{n+1}$, we can substitute the above FOCs to obtain

$$\lambda = [1-q][\frac{H^*}{n+1} + h_1^*] - qh_n^*$$

Thus the quota constraint is binding for quotas more restrictive than

$$\hat{q} = \frac{H^* + h_1^*[n+1]}{H^* + [h_1^* + h_n^*][n+1]} \tag{56}$$

Since the quota constrains the ability of foreign firms to respond to the potential merger-induced changes in the home market, the potential anti-competitive gain (form higher price) for the merged firm will be limited if the quota is so restrictive. In such case the merged firm will find it is more profitable to capture only the efficiency gain by utilising the combined quota right of the two partners. The merger gain in this case is given by

$$\tilde{G}(1^*, n^*) = \Delta\tilde{\pi}_1^* - \tilde{\pi}_n^*$$

where $\Delta\tilde{\pi}_1^* = (\tilde{p} - c_1^*)qh_n^* + \Delta p^*(2f_1^* + \Delta p^*)$ and $\tilde{\pi}_n^* = (\tilde{p} - c_n^*)qh_n^* + (f_n^*)^2$.

Then we have

$$\tilde{G}(1^*, n^*) = [c_n^* - c_1^*]qh_n^* + \frac{2f_n^*}{N}R^*(1^*, n^*) \tag{57}$$

The merger gain in the home market results from the transfer of the less efficient partner's (firm n^*'s) quota allocation to the more efficient partner (firm 1^*). Thus this merger always yields positive gain from the home market.

The effect of a small change in the quota on the gain of a merger of this type where the quota constraint continues to bind is given by

$$\frac{d\widetilde{G}(1^*,n^*)}{dq} = (c_n^* - c_1^*)h_n^* \tag{58}$$

which is positive for all constrained mergers. This result is not surprising as the higher quota rate means that the merged firm can achieve a greater efficiency gain by switching more production from firm n^* to firm 1^*. Thus the loosening of a quota will raise the potential profitability of this merger further. However if the quota rises above $\hat{q}$, the quota constraint will not be binding on the merged firm. Then the effects of a small change in the quota on the merger gain may be different from this binding case.

If the quota constraint is not binding on the merged firm, then imports to the home market fall as a result of this merger and the home price increases. However analysing this case is complicated because the home sales of the continuing partner are constrained by the quota pre-merger, but not post-merger.[6] The merger induced price increase is not simply proportional to the domestic sales of the closing partner, but it is given by

$$\Delta\widetilde{p} = \widetilde{p}^m - \widetilde{p} = \frac{q[h_1^* + h_n^*] - \widetilde{h}_1^{*m}}{n+1} = \frac{[\frac{H^*}{n+1} + h_1^* + h_2^*][q - \hat{q}]}{n+2} \tag{59}$$

The gain from this merger is then

$$\widetilde{G}(1^*,n^*) = [\widetilde{p}^m - c_1^*]\widetilde{h}_1^{*m} - [\widetilde{p} - c_1^*]q(h_1^* + h_n^*) + [c_n^* - c_1^*]qh_n^* + \frac{2f_n^*}{N}R^*(1^*,n^*) \tag{60}$$

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[6] So that $\widetilde{h}_m^* = \Delta\widetilde{p} + qh_1^* + [1-q][\frac{H^*}{n+1} + h_1^*] > \Delta\widetilde{p} + qh_1^*$.

To consider the effects of changes in the quota on the profitability of this merger, it is useful to write the gain in the home market as a function of q – i.e.

$$\widetilde{G}_D(1^*,n^*)=\gamma(q)=[1-\delta]\gamma(1)+\delta\cdot\gamma(\hat{q})-\delta[1-\delta]B \tag{61}$$

where $\delta=\frac{1-q}{1-\hat{q}}$; $\gamma(1)=\frac{2h_n^*}{n+2}[h_1^*-h_n^*g(n+2)]$; $\gamma(\hat{q})=[h_1^*-h_n^*]\hat{q}h_n^*>0$ and $B=\frac{h_n^*}{n+2}\left[\frac{h_n^*}{n+2}+[1-\hat{q}]n\frac{H^*}{n+1}\right]>0$. If the quota is set near to the free trade volume of imports ($q\approx 1$, $\delta\approx 0$), then the gain in the home market, $\widetilde{G}_D(1^*,n^*)=\gamma(1)$, is what one would expect from a merger under free trade (see equation 34 in chapter 1) for the case where n+1 firms are free to respond to the price increase. This term can be positive or negative in general. If the quota is set close to the binding level ($q\approx\hat{q}$, $\delta\approx 1$), then the gain in the home market, $\widetilde{G}_D(1^*,n^*)=\gamma(\hat{q})$, is positive and arises largely from the transfer of quota to the more efficient partner as in (57) – the case where the quota constraint is binding. For quotas in between, the merger gain in the home market is a weighted average of these two extremes, minus a positive term. But one can show that $\gamma(\hat{q})-B>0$[7], so that if $\gamma(1)\geq 0$, there is a gain from this merger at all tighter quotas. Otherwise (i.e. $\gamma(1)<0$), the merger may only become profitable once the quota is sufficiently restrictive.

The effects of a change in the quota on the profitability of this merger can be derived from (61). We have $\frac{\partial\widetilde{G}}{\partial q}=\frac{\partial\widetilde{G}}{\partial\delta}\frac{\partial\delta}{\partial q}$ and $\frac{\partial\delta}{\partial q}=-\frac{1}{1-\hat{q}}<0$, then

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[7] $\gamma(\hat{q})-B=\frac{h_n^*}{n+2}\{[h_1^*-h_n^*][[n+1]\hat{q}+\frac{1}{n+2}]+h_1^*[n[1-\hat{q}]+\hat{q}-\frac{1}{n+2}]\}>0$

$$\frac{\partial \widetilde{G}(1^*,n^*)}{\partial \delta} = \gamma(\hat{q}) - \gamma(1) + [2\delta - 1]B \tag{62}$$

Two observations can be made concerning (62). First, $\frac{\partial \widetilde{G}}{\partial \delta}$ is increasing in δ, and, since $\gamma(\hat{q}) - \gamma(1) > 0$[8], we know that $\frac{\partial \widetilde{G}}{\partial \delta}$ is positive for high values of δ (i.e. $\delta \geq \frac{1}{2}$). Hence for $\hat{q} \leq q \leq \frac{1-\hat{q}}{2}$, $\frac{\partial \widetilde{G}}{\partial q} < 0$, i.e. a loosening of the quota lowers the profitability of the merger. For the quota that is originally less restrictive than $\frac{1-\hat{q}}{2}$, $\frac{\partial \widetilde{G}}{\partial \delta}$ and hence $\frac{\partial \widetilde{G}}{\partial q}$ have ambiguous signs. Second, since $\gamma(\hat{q}) - B > 0$, $\frac{\partial \widetilde{G}}{\partial \delta}$ is always positive if $\gamma(1) \leq 0$. Recalling that the merger gain in domestic market is the weighted average of the two extremes ($\gamma(1)$ and $\gamma(\hat{q})$), minus a positive term. The larger quota increases the weighted average of $\gamma(1)$, while it reduces the weighted average of $\gamma(\hat{q})$ (which is always positive). Thus the loosening of a quota will tend to reduce the merger gain, except where the merger under a quota set at a near free trade volume was profitable ($\gamma(1) > 0$), in which case the small increase in quota may reduce the merger gain for some range of quotas while it may increase the merger gain for the other range of quotas.

[QC] <u>An International Merger that closes a firm in the Restricting Country</u>

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[8] $\gamma(\hat{q}) - \gamma(1) = \frac{h_n^*}{n+2}\{h_1^*[n-2+2\hat{q}] + h_n^*[[n-2][1-\hat{q}] - \frac{1}{n+2}]\} > 0$

An international merger between the most efficient foreign firm (firm *1**) and the least efficient home firm (firm n), again sees firm n exits both markets. The effects of this merger on prices are similar to the case [QA], but the merger gain in this case is given by

$$\widetilde{G}(1^*,n) = \Delta\widetilde{\pi}_1^* - \widetilde{\pi}_n$$

where $\Delta\pi_1^* = \Delta\widetilde{p}qh_1^* + \Delta p^*[2f_1^* + \Delta p^*]$; $\widetilde{\pi}_n = (\widetilde{h}_n)^2 + (f_n)^2$; $\Delta\widetilde{p} = \frac{\widetilde{h}_n}{n}$;

$\Delta p^* = \frac{f_n}{N}$, then

$$\widetilde{G}(1^*,n) = \frac{\widetilde{h}_n}{n}\widetilde{R}(1^*,n) + \frac{2f_n}{N}R^*(1^*,n) \tag{63}$$

where $\widetilde{R}(1^*,n) = qh_1^* - n\widetilde{h}_n$. The expression for the gain in the home market reflects the fact that the quota prevents the continuing partner from increasing its sale to the home market in response to the price increase. It is worth noting that for a given quota, the merger gain in the home market is likely to be profitable if the continuing partner is large and the number of home firm is small. This is because a large firm *1** can benefit more from the merger-induced price increase in the home market, while a small number of home firms (which all but one will respond to the initial price increase) imply a small output expansion, and hence large price effects.

Changing the quota will only affect the merger profitability in the home market – i.e.

$$\frac{d\widetilde{G}(1^*,n)}{dq} = \frac{\widetilde{R}(1^*,n)}{n}\frac{d\widetilde{p}}{dq} + \frac{\widetilde{h}_n}{n}[h_1^* - n\frac{d\widetilde{p}}{dq}] \tag{64}$$

which is positive for mergers that were initially unprofitable in the home market (where $\widetilde{R}(1^{*},n) \leq 0$), thus a loosening of the quota increases the profitability of this merger. This is because higher quota reduces the domestic sales of the less efficient home partner and increases the domestic sales of the more efficient foreign partner (thus increases $\widetilde{R}(1^{*},n)$). However for some profitable mergers, especially where $\widetilde{h}_1^{*}(=qh_1^{*}) \geq 2\widetilde{h}_n$, a less restrictive quota will lead to a fall in the merger gain. A less restrictive quota increases $\widetilde{R}(1^{*},n)$, but it also reduces the price effect ($\frac{\widetilde{h}_n}{n}$) of the merger. In these cases the smaller increase in post-merger price becomes more significant, and will reduce the overall merger gain in the home market.

Given that the merged firm is prevented by the quota from expanding its domestic sales from the lower cost foreign source, it might contemplate production for domestic sale using firm n's inefficient technology. This would not happen however, since the profit margin on a unit of domestic production ($\widetilde{p}-c_n(=\widetilde{h}_n)$) is less than the reduction in revenue on firm imports ($qh_1^{*}\frac{d\widetilde{p}}{d\widetilde{h}_n}=-qh_1^{*}$), if the merger was profitable in the first place (which requires $qh_1^{*}>\widetilde{h}_n$).

[QD] An International Merger that closes a firm in the Non-restricting Country

We would expect a merger between the most efficient domestic firm and the least efficient foreign firm, to see the departure of the latter from both markets, and we assume that the merged firm retains the quota rights (but does not use them as we shall see). In this case the changes in domestic price is given by

$$\Delta\tilde{p} = \frac{qh_n^*}{n+1} \tag{65}$$

It is worth noting that the merger-induced price change in this case is larger than it would have been if the foreign firm were able to respond to the price increase. The merger gain from this merger is given by

$$\tilde{G}(1,n^*) = \Delta\tilde{\pi}_1 - \tilde{\pi}_n^*$$

where $\Delta\tilde{\pi}_1 = \Delta\tilde{p}(2\tilde{h}_1 + \Delta\tilde{p}) + \Delta p^*(2f_1 + \Delta p^*)$ and $\tilde{\pi}_n^* = (\tilde{p} - c_n^*)qh_n^* + (f_n^*)^2$, then

$$\tilde{G}(1,n^*) = \frac{qh_n^*}{n+1}\tilde{R}(1,n^*) + \frac{f_n^*}{N}R^*(1,n^*) \tag{66}$$

where $\tilde{R}(1,n^*) = 2\tilde{h}_1 + \Delta\tilde{p} - [n+1][\tilde{p} - c_n^*]$. The effects of a small change in the quota on the profitability of this merger is given by

$$\frac{dG(1,n^*)}{dq} = \frac{h_n^*}{n+1}\tilde{R}(1,n^*) + \frac{qh_n^*}{n+1}[2\frac{d\tilde{p}}{dq} + \frac{h_n^*}{n+1} - (n+1)\frac{d\tilde{p}}{dq}]$$

$$= \frac{h_n^*}{n+1}\tilde{R}(1,n^*) + \frac{qh_n^*}{[n+1]^2}[h_n^* + [n-1]H^*] \tag{67}$$

The above derivative is positive for $\tilde{R}(1,n^*) \geq 0$. Thus a loosening of the quota leads to an increase in the profitability of any merger that was not initially unprofitable. The less restrictive quota increases the sales in the home market of the departing partner, and hence increases the merger-induced price effects. But the less restrictive quota may not increase the potential loss of profit of firm n^*, it depends on whether the initial quota happen to be set at the profit maximising value as given in (48).

The merged firm would not wish to continue importing output from firm n^*, because the profit from selling an additional unit from this source ($\tilde{p}-c_n^*$) is less than the loss on home produced sales ($\tilde{h}_1 \frac{d\tilde{p}}{dh_n^*} = -[\tilde{p}-c_1]$). It may, however, constrained by use-it-or-lose-it provisions of the quota regime. If these provisions apply, then failure by the merged firm to employ its quota entitlement will see those rights redistributed to other foreign firms, who can be expected to exercise them. In such a case the merged firm might as well continue to import from the foreign source and accept the profits that would otherwise go to its foreign competitors. Any potential gain from this merger would arise only in the foreign market, and would not be affected by a change in the quota.

2.3 Comparison of the Effects of Tariff and Quota on Mergers

In this section we compare the effects of tariff on mergers (Falvey, 1998) with the effects of quota on mergers. We begin with the initial equilibriums under the tariff and the quota regimes. Because of the assumption of segmented markets, both the tariff and the quota affect only the equilibrium in the home market. Recalling that the initial domestic prices under the two regimes are

	Tariff	Quota
Domestic Price	$\overline{p}=\frac{A+C+C^{*}+n^{*}t}{N+1}=p+\frac{n^{*}t}{N+1}$	$\tilde{p}=\frac{A+C-qH^{*}}{n+1}=p+\frac{[1-q]H^{*}}{n+1}$

Both the tariff and the quota lead to a fall in the volume of imports (in the home market) and hence lead to the increase in the domestic price. By relating the above tariff-induced and quota-induced prices, we can find a tariff and a quota that lead to the same domestic price. In such case we require

$$t=[1-q][\frac{N+1}{n+1}][\frac{H^{*}}{n^{*}}] \tag{68}$$

If the above condition is satisfied, both regimes will lead to the same total volume of imports. For the home firms, they may be indifferent to the regime employed as we can always find tariffs and quotas that satisfied equation (68). However the two regimes affect the sale of each foreign firm differently. The (specific) tariff reduces each foreign firm's export (to the home market) by the same absolute amount. The quota, however, reduces each foreign firm's export proportionate to the original (free-trade) size of firm. Using condition (68), we can show that when the two regimes are equivalent, the more efficient foreign firms export relatively more under the tariff regime and the less efficient foreign firms relatively less – that is[9]

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[9] Substituting $t=[1-q][\frac{N+1}{n+1}][\frac{H^{*}}{n^{*}}]$ into $\overline{h}_i^{*}=\overline{p}-c_i^{*}-t=p+\frac{n^{*}t}{N+1}-c_i^{*}-t=h_1^{*}-\frac{(n+1)t}{(N+1)}$, we get $\overline{h}_i^{*}=h_i^{*}-[1-q]\frac{H^{*}}{N}=qh_i^{*}+[1-q][h_i^{*}-\frac{H^{*}}{N}]$.

$$\bar{h}_i^* = qh_i^* + [1-q][h_i^* - \frac{H^*}{N}] \quad (69)$$

As a foreign firm *i** has different domestic sales under the two regime, its' profits in the domestic market would also be different. We have[10]

$$\bar{\pi}_i^* - \tilde{\pi}_i^* = [\bar{p} - c_i^*][1-q][h_i^* - \frac{H^*}{N}] - t\bar{h}_i^* \quad (70)$$

Equation (70) implies that most foreign firms, with the possible exception of relatively large firms[11], would prefer the quota regime. The other argument for foreign firms preferring the quota to the tariff is the rents-capture argument. Under the tariff, the home government captures the rents in form of tariff revenue. Under the quota, however, it generates rents for the exporters.

Next we compare the potential merger gains under the two equivalent regimes. With the assumption of segmented markets, both the tariff and the quota affect only the home market. Thus we consider only the merger gains in the home market as the gains in the foreign market for each merger case are identical under the two regimes.

(A) A National Merger in the Restricting Country

The equivalent tariff and quota regimes lead to the same volume of imports to the home market, and hence the same domestic price. Thus the pre-merger sale in home market of each home firm is the same under the tariff and the quota. But the merger-induced price increase is higher under the quota as we have $\Delta\tilde{p} - \Delta\bar{p} = \frac{\tilde{h}_n}{n} - \frac{\bar{h}_n}{N} > 0$ for $\tilde{h}_n = \bar{h}_n$ initially. This is because under the quota

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[10] $\bar{\pi}_i^* - \tilde{\pi}_i^* = [\bar{p} - c_i^* - t]\bar{h}_i^* - [\tilde{p} - c_i^*]qh_i^* = [\bar{p} - c_i^*][\bar{h}_i^* - qh_i^*] - t\bar{h}_i^*$

regime only n-1 domestic firms (as oppose to N-1 domestic and foreign firms under the tariff) can increase their sales in the home market in response to the initial price increase as a result of a closing down of firm n, the foreign firms are forbidden to increase their exports by the quota restriction. From [TA] the merger gain in the home market under the tariff is given by $\frac{2\bar{h}_n}{N}\bar{R}(1,n)=\frac{2\bar{h}_n}{N}[\bar{h}_1-\bar{h}_n g(N)]$, while [QA] gives the merger gain in the home under the quota as $\frac{2\tilde{h}_n}{n}\tilde{R}(1,n)=\frac{2\tilde{h}_n}{n}[\tilde{h}_1-\tilde{h}_n g(n)]$. The difference between the merger gains under the two regimes is then given by[12]

$$\tilde{G}(1,n)-\bar{G}(1,n)=\frac{2n^{*}\bar{h}_n}{nN}[\bar{h}_1+\frac{\bar{h}_n(N+n)}{2nN}]>0 \tag{71}$$

The potential profitability of this merger is higher under the equivalent quota regime as the merger-induced price increase is larger.

(B) <u>A National Merger in the Non-restricting Country</u>

In this case, we are dealing with two foreign firms, thus the pre-merger sales in the home market of both participants are different under the two equivalent regimes from the start. While the merger induces a price increase in the home market under the tariff, the home price is unchanged by the merger under the quota, if the quota constraint continues to be binding on the merged firm. The merger gains in the home market under the tariff and under the quota (binding

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[11] Equation (70) will have a positive sign if the term $[h_i^{*}-\frac{H^{*}}{N}]$ is positive and big enough.

[12]

$$\tilde{G}(1,n)-\bar{G}(1,n)=\frac{2n^{*}}{nN}\bar{h}_1\bar{h}_n+\frac{2(\bar{h}_n)^2}{nN}[ng(N)-Ng(n)]=\frac{2n^{*}}{nN}\bar{h}_1\bar{h}_n+\frac{2(\bar{h}_n)^2}{nN}[\frac{(N+n)(N-}{2nN}$$

case) are given respectively in [TB] and [QB] as $\frac{2\bar{h}_n^*}{N}[\bar{h}_1^* - \bar{h}_n^* g(N)]$ and $[c_n^* - c_1^*]qh_n^*$. Then the difference in merger gains under the two regimes is given by[13]

$$\tilde{G}(1^*,n^*) - \bar{G}(1^*,n^*) = [qh_n^* - \frac{2\bar{h}_n^*}{N}][\bar{h}_1^* - \bar{h}_n^*] + \frac{2[\bar{h}_n^*]^2}{N}[g(N)-1] > 0 \qquad (72)$$

Since $g(N) > 1$ and $qh_n^* > \bar{h}_n^*$ (as we have shown in (69) that a less efficient foreign firm exports relatively less under the equivalent tariff regime), then the above term has a positive sign. That is, where the regimes are equivalent, the merger gain under the quota regime is larger than the gain under the tariff regime if the quota constraint continues to be binding on the merged firm.

If the quota constraint is not binding on the merged firm, then the merger gain in the home market under the quota regime is a weighted average of the gain where the quota is set near the free trade volume and the gain where the quota is set close to the binding level, minus a positive term.[14] Comparing this merger gain with the gain under the equivalent tariff regime is difficult in general. However we can make two observations. First, if the two equivalent

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[13] Since $[c_n^* - c_1^*] = [\bar{h}_1^* - \bar{h}_n^*]$, then

$$\tilde{G}(1^*,n^*) - \bar{G}(1^*,n^*) = [c_n^* - c_1^*]qh_n^* - \frac{2\bar{h}_n^*}{N}[\bar{h}_1^* - \bar{h}_n^* g(N)]$$

$$= qh_1^* h_n^* - q[h_n^*]^2 - \frac{2\bar{h}_1^* \bar{h}_n^*}{N} + \frac{2[\bar{h}_n^*]^2 g(N)}{N}$$

[14] Specifically the gain is given by $[1-\delta]\gamma(1) + \delta \cdot \gamma(\hat{q}) - \delta[1-\delta]B$, where $\delta = \frac{1-q}{1-\hat{q}}$;

$\gamma(1) = \frac{2h_n^*}{n+2}[h_1^* - h_n^* g(n+2)]$; $\gamma(\hat{q}) = [h_1^* - h_n^*]\hat{q}h_n^*$ and

$$B = \frac{h_n^*}{n+2}\left[\frac{h_n^*}{n+2} + [1-\hat{q}]n\frac{H^*}{n+1}\right] > 0.$$

regimes are set near the free trade level ($t \approx 0,\ q \approx 1$), this merger is more profitable under the quota. This is because, while the initial sales of the participants are almost the same, fewer firms can respond to the price increase under the quota. Second, once the policies become sufficiently restrictive ($q \approx \hat{q}$), the merger will be more profitable under the quota as suggested by (72). These two observations lead us to presume that the merger will be more profitable under the quota.

(C) <u>An International Merger that closes a firm in the Restricting Country</u>

Using the results from [TC] and [QC] we can show that the difference between merger profitability under the quota and under the tariff is given by[15]

$$\tilde{G}(1^*,n) - \overline{G}(1^*,n) = \overline{h}_n[\frac{qh_1^*}{n} - \frac{2\overline{h}_1^*}{N} - \frac{\overline{h}_n}{N^2}] \tag{73}$$

which has ambiguous sign. In this merger case the output of the closing firm is the same in each regime, which means that its lost profits are the same. The merger-induced price increase is greater under the quota (again because under quota fewer firms can respond to the initial price increase), but the home sales of the continuing firm (firm *1**) are higher under the tariff regime. The overall comparison of profitability is therefore ambiguous.

(D) <u>An International Merger that closes a firm in the Non-restricting Country</u>

In this case the merger-induced price increase is higher under the equivalent quota regime because the output of the closing inefficient foreign firm is higher (as suggested by equation 69) and because all other foreign firms are not allowed to respond to the price increase. At the same time the profits of the departing firm are higher under the equivalent quota regime. Thus in general we cannot compare the potential merger gains under the two equivalent regimes.

2.4 Conclusions

In this chapter we examine the effects of quota and quota liberalization on profitability of potential mergers in open economies by extending Falvey's (1997) model. Setting in a simple international Cournot model with linear demand and constant marginal cost, we can summarise this chapter's main results of mergers under the quota compared with the results of mergers under the tariff (Falvey 1997) in the following tables.

Case	Merger gain under tariff	Comparison	Merger gain under quota
$(1,n)$	$\frac{2\bar{h}_n}{N}[\bar{h}_1 - \bar{h}_n g(N)]$	$<$	$\frac{2\tilde{h}_n}{n}[\tilde{h}_1 - \tilde{h}_n g(n)]$
$(1^*,n^*)$	$\frac{2\bar{h}_n^*}{N}[\bar{h}_1^* - \bar{h}_n^* g(N)]$	$<$ $<$ (presumption)	$[c_n^* - c_1^*]qh_n^*$ (binding) or $[1-\delta]\gamma(1)+\delta\cdot\gamma(\hat{q})-\delta[1-\delta]B$ (not binding)
$(1^*,n)$	$\frac{2\bar{h}_n}{N}[\bar{h}_1^* - \bar{h}_n\, g(N)]$	ambiguous	$\frac{\tilde{h}_n}{n}[qh_1^* - n\tilde{h}_n]$

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$$\tilde{G}(1^*,n)-\bar{G}(1^*,n)=\frac{\tilde{h}_n}{n}[qh_1^*-n\tilde{h}_n]-\frac{2\bar{h}_n}{N}[\bar{h}_1^*-\bar{h}_n\, g(N)]=\bar{h}_n[\frac{qh_1^*}{n}-\frac{2\bar{h}_1^*}{N}-\bar{h}_n+\frac{2\bar{h}_n}{N}(\frac{N}{2}-$$

$(1,n^*)$	$\frac{2\bar{h}_n^*}{N}[\bar{h}_1 - \bar{h}_n^* g(N)]$	ambiguous	$\frac{qh_n^*}{n+1}[2\tilde{h}_1 + \frac{qh_n^*}{n+1} - (n+1)(\tilde{p} - c_n^*)]$

Table 1: Comparison of the merger profitability under the tariff and the quota regimes

Case	The Effects of Tariff Liberalisation on Merger Gain ($dt < 0$)	The Effects of Quota Liberalisation on Merger Gain ($dq > 0$)
$(1,n)$	(+) at the margin	(+) at the margin
$(1^*,n^*)$	(-) at the margin	(+) if binding (-) if not binding
$(1^*,n)$	(+) at the margin	(+) at the margin
$(1,n^*)$	(-) at the margin	(+) at the margin

Table 2: The effects of tariff and quota liberalisation on merger profitability

The quota, which is allocated in proportion to the free trade sales, increases the sales of home firms (it raise each home firm's sales by the same amount) and it decreases the sales of foreign firms (each firm by the same proportion) relative to free trade. Comparing with the tariff we find that the price effect of the merger under the equivalent quota is larger since the foreign firms are not allowed to increase their outputs in response to the close down of a firm. Then we find that merger gains for national mergers under the quota are larger than those under the equivalent tariff regime, but the comparison leads to ambiguous outcomes in international mergers.

Unlike the tariff reduction which encourages mergers that involve the inefficient firm in the restricting country, the loosening of quota encourages almost all merger cases. The quota protects the inefficient firm in the restricting country and renders it as a less attractive merger partner. Thus the quota liberalisation which removes this distortion will encourage mergers that involve the closing down of the inefficient home firm. For the national merger in the non-restricting country, the loosening of quota will increase the potential merger gain (if the quota constraint is binding) because it allows the efficient foreign firm to export more to the home market by taking over the quota of the inefficient partner. However if the quota constraint is not binding the quota liberalisation may in some cases reduce the merger profitability of a national merger in the non-restricting country. For the international merger that closes the relatively inefficient foreign firm, the loosening of quota will increase the merger-induced price and hence it will increase the potential profits of the surviving merger partner, and this effect is likely to outweigh the higher cost of closing down the less efficient foreign partner.

It is worth noting that the results and implications of Falvey (1998) and this model depend crucially on the assumption of market-concentrating merger. If the more efficient firm can transfer its superior technology to its merger target, the decision to close down the pre-merger high cost plant may not be optimal. Ryan (2002) shows that when technology transfer option is available, tariffs and quotas affect the merger profitability differently from our case of market-concentrating merger. In this case, the merger between the low cost firm and the high cost firm lead to the transfer of technology from the low cost plant to the high cost plant and the merged firm produces from both plants. Tariffs and quotas in this model both make the inefficient firm in the restricting country become more attractive as a merger partner. This is because both trade policies increase the pre-merger sales of the inefficient home firm more proportionately, and this increases the potential gain from transferring technology form the low cost firm when a merger occurs – in contrast to our case of market-concentrating merger where trade policies protect the inefficient home firm by increasing the compensation the predator firm needs to pay.

CHAPTER 3

TARIFF v QUOTA WHEN FIRMS HAVE THE OPTION OF DIRECT FOREIGN INVESTMENT

3.1 Introduction

Tariffs and quotas are the main alternative methods of reducing foreign imports below the free trade level. The two policies are different in nature, while tariffs distort relative price of foreign goods and hence reduces import volumes; quotas directly distort import volumes to a certain level. There have been considerable works that focus on the question of whether the two policies result in equivalent economic effects. It is well understood that under perfect competition with a homogeneous product, any tariff has an **equivalent** quota (and *vice versa*) in the sense that these two equivalent regimes lead to the same volume of imports and the same domestic price. The only difference between the two is, perhaps, the distribution of the revenue from these trade distortions. Tariffs directly generate extra revenues to the government, while quotas generate extra revenues to the holder of the quota right. If the domestic government holds a competitive auction to sell the quota right, it would generates identical revenue as in the tariff case. However Bhagwati (1965) shows that the tariff-quota equivalence breaks down, if we introduce some elements of monopoly. For example, if we have a monopolist domestic producer, the two polices will not be equivalent. The quota regime that leads to the same level of imports (as the tariff regime) will induce higher domestic price than the tariff regime. While these two cases of perfect competition and monopoly are informative, much of international trade is conducted in markets that lie somewhere between perfect competition and monopoly. Our main attention is on Cournot oligopoly case. It can be demonstrated that the tariff-quota equivalence is holding in case of Cournot competition (Hwang and Mai, 1988). This is because the home firms take the output of the foreign firms as given whether there is a tariff or a quota. If the two policies lead to the same volume of imports, the home firms will react with the same output and hence leading to the same price. So we have tariff-quota equivalence in Cournot oligopoly case.

While the introduction of imperfect competition may reflect a more realistic approach to the question of tariff-quota equivalence, modern day international trade often involves large multinational players who act strategically. A large foreign multinational firm may choose investing directly in the home market if it is more profitable than exporting, which is subjected to home country trade barriers. Levinsohn (1989) consider the tariff-quota equivalence when the competition is oligopolistic and open to direct foreign investment (DFI). He finds that the optimal trade policies for a domestic country is to set the largest tariff or the smallest quota that do not induce DFI production, This is because DFI production is welfare worsening for a domestic country in this model. However it could be argued that foreign direct investment can have positive welfare effects on the domestic country, and DFI-inducing trade policies could be optimal. Brander and Spencer (1987) show that when FDI increases domestic employment, the optimal tariff policy for a country with unemployment is a tariff that induces investment. Tariff-jumping foreign investment can also be beneficial to the domestic country if there exists capital taxation (Dehejia and Weichenrieder, 2001) or if the profits of multinationals' subsidiaries are taxed by the domestic government (Svedberg, 1979). Moreover Levinsohn's result is fairly narrow, since it focuses only on comparing optimally set policies, DFI-inducing trade policies might occur in the equilibrium anyway. If we allow strategic interaction among countries involved, the equilibrium outcome could be a trade policy that induces foreign direct investment. For example, the equilibrium outcome of investment-inducing VER in a custom union model is demonstrated in Flam (1994).

Levinsohn's result and its implication also do not reflect situation in the real world. Most governments are welcoming foreign direct investment and it is happening anyway. Since the possibility of DFI production affects the ability of the domestic government to set tariff and quota differently, it would be more useful to broaden the comparison beyond the no DFI-inducing levels. In the main analysis in this chapter we compare the tariff and the quota regimes when the market of Cournot and DFI production is possible. Our results show that the tariff-quota equivalence is not straightforward as in Levinsohn's result.

The rest of this chapter is organized as follows. Section 3.2 presents the review of tariff-quota equivalence in a perfect competition, monopoly, and Cournot competition. In section 3.3 we examine the tariff-quota equivalence in Levinsohn (1989) model. We analyse the tariff and quota regimes under Cournot competition where the possibility of direct investment exists in 3.4.1 and 3.4.2, and then we make the tariff-quota equivalence analysis in section 3.4.3. Summary and concluding remarks are given in section 3.5.

3.2 The Equivalence of Tariffs and Quotas

In this section we look at the equivalence of tariffs and quotas under different market assumptions. We demonstrate the equivalence under the perfect competition and the non-equivalence under the monopoly. In the last subsection we provide another example of tariff-quota equivalence under Cournot duopoly.

3.2.1 Perfect Competition

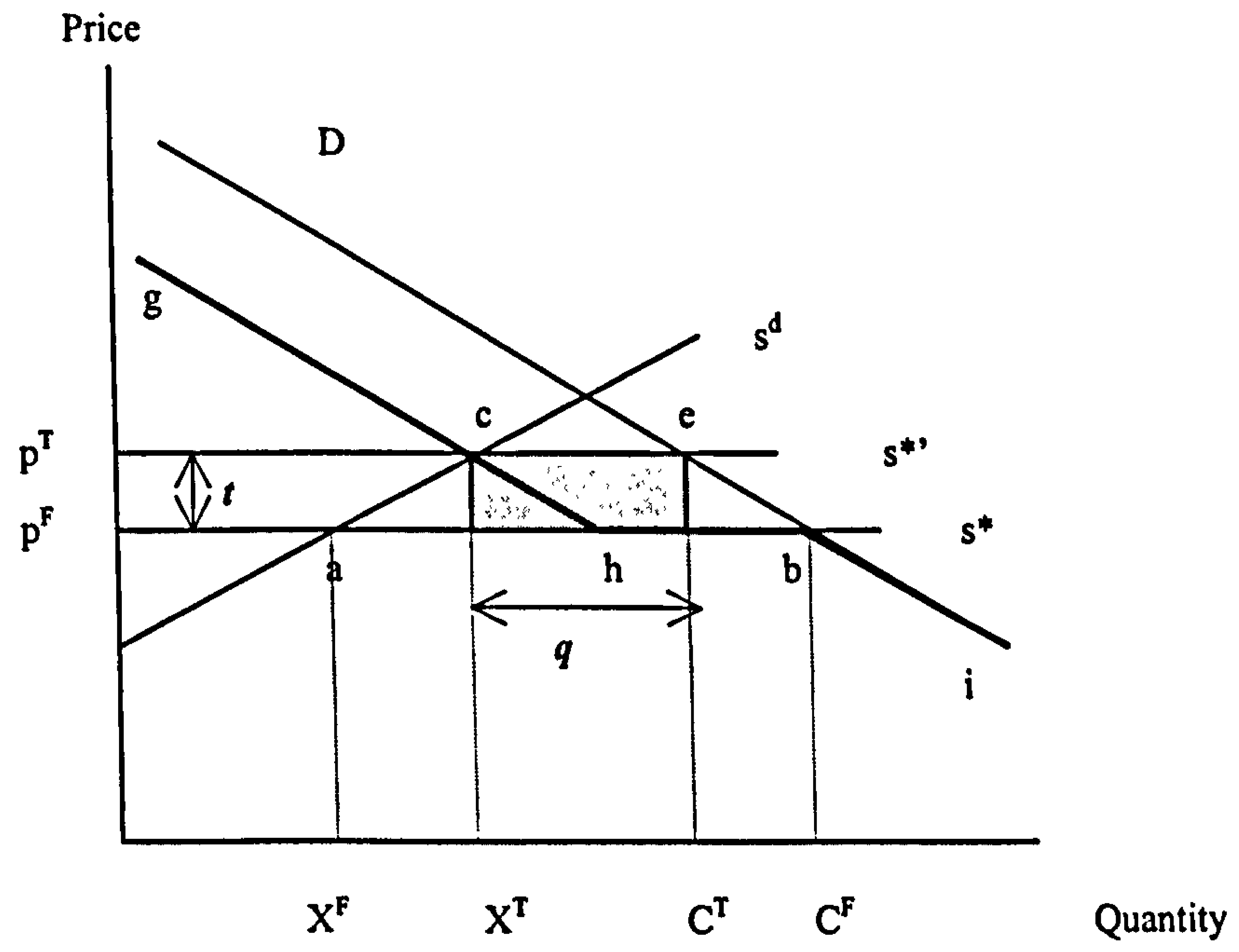

Figure 1

The equivalence of tariffs and quotas under perfect competition can be illustrated by Figure 1. Consider a market for good *A*, where schedule **D** represents a linear demand in the home market, schedule s^d the domestic supply, schedule s* the perfectly elastic foreign supply. Under free trade, the equilibrium price is given by the world price p^F at which the gap between demand and domestic supply, given by **ab**, is met by foreign imports. The total domestic consumption is $\mathbf{C}^F$, but only $\mathbf{X}^F$ of good *A* is supplied domestically. Next suppose that the domestic government impose a specific tariff of *t* on foreign imports, the new foreign supply curve is schedule **s*'**. The vertical gap between **s*** and **s*'** is equal to the tariff rate. In this case the tariff-induced equilibrium price is given by $\mathbf{p}^T$ ($\mathbf{p}^T > \mathbf{p}^f$). Domestic consumption is now reduced to $\mathbf{C}^T$, but domestic supply is increased to $\mathbf{X}^T$, with the reduced foreign imports equal to the distant **ce**.

Now suppose that a quota (*q*) equal to the distant **ce** of foreign imports is now imposed instead of a tariff. Assume further that the foreign firms utilise the quota fully, the total foreign supply is equal to the distant **hb** (which is equal to **ce**). Then the residual demand (i.e. the total demand minus foreign supply) facing domestic firms, is represented by the kinked schedule **ghbi**. It is clear from the above diagram that at the initial free trade price there is a gap between the residual demand and the domestic supply. In order to clear the market, the price of good *A* must rise from the initial free trade level ($\mathbf{p}^F$) to $\mathbf{p}^T$ where all the residual demands are met by domestic supplies. Under this quota regime, we also have the domestic consumption level of $\mathbf{C}^T$, the domestic production of $\mathbf{X}^T$, and the foreign imports of **ce**, as in the tariff regime.

Thus under perfect competition, the tariff regime and the quota regime are equivalent in terms of the equilibrium domestic price and the volume of imports. However the two regimes may not be equivalent on the issue of revenue. Under the tariff regime the home government captures the tariff revenue, which is represented by the shaded rectangular in the above diagram. Under the quota regime the home government can capture all the quota rents (which have the same size as the tariff revenue) if it sells the quota licences at auction. Thus in theory an auctioned import quota can be equivalent in its revenue (and also welfare effects) to that of a tariff. But if the quota licences are simply issued (for free) to importers, then these importers, who may be domestic or foreign-based firms, get all the quota rents. In this case the two regimes are not equivalent in their revenues, however their welfare effects could be the same if the importers are all domestic owned firms.

3.2.2 Monopoly

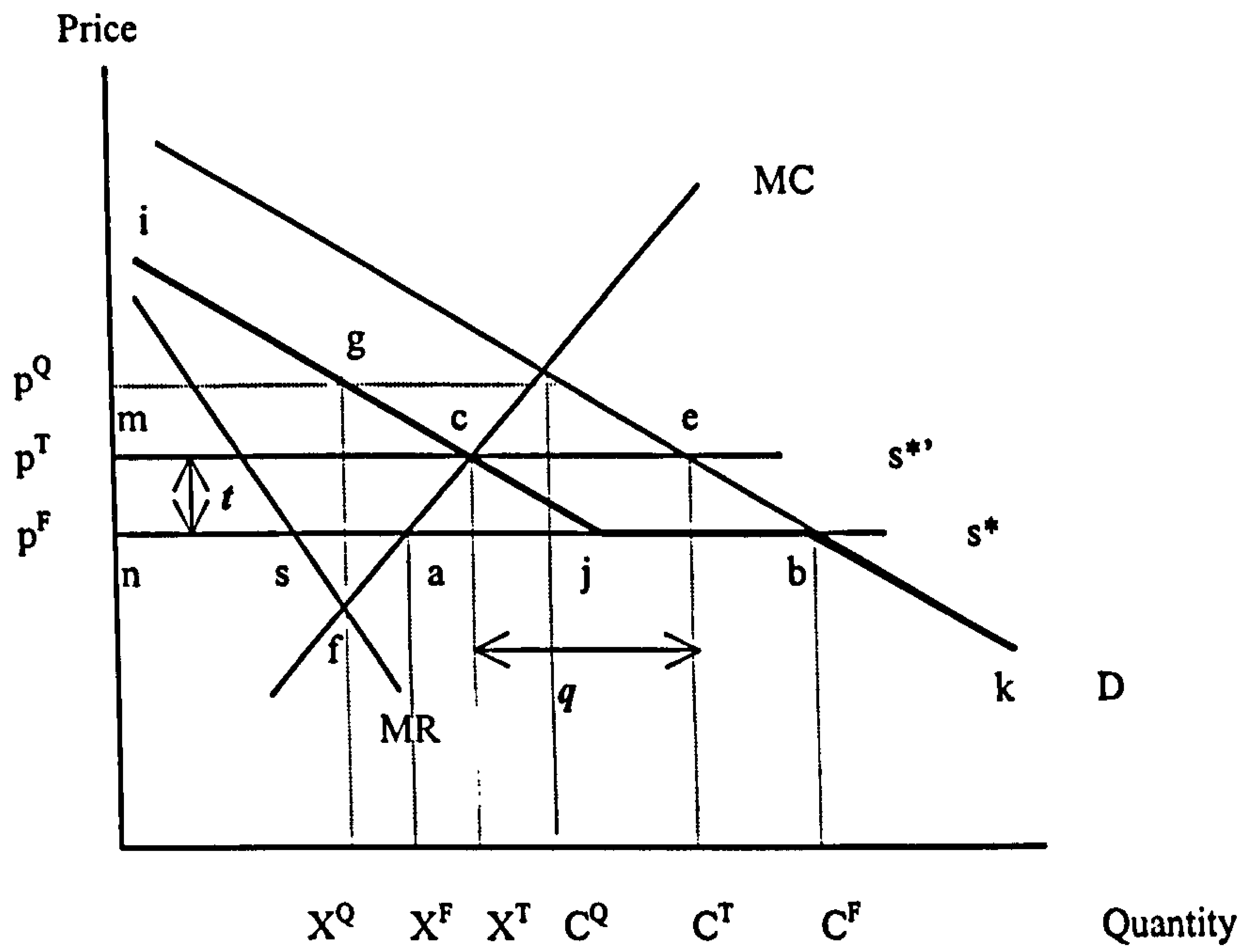

Figure 2

Bhagwati (1965) shows that a natural equivalence between tariff and quota breaks down once monopoly elements are introduced. For example consider a simple case of domestic monopolist. A domestic monopolist will perceive and react to tariff and quota imposed on competitive foreign firms differently. Figure 2 illustrates this case. Schedule **D** is the domestic demand, and schedule s* is the perfectly elastic foreign supply. There is no supply schedule for a domestic monopolist, but instead there is a marginal cost schedule **MC**. Under free trade the local monopolist cannot exercise any monopoly power, since at any local price higher than $\mathbf{p^F}$ consumers will demand only imports. In this sense free trade forces the local monopolist to act in the same manner as a competitive market. The residual demand (total demand minus foreign supply) perceived by the local monopolist is the kinked schedule **nbk**. Since the marginal revenue equals price when demand is horizontal, the condition **MR** = **MC** is satisfied at point **a**. The total consumption under free trade is $\mathbf{C^F}$, of which $\mathbf{X^F}$ are supplied by the local monopolist and the rest are imported from foreign firms. Under a tariff regime the foreign supply schedule will shift to **s*'** after a specific tariff of *t* is imposed on imports. Provided that the tariff is non-prohibitive, the local monopolist will again act competitively with the foreign firms. Under the tariff regime the residual demand becomes the kinked schedule **mek**, and the marginal cost meets the marginal revenue at point **c**. The tariff-induced price is $\mathbf{p^T}$ ($\mathbf{p^T} > \mathbf{p^F}$) and the total consumption is $\mathbf{C^T}$ ($\mathbf{C^T} < \mathbf{C^F}$), but the domestic output is higher at $\mathbf{X^T}$ ($\mathbf{X^T} > \mathbf{X^F}$) with the foreign imports equal to distant **ce**.

Next we consider the quota regime that leads to the same level of imports. Suppose the government imposes a quota of q = **ce** = **jb** on foreign imports and assume further that the foreign firms utilise the quota right fully. Under the quota regime the residual demand schedule becomes the kinked schedule **ijbk** (resulting from the aggregate demand minus the volume of imports under the quota system). Then **MR** is the associated marginal revenue with this residual demand. As shown in the above diagram, the marginal revenue intersects the marginal cost at point **f** leading to a price of $\mathbf{p^Q}$ ($\mathbf{p^Q} > \mathbf{p^T} > \mathbf{p^F}$), domestic output of X^Q ($X^Q < X^F < X^T$), and total consumption of C^Q ($C^Q < C^T < C^F$).[1] These results under the quota regime differ from the results under the tariff regime because we no longer have zero demand for domestically produced goods for price higher than p^T. In essence the quota regime allows the local monopolist to exercise its dominant market power, whereas the monopolist has to act competitively under the tariff regime. This is because a quota system renders the supply of imports inelastic at the level imposed by the quota, whereas a tariff system allows a perfectly elastic supply of imports at a world price plus the tariff.

3.2.3 Cournot Competition

Thus far we have the equivalence of tariffs and quotas in a perfectly competitive environment, but the non-equivalence if monopoly elements are introduced. However, much of international trade is conducted in markets that lie between the two extreme cases. We now examine the equivalence of tariffs and quotas under oligopolistic market. Hwang and Mai (1988) use a conjectural variation approach to examine the equivalence of tariffs and quotas under duopoly.[2] Consider a duopoly model in a domestic country where a home firm and a foreign firm compete to supply a homogeneous good. The inverse demand is given by

$$P = P(h + h^*),\ P' < 0$$

[1] To attain this result we implicitly assume that the domestic firm cannot export at the world price. If, however, the home firm can export at the world price, its production will be at point a and its domestic sales will be at s.

[2] Other works in this topic include Itoh and Ono (1982), which examines the tariff-quota equivalence under price leader oligopoly, and Krishna (1989) which considers the equivalence under the Bertrand competition.

where h (h^*) is the amount of production by the domestic (foreign) firm. Suppose that the home government imposes a specific tariff t on imports, then the home firm's and the foreign firm's profit functions are

$$\pi = P(h+h^*)\cdot h - C(h);\ \pi^* = P(h+h^*)\cdot h^* - C^*(h^*) - th^*$$

where $C(h)$ and $C^*(h^*)$ are the total cost for the domestic and the foreign firm respectively. Then the first order conditions for the home firm's profit maximisation problem is given by

$$\frac{\partial \pi}{\partial h} = P + h[1+\lambda]P' - C' \tag{1}$$

where $\lambda = \frac{dh^*}{dh}$ is the conjectural variation. Similarly the first order condition for the foreign firm is

$$\frac{\partial \pi^*}{\partial h^*} = P + h^*[1+\lambda^*]P' - C^{*'} \tag{2}$$

where $\lambda^* = \frac{dh}{dh^*}$. For simplicity we assume that the conjectural variations are fixed and the same for both firm, i.e. $\lambda = \lambda^*$.[3] We also assume that both the second-order and stability conditions are satisfied so that the global uniqueness of the equilibrium exists.[4] Then the equilibrium solutions are obtained by equating the first order condition with zero, i.e.

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[3] The value of the λ reflects a firm's conjecture on another firm behavior. If $\lambda = 0$ then the Cournot equilibrium is obtained. If $\lambda > 0$, then the solution is more collusive than the Cournot outcome (we get the collusive equilibrium if $\lambda = 1$). If $\lambda < 0$, the solution is more competitive than the Cournot one (we obtain the quasi-competitive if $\lambda = -1$).

[4] For the home firm's profit maximisation problem we assume that $P' + hP'' \leq 0$ and $C'' - P' > 0$. Thus the second order condition, $2P' + hP'' - C''$, is negative. Similar conditions are also imposed on the foreign firm's profit function.

$$h^T = -\frac{[P - C']}{[1+\lambda]P'};\ h^{*T} = -\frac{[P - C^{*'} - t]}{[1+\lambda]P'} \tag{3}$$

are the equilibrium outputs of home and foreign firm under the tariff.

Next suppose that the home government impose an import quota instead of the tariff. Consider the case that the quota permits the same amount of import as the tariff, i.e. h^{*T}, and assume that the quota is always binding. Denote the sale of the home firm under the quota regime as $\tilde{h}$, thus the quota-induced price is $\tilde{P} = P(\tilde{h} + h^{*T})$. The home firm's profit is now given by

$$\tilde{\pi} = P(\tilde{h} + h^{*T}) \cdot \tilde{h} - C(\tilde{h})$$

Then first order condition for this profit maximisation problem is

$$\frac{d\tilde{\pi}}{d\tilde{h}} = P + \tilde{h}[1+\lambda]P' - C' \tag{4}$$

Again we can obtain the equilibrium value of quota-induced sales of the home firm, $\tilde{h}^Q$, by solving FOC = 0. To compare the two equivalent regime we evaluate the first order condition (4) at $\tilde{h} = h^T$. Using the result in (3) we obtain

$$\left.\frac{d\tilde{\pi}}{d\tilde{h}}\right|_{\tilde{h}=h^T} = -\lambda h^T P' \tag{5}$$

which has the same sign as λ since $P' < 0$. Then it follows that $[\tilde{h}^Q - h^T]$ and $[P - \tilde{P}]$ have the same sign as λ.[5]

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[5] Given that we have a negative second order condition, $\left.\frac{d\tilde{\pi}}{d\tilde{h}}\right|_{\tilde{h}=h^T} = 0$ implies that the equilibrium sales of the home firm under the quota ($\tilde{h}^Q$) has the same value as h^T, since the

If the two regimes have equal imports, then the equilibrium prices under the two regimes are equal for the Courtnot equilibrium ($\lambda = 0$). The equilibrium price under the quota is lower than under the tariff when the equilibrium solution is more collusive than the Cournot one ($\lambda > 0$). And the equilibrium price under the quota is higher than under the tariff when the equilibrium solution is more competitive than the Cournot one ($\lambda < 0$). For the Cournot equilibrium case, the home firm takes the foreign firm's output as given under the tariff regime and this conjecture is precisely what happens under the quota (as the permitted imports are set at h^T). Thus the two regimes yield identical equilibrium outcomes.[6] If $\lambda > 0$, the home firm under the tariff acts on the perception that the foreign firm will increase output in response to a change in its own output. But under the quota the home firm's perception on the foreign firm behaviour must change. Thus the equilibrium price under the quota (which yields equal imports) is lower as firms behave relatively less collusive than they do under the tariff. The result is reversed in the case where the equilibrium is more competitive than the Cournot one ($\lambda < 0$).

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condition for optimal solution is met. If $\left.\frac{d\tilde{\pi}}{d\tilde{h}}\right|_{\tilde{h}=h^T} > 0$, then $\tilde{h}$ must rise above h^T in order to yield the maximum profit. If $\left.\frac{d\tilde{\pi}}{d\tilde{h}}\right|_{\tilde{h}=h^T} < 0$, then $\tilde{h}^Q$ must be smaller than h^T.

[6] On the issue of revenue comparison, it is similar to the perfect competition case. In theory the auctioned import quota could be equivalent in its revenue to that of the tariff. If the quota is awarded (for free) to importers then the revenues from the two regimes are not equal.

3.3 The Equivalence of Optimal Tariffs and Quotas

Levinsohn (1989) examines the equivalence between tariffs and quotas when the market is imperfectly competitive and open to direct foreign investment (DFI). In this model a foreign firm may avoid the effects of a domestic country's trade policies by producing in its subsidiary plant in the domestic country. Levinsohn shows that if the optimal tariff neglecting the possibility of DFI is profitably jumped, then the optimal cum-DFI tariff is equivalent to the optimal cum-DFI quota. Although the presence of DFI affects the tariff setting significantly different from its effect on the quota setting[7], the non-equivalence of tariff and quota is ruled out by the finding that DFI is welfare worsening for domestic country since it undermines optimal rent extracting trade policies. The equivalent tariff and quota in this case are the largest tariff and the smallest quota that do not provoke foreign firms engage in DFI.

We can demonstrate Levinsohn's result by using a simple model of international Cournot model with the possibility of direct foreign investment.[8] Since the main objective of this model is to compare the effects of two trade policies imposed by the home government, we will focus our attention to the home market alone. Suppose that there are n identical domestic firms and n^* identical foreign firms producing homogeneous goods to serve the home market and the entry of new firm is not possible. A home firm and a foreign

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[7] The presence of DFI in this model constrains tariff setting to a certain level after which no revenue would be collected since the foreign firms would switch from exporting to DFI. However the possibility of DFI does not constrains the choice of quota since the foreign firm would always keep exporting even though they may engage in DFI.

firm have different technology reflecting by different constant marginal costs, c and c* respectively. A foreign firm may engage in DFI production, which represents an increase in output but it is not an increase in the number of firms. The cost of DFI production is represented by a new marginal of γc^*, with $\gamma > 1$. This higher operational cost may reflect the additional cost due to unfamiliar production condition or the imperfect transfer of technology. Like Levinsohn's model we assume that the set up cost for the DFI production and the transport cost for the production in the foreign country are both equal to zero. We then compare tariff and quota policies imposed by the domestic government.[9] The home government sets a trade policy to maximise national welfare (W) upon firms' profit maximisation. In this case the national welfare is the sum of consumer surplus, domestic profits, and the tariff revenue or the licence revenue from quotas. Assume that demand in the domestic country is linear and given by

$$D = A - p$$

where A is a positive constant. The market clearing condition requires that

$$D = nh + n^* h^*$$

where h (h*) is the output of each home (foreign) firm.

Lets first consider free trade equilibrium. Under the free trade regime each home and foreign firm maximise its profit:

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[8] In the original model, Levinsohn considers a case of international oligopoly (with conjectural variations), general demand, and constant marginal cost.

[9] In this simple model we only consider tariff and quota policies. In Levinsohn's model, the tariff/subsidy and the quota/subsidy regimes are considered as in Dixit (1984). However Levinsohn demonstrates that the main results do not change when the production subsidy is set to zero.

$$\underset{h}{Max} \quad (p-c)h \qquad \text{and} \qquad \underset{h^*}{Max} \quad (p-c^*)h^*$$

By taking $\frac{dp}{dh}=\frac{dp}{dh^*}=-1$, we obtain the free trade Cournot equilibrium outputs by solving the above profit maximisation problems, which give

$$h=p-c \quad \text{and} \qquad h^*=p-c^*$$

Thus the free trade equilibrium price is given by

$$p^F=\frac{A+nc+n^*c^*}{n+n^*+1} \tag{6}$$

Under the tariff regime, the home government imposes a specific tariff of t on foreign imports. The tariff acts as a unit cost increase for the foreign firms supplying the home market. Then the tariff-induced equilibrium output for each firm and the tariff-induced equilibrium price ($\overline{p}$) are

$$\overline{h}=\overline{p}-c \quad \text{and} \qquad \overline{h}^*=\overline{p}-c^*-t;$$

$$\overline{p}=\frac{A+nc+n^*c^*+n^*t}{n+n^*+1}=p^F+\frac{n^*t}{n+n^*+1} \tag{7}$$

If the tariff is set too high, a foreign firm may switch to the DFI production in order to jump the tariff. The DFI option yields a cost of γc^*, while the export option yields a cost of c^*-t. Cost minimisation and constant marginal cost assumption imply that a foreign firm will switch from the export option to the DFI option if

$$t>(\gamma-1)c^* \tag{8}$$

That is a foreign firm will switch from the export option to the DFI option if the saving from tariff is greater than the increase in marginal cost from choosing DFI production.[10] In the case where all foreign firm choose the DFI option, the equilibrium outputs and the DFI-induced equilibrium price ($\hat{p}$) are given by

$$\hat{h} = \hat{p} - c \quad \text{and} \quad \hat{h}^* = \hat{p} - \gamma c^*;$$

$$\hat{p} = \frac{A + nc + n^*\gamma c^*}{n + n^* + 1} = p^F + \frac{n^*(\gamma - 1)c^*}{n + n^* + 1} \tag{9}$$

The above expression shows that once the foreign firms switch to the DFI option, the change in tariff no longer affects the domestic price, because none of the foreign firms choose the export option.

For the domestic government, it sets a tariff to maximise domestic welfare, which is given by the sum of consumer surplus, aggregate domestic firms' profits, and tariff revenue. Let's first ignore the possibility of DFI, then the domestic welfare function is given by

$$\overline{W} = \frac{(A - \overline{p})^2}{2} + n[\overline{h}]^2 + n^* t \overline{h}^* \tag{10}$$

The above welfare function is concave in t, thus the no-DFI optimal tariff (t^O) can be found by solving $\frac{dW}{dt} = 0$.[11] The solution t^O is also the cum-DFI

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[10] This condition can also be derived independently by comparing the foreign firms' profits from the two options. This profits differential is given by $\hat{\pi}^* - \overline{\pi}^* = (\hat{p} - \gamma c^*)\hat{h}^* - (\overline{p} - c^* - t)\overline{h}^*$. After substituting $\overline{h}^* = \overline{p} - c^* - t$, $\overline{p} = p^F + \frac{n^* t}{n + n^* + 1}$, $\hat{h}^* = \hat{p} - \gamma c^*$, and $\hat{p} = p^F + \frac{n^*(\gamma - 1)c^*}{n + n^* + 1}$, we have $\hat{\pi}^* - \overline{\pi}^* = \frac{n + 1}{n + n^* + 1}[t - (\gamma - 1)c^*][\hat{h}^* + \overline{h}^*]$. Then the profit from DFI option is higher ($\hat{\pi}^* - \overline{\pi}^* > 0$) if $t > (\gamma - 1)c^*$.

[11] The total derivative of domestic welfare with respect to tariff is given by

$$\frac{dW}{dt} = -D\frac{d\overline{p}}{dt} + 2n\overline{h}\frac{d\overline{p}}{dt} + n^*\overline{h}^* + n^* t(\frac{d\overline{p}}{dt} - 1) = \frac{n^*}{(n + n^* + 1)}[n\overline{h} + (n + 1)(\overline{h}^* - t)]$$

optimal tariff if it is no greater than $(\gamma-1)c^*$. If t^O were greater than $(\gamma-1)c^*$, it would induce all foreign firms to switch to DFI option and it would no longer affect the equilibrium price, $\hat{p}$. No revenue would be raised at this tariff rate. Since the domestic welfare is concave in t (i.e. $\frac{dW}{dt}$ evaluated at any tariff lower than t^O is positive), then the cum-DFI optimal tariff in this case is the maximum tariff that does not induce DFI production, or $t \approx (\gamma-1)c^*$.

Next consider the quota policy, under this regime the domestic government imposes a quota instead of a tariff on imports. As in Levinsohn's model we assume that quotas are auctioned to foreign producers and the home government collects the entire licence revenue. Assume further that the quota allocation is in proportion to each foreign firm's sales in the home market under the free trade. Because the permitted sales by foreign firms are proportional to their optimal free trade sales, the quota constraint is binding. Lets q, $0 \le q \le 1$, be a quota rate, then each foreign firm produces qh^* to export to the home market. Each home firm maximises its profit by producing $\tilde{h} = \tilde{p} - c$. Then initial quota-induced equilibrium price is given by

$$\tilde{p} = \frac{A + nc - qn^*h^*}{n+1} = p^F + \frac{[1-q]n^*h^*}{n+1} \tag{11}$$

In the case where DFI production is possible, a foreign firm profit function becomes

$$\tilde{\pi}^* = (\tilde{p} - c^* - l)\tilde{h}^* + (\tilde{p} - \gamma c^*)\tilde{s}^* \text{ where } \tilde{h}^* \le qh^* \tag{12}$$

The second order condition is

$$\frac{d^2W}{dt^2} = -\frac{n^*(2n^2 + 4n + n^* + 2)}{(n + n^* + 1)^2} < 0$$

where l is the quota's licence fee and $\tilde{s}^*$ is the DFI production. Since the quota constraint is binding ($\tilde{h}^* = qh^*$), a foreign firm maximises its profit only with respect to $\tilde{s}^*$. The profit maximisation, then, implies[12]

$$\frac{\partial \tilde{\pi}^*}{\partial \tilde{s}^*} = 0 = \tilde{p} - \gamma c^* - qh^* - \tilde{s}^*$$

Thus the condition for a foreign firm to start DFI production ($\tilde{s}_i^* > 0$) is that

$$(\tilde{p} - \gamma c^*) - qh^* > 0 \tag{13}$$

The first term on the right hand side of the above inequality reflects the optimal output for a foreign firm were it to choose the DFI option alone. If the permitted amount to export is less than that shadow DFI-only optimal output, the quota only option is no longer optimal. A foreign firm can then improve its profit by producing additional output via the DFI production.

Once the foreign firms start their DFI production in addition to the production in the foreign country under the quota, the equilibrium price ($\tilde{p}$), is given by

$$\tilde{p} = A - n(\tilde{p} - c) - n^*(\tilde{s}^* + qh^*)$$

Substituting $\tilde{s}^* = \tilde{p} - \gamma c^* - qh^*$ into the above equation, we get the cum-DFI equilibrium price,

$$\tilde{p} = \frac{A + nc + n^*\gamma c^*}{n + n^* + 1} = p^F + \frac{n^*(\gamma - 1)c^*}{n + n^* + 1} \tag{14}$$

The above expression shows that a further reduction in a quota rate will not raise the equilibrium price from this level. This is because the foreign firms

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With negative second order condition this welfare function is concave in t.

[12] Noting that $\frac{\partial \tilde{p}}{\partial \tilde{s}^*} = -1$.

will fully compensate a reduction in the allowed export by an increase in DFI production (so that the total output is equal to the shadow DFI-only optimal output). Next we can find the maximum price a foreign firm would be willing to pay for a quota licence by making a comparison with the tariff case. Since the quota licence fee acts in a similar way to the specific tariff, the maximum price for a quota licence is $(\gamma-1)c^*$, (were it greater, the DFI-only production would be more profitable). However the difference between the tariff and the quota regime is that the DFI production does not constrain the choice of the quota. The DFI-induced quota does not prevent the home government from getting quota licence revenue, although the price for a licence fee it received remains constant at $(\gamma-1)c^*$.

The domestic welfare function under the quota is given by

$$\tilde{W} = \frac{(A-\tilde{p})^2}{2} + n[\tilde{h}]^2 + l(n^* q h^*) \tag{15}$$

where the last term of the above equation is the revenue from quota licence. Lets q^O be the no-DFI optimal quota, this quota would also be the cum-DFI optimal quota if it does not induce DFI production. In this case we can use Hwang and Mai (1988) result to prove that the optimal tariff is equivalent to the optimal quota. If q^O induces DFI, then the above welfare function implies that the optimal policy is to set a quota such that revenue $[(\gamma-1)c^*]n^* q h^*$ is collected but no DFI is provoked (since a positive DFI production implies a fall in qh^*, while the licence fee remains at $l=(\gamma-1)c^*$ and the equilibrium price is constant in q at $\tilde{p}=p^F+\frac{n^*(\gamma-1)c^*}{n+n^*+1}$). This is exactly what the cum-DFI tariff, $t \approx (\gamma-1)c^*$, accomplishes. That is, if the no-DFI tariff is profitably jumped, then both the maximum tariff and the minimum quota that do not induce DFI are the cum-DFI optimal policies, and the two are equivalent.

Ellinsen and Warneryd (1999) also derive a similar result in a political economy model. In this model the government chooses trade policies to maximize domestic firms' profit, and the optimal level of protection will be set just low enough to limit foreign direct investment. However in this model a particular form of quota, VER, is preferred to a tariff since it leaves export rents with a foreign firm and hence it is a more effective tool make a foreign firm to stay at home. The non-equivalence of tariff and VER in this sense is also found in Konishi *et al* (1999). In this model both a home firm and a foreign firm exert political influence on domestic trade policy by contributing some of their profits to the domestic government. If the domestic government weights dollar contributions more than domestic surplus, it prefers a VER that just deters FDI over a tariff that just deters FDI (again FDI in this model reduces domestic welfare). This is because a VER generates more contributions.

The Levinsohn's tariff-quota equivalence might break down if we alter some of the assumptions in the model. Firstly as demonstrated in Levinsohn's article, increasing marginal costs may lead to the tariff-quota non-equivalence. With increasing marginal cost functions, DFI and foreign local production might coexist even if the tariff is greater than the marginal cost differential. Using a numerical counterexample, in a setting of a Cournot duopoly and a specific demand and cost functions, Levinsohn shows that the optimal tariff/subsidy is not equivalent to the optimal quota/subsidy. And in this specific example both sets of optimal policies lead to the coexistence of DFI and foreign local production.

Secondly Levinsohn's optimal policies are derived from conventional welfare functions, which do not address the potential benefits of direct foreign investment to the home country. If the welfare gains from the DFI to the home country (such as increased employment, transfer of technology, or tax revenue) are considered, then the optimal trade policies might encourage DFI activity. For example in Brander and Spencer (1987), foreign direct investment increases employment in the domestic country. In this case the optimal tariff for a country with a presence of unemployment leads to foreign direct investment. Svedberg (1979) illustrates that the optimal tariff may be the one that induces foreign direct investment if the profits of a subsidiary are also taxed. A similar conclusion is also reached in Dehejia and Weichenrieder (2001), which shows that tariff jumping direct investment is beneficial to the receiving country if mobile capital is subjected to taxation. If the optimal trade policies induce foreign direct investment, then tariff and quota may no longer be equivalent.

Thirdly, the equivalence result can break down if we do not have identical foreign firms. The main analysis in the following section shows that, when we have heterogeneous foreign firms, a tariff that just deters DFI is not equivalent to a quota that just deters DFI. Thus if the optimal trade policy is the one that just prevents DFI, the two regimes will yield different price and imports. If the optimal policy is the one that yields some DFI production, the two regimes may yield different price, imports and welfare level.

Another shortcoming of Levinsohn's model is that the equivalence result is fairy narrow. This is because it focuses only on optimally set policies. The equilibrium outcome of a trade policy that induces FDI, though might not be the first best solution, may occur anyway as a result of strategic interaction. For example, Flam (1994) demonstrates that the equilibrium outcome of a trade policy (VER) in a customs union is the VER that allows FDI. In this model, which has Japan producing cars under VER agreement to supply two members of the EC, FDI is the result of uncoordinated policies of the two competing EC members. VER alone benefits the car producing EC member, and hurts the non-producing EC member, however FDI reverse these effects. Motta (1992) analyses the interactions between a home firm's entry decisions and a foreign firm's direct investment decision (export v FDI), and finds that tariff-jumping FDI can be welfare improving if no local firms would have entered the market under the free trade.[13] Since it is possible that the equilibrium outcomes could be trade policies that induce foreign direct investment, then it might be more useful to broaden our analysis to include the comparison of tariffs and quotas that induce DFI.

3.4 Tariff v Quota when firms can invest abroad

In this section we use a simple model to analyse the nature of tariff and quota policies when it is open to DFI. However we leave the question of the optimal trade policies open. This is because the solutions for optimal trade

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[13] However, similar to Smith (1987) and Campa et al (1998), a tariff has no definite impact on the choice of the foreign firm between export and FDI. High tariff may lead to less FDI when a home firm's entry decision is taken into account.

policies depend on how we define the welfare functions. DFI has potential welfare benefits to the domestic country, and these benefits (employment, technology transfer, or tax revenue) could outweigh the loss of tariff revenue or the loss of quota licence revenue. Moreover in our main analysis we consider the case of heterogeneous foreign firms. Unlike the above case of identical foreign firms, there would be a certain range of trade policies that induce some but not all foreign firms to take DFI production. It would be interesting to closely examine this range of tariff and quota policies.

Here we use a model of international Cournot model similar to the one in the previous section (3.3) but with a different assumption about foreign firms. In particular, we consider a case of two heterogeneous foreign firms. We assume that a foreign firm *1** is more efficient than a foreign firm *2**. We maintain all other assumptions, which include a linear demand curve $(D = A - p)$, n identical home firms, constant marginal costs, no new entry, and no transport cost. We can then replicate some results from the previous section. The equilibrium free trade price (p^F), and outputs are now given by

$$p^F = \frac{A + nc + c_1^* + c_2^*}{n+3}; \qquad h = p^F - c; \qquad h_i^* = p^F - c_i^* \tag{16}$$

where c_i^* is a constant marginal cost of a foreign firm i, and $c_1^* < c_2^*$.

The domestic government has two trade policy options, a tariff or a quota. For a foreign firm, DFI production is possible. The DFI production represents an increase in output but it is not an increase in the number of firms. As in section 3.3 we assume that there is no set up cost for the DFI production, but the marginal cost of DFI production is higher than the marginal cost of producing from the original plants in the foreign country. The marginal cost of DFI production for each foreign firm is given by γc_i^*, with $\gamma > 1$. Unlike the previous section (3.3), the cost of DFI production for each (foreign) firm is now different. The marginal cost of DFI production is lower for a more efficient foreign firm (since $\gamma c_1^* < \gamma c_2^*$).

<u>3.4.1 Tariff</u>

Again suppose that the home country imposes a specific tariff of t on foreign imports. This specific tariff acts as a unit cost increase on goods produced in the foreign country. Each foreign firm has two methods of supplying the domestic market, the export option or the DFI option. For each foreign firm, the cost of the export option is $c_i^* - t$, while the cost of the DFI option is γc_i^*. Similar to condition (8) in the section 3.3, cost minimisation and constant marginal cost imply that a foreign firm i will switch from the export option to the DFI option if

$$t > (\gamma - 1)c_i^* \qquad (17)^{14}$$

The above condition is a simple comparison of costs between the two options. When a foreign firm switches to the DFI option it no longer pays a tariff (t), but its marginal cost increases by $(\gamma - 1)c_i^*$. Therefore it would be more profitable to switch to the DFI option if the marginal cost increase is smaller than the saving from not paying the tariff. We can then derive the pattern of

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[14] Again this condition can also be derived independently by comparing the profits from the two options.

home market entry decisions by the two foreign firms and the equilibrium prices for any tariff rate. The results can be illustrated by the following diagram.

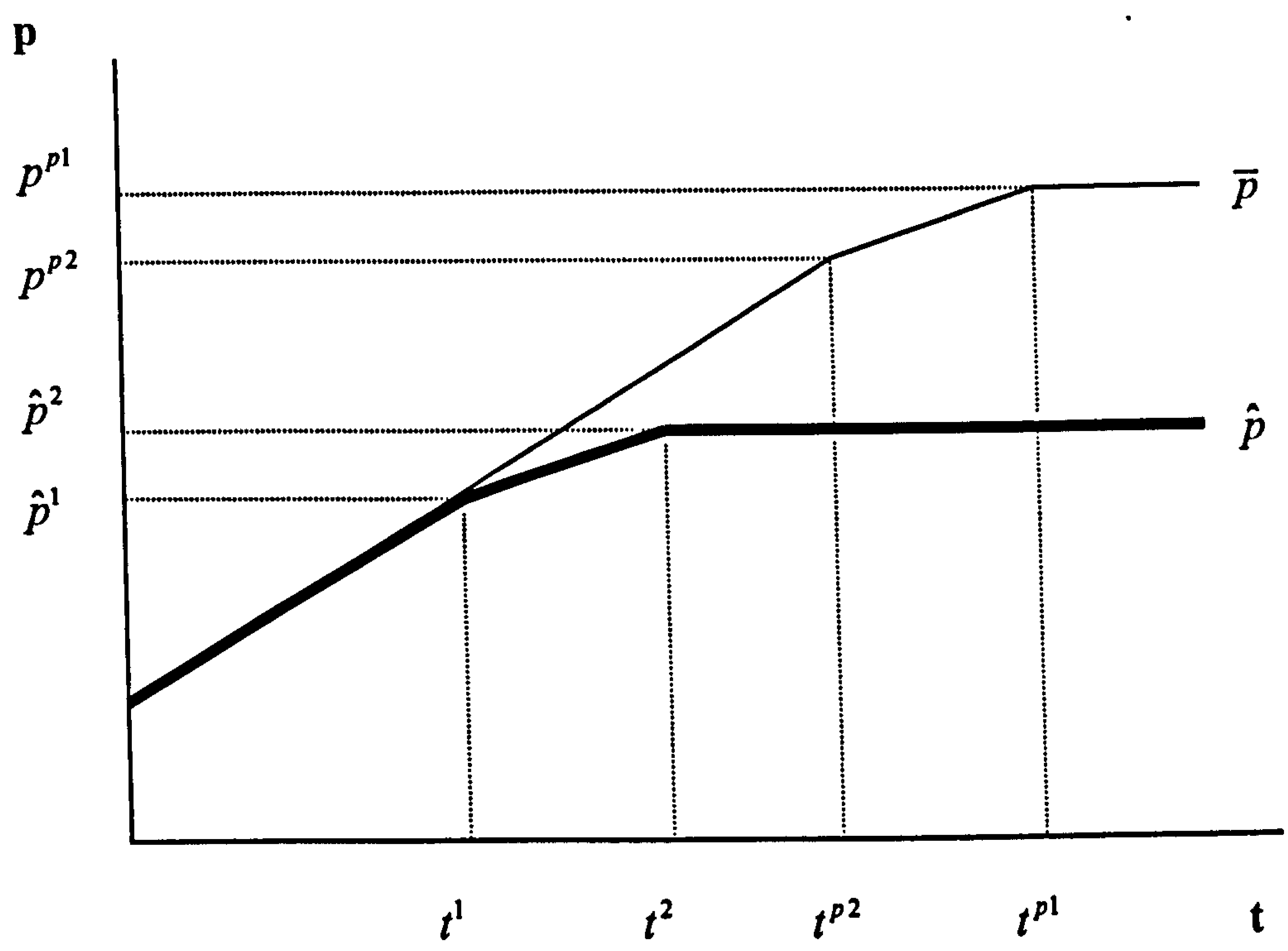

Figure 3a

In the above diagram we show the relationship between tariff rate and domestic price. The kinked schedule $\overline{p}$ shows us the projected tariff-induced price if the DFI production were not possible. In such case, the equilibrium price is given by

$$\overline{p} = p^F + \frac{2t}{n+3} \quad \text{with} \quad \frac{d\overline{p}}{dt} = \frac{2}{n+3} > 0 \qquad (18)^{15}$$

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[15] If DFI production were not possible, profits maximization would yield $\overline{h} = \overline{p} - c$ and $\overline{h}_i^* = \overline{p} - c_i^* - t$. And by substituting these optimal outputs into the demand function we get $\overline{p} = \frac{A + nc + c_1^* + c_2^* + 2t}{n+3} = p^F + \frac{2t}{n+3}$.

However in this case there would also be a certain range of tariff that prohibits foreign firm(s) from exporting to the home market, if a tariff is set very high, There would be a prohibitive tariff t^{P2}, which prevents firm *2** from exporting, and a prohibitive tariff t^{P1}, which prevents both foreign firms from exporting.[16] The kinks at t^{P2} and t^{P1} represent the withdrawal of firm *2**'s production and the withdrawal of both foreign firms' production, respectively.

If DFI production is possible, the relevant equilibrium prices are represented by the kinked schedule $\hat{p}$. To rule out trivial outcomes where DFI production would never occur, we shall assume that the switchover tariffs are less than the prohibitive tariffs. In general we observed that the equilibrium prices when DFI is possible are no higher than the no-DFI equilibrium prices, and $\hat{p}$ is lower than $\overline{p}$ once a foreign firm start DFI production.

If $t < t^1$, where $t^1 = (\gamma - 1)c_1^*$, then both foreign firms choose the export option and the equilibrium price is given by $\overline{p} = p^F + \frac{2t}{n+3}$. If $t^1 > t > t^2$, where $t^2 = (\gamma - 1)c_2^*$, then it is more profitable for firm *1** (but not firm *2**) to switch to the DFI option. The equilibrium price in this tariff range is given by

[16] Prohibitive tariffs imply that the optimal solution for a foreign firm's output would yield a non-positive outcome. Then a tariff that makes firm *2**'s optimal output equal to zero is $t^{P2} = \frac{n+3}{n+1}h_2^*$. A tariff that makes firm *1** 's optimal output equal to zero, when the less efficient foreign firm (*2**) has already produced nothing, is $t^{P1} = \frac{n+3}{n+1}h_1^* - \frac{c_2^* - c_1^*}{n+1}$. And $t^{P1} - t^{P2} = \frac{n+2}{n+1}[c_2^* - c_1^*] > 0$.

$$\hat{p}^1 = p^F + \frac{(\gamma-1)c_1^* + t}{n+3} \quad \text{with} \quad \frac{d\hat{p}^1}{dt} = \frac{1}{n+3} > 0 \qquad (19)^{17}$$

Unlike the identical foreign firms case, a tariff that induces some DFI production in this model can still be used to limit foreign imports. But since only firm *2** is now exporting to the domestic market, the (positive) effect of a tariff on domestic price is smaller than the effect in the no-DFI case. More interestingly, an increase in tariff is now helping to increase the optimal output and consequently the profit of the more efficient foreign firm (firm *1**).

If $t > t^2$, then both foreign firms choose the DFI option. There would be no import; all the goods are now produced inside the domestic country. The equilibrium price is now given by

$$\hat{p}^2 = p^F + \frac{(\gamma-1)(c_1^* + c_2^*)}{n+3} \quad \text{with} \quad \frac{d\hat{p}^2}{dt} = 0 \qquad (20)^{18}$$

Thus in this case, a small increase in tariff has no effect on domestic price, and consequently on firms' optimal output and profits.

It is also worth noting that the role of the prohibitive tariffs in the no-DFI case and the role of the switchover tariffs are very different. The prohibitive tariff prevents foreign firm(s) from exporting to the home country, and it requires a smaller prohibitive tariff to prevent the less efficient foreign firm.

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[17] With a foreign firm *1** chooses the DFI option, its' optimal output is $\hat{s}_1^* = \hat{p}^1 - \gamma c_1^*$, where $\hat{s}_1^*$ is firm *1**'s DFI production. While other firms' optimal outputs are as before, i.e. $\hat{h} = \hat{p}^1 - c$ and $\hat{h}_2^* = \hat{p}^1 - c_2^* - t$. The equilibrium price is then given by $\hat{p}^1 = \dfrac{A + nc + \gamma c_1^* + c_2 + t}{n+3} = p^F + \dfrac{(\gamma-1)c_1^* + t}{n+3}$.

The switchover tariff, on the other hand, induces foreign firm(s) to abandon the export option in favour of the DFI option. That is a foreign firm does not stop supplying the domestic market (i.e. the switchover tariff simply makes a foreign firm to change the location of production). And it requires a smaller switchover tariff to induce the more efficient foreign firm to switch production option.

We can now summarise foreign firms' home market entry decisions, the equilibrium prices, optimal outputs, and profits for any tariff rate as follows:

[T1] If $t < t^1$, $t^1 = (\gamma - 1)c_1^*$, both foreign firms choose the export option.

a) The equilibrium price is $\bar{p} = p^F + \frac{2t}{n+3}$, and $\frac{d\bar{p}}{dt} = \frac{2}{n+3} > 0$.

b) Total imports are $\bar{M} = \bar{h}_1^* + \bar{h}_2^* = h_1^* + h_2^* - \frac{2n+2}{n+3}t$, and $\frac{d\bar{M}}{dt} = -\frac{2n+2}{n+3} < 0$.

c) Total domestic outputs are $\bar{H} = n\bar{h} = n[h + \frac{2t}{n+3}]$, and $\frac{d\bar{H}}{dt} = \frac{2n}{n+3} > 0$.

d) Profits are $\bar{\pi} = (\bar{p} - c)^2$, $\bar{\pi}_i^* = (\bar{p} - c_i^* - t)^2$, and

$$\frac{d\bar{\pi}}{dt} = 2\bar{h}\frac{d\bar{p}}{dt} > 0, \quad \frac{d\bar{\pi}_i^*}{dt} = 2\bar{h}_i^*[\frac{d\bar{p}}{dt} - 1] < 0.$$

[T2] If $t^1 > t > t^2$, $t^2 = (\gamma - 1)c_2^*$, firm 1 chooses DFI, but firm 2 chooses export.

a) The domestic price is $\hat{p}^1 = p^F + \frac{(\gamma - 1)c_1^* + t}{n+3}$ and $\frac{d\hat{p}^1}{dt} = \frac{1}{n+3} > 0$.

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[18] In this case the optimal outputs for home firms and the two foreign firms are $\hat{h} = \hat{p}^2 - c$ and $\hat{s}_i^* = \hat{p}^2 - \gamma c_i^*$. The equilibrium price is then

b) Total imports are $\hat{M}^1 = \hat{h}_2^* = h_2^* - [\frac{(n+2)t-(\gamma-1)c_1^*}{n+3}]$ and $\frac{d\hat{M}^1}{dt} = -\frac{n+2}{n+3} < 0$.

c) Total DFI production is $\hat{S}^1 = \hat{s}_1^* = h_1^* - [\frac{(n+2)(\gamma-1)c_1^* - t}{n+3}]$ and

$$\frac{d\hat{S}^1}{dt} = \frac{1}{n+3} > 0.$$

d) Total domestic outputs are $\hat{H}^1 = n\hat{h} = n[h + \frac{(\gamma-1)c_1^* + t}{n+3}]$, and

$$\frac{d\hat{H}^1}{dt} = \frac{n}{n+3} > 0.$$

e) Profits are $\hat{\pi} = (\hat{p}^1 - c)^2$, $\hat{\pi}_1^* = (\hat{p}^1 - \gamma c_1^*)^2$, $\hat{\pi}_2^* = (\hat{p}^1 - c_2^* - t)^2$, and

$$\frac{d\hat{\pi}}{dt} = 2\hat{h}\frac{d\hat{p}^1}{dt} > 0,\ \frac{d\hat{\pi}_1^*}{dt} = 2\hat{s}_1^*\frac{d\hat{p}^1}{dt} > 0,\ \frac{d\hat{\pi}_2^*}{dt} = 2\hat{h}_2^*[\frac{d\hat{p}^1}{dt} - 1] < 0.$$

[T3] If $t > t^2$, both foreign firms choose DFI.

a) The domestic price is $\hat{p}^2 = p^F + \frac{(\gamma-1)(c_1^* + c_2^*)}{n+3}$ and $\frac{d\hat{p}^2}{dt} = 0$.

b) Total DFI production is $\hat{S}^2 = \hat{s}_1^* + \hat{s}_2^* = h_1^* + h_2^* - [\frac{n+1}{n+3}(\gamma-1)(c_1^* + c_2^*)]$

and $\frac{d\hat{S}^2}{dt} = 0$.

c) Total domestic outputs are $\hat{H}^2 = n\hat{h} = n[h + \frac{(\gamma-1)(c_1^* + c_2^*)}{n+3}]$, and

$$\frac{d\hat{H}^2}{dt} = 0.$$

d) Profits are $\hat{\pi} = (\hat{p}^2 - c)^2$, $\hat{\pi}_i^* = (\hat{p}^2 - \gamma c_i^*)^2$, and $\frac{d\hat{\pi}}{dt} = \frac{d\hat{\pi}_i^*}{dt} = 0$.

$$\hat{p}^2 = \frac{A + nc + \gamma c_1^* + \gamma c_2^*}{n+3} = p^F + \frac{(\gamma-1)(c_1^* + c_2^*)}{n+3}.$$

Before we move to the analysis of a quota policy, it is worth mentioning the case of positive set up cost for DFI option. Suppose that a foreign firm i^* needs to pay a fixed cost of $(F_i^*,\ F_1^* < F_2^*)$ for setting up a subsidiary plant. The involvement of a fixed cost implies that we can no longer find the switch over tariff by comparing the marginal costs of the two options. Here we need to compare the profits from the two options. For firm *1**, the DFI option yields profit of $\hat{\pi}_1^* = (\hat{p}^1 - \gamma c_1^*)^2 - F_1^*$, while the export option yields profit of $\overline{\pi}_1^* = (\overline{p} - c_1^* - t)^2$. Since a fixed cost does not affect the equilibrium outputs and prices we can use the above results to derive the profits differential term $(\hat{\pi}_1^* - \overline{\pi}_1^*)$;

$$\hat{\pi}_1^* - \overline{\pi}_1^* = \frac{n+2}{n+3}[t - (\gamma - 1)c_1^*][(\hat{p}^1 - \gamma c_1^*) + (\overline{p} - c_1^* - t)] - F_1^* \qquad (21a)$$

The above condition implies that at the original switchover tariff $t^1 = (\gamma - 1)c_1^*$, firm *1** is no longer indifferent between the two options. This is because at this tariff rate the export option yields higher profit than the DFI option (as $\hat{\pi}_1^* - \overline{\pi}_1^* = -F < 0$). The new switchover tariff for firm *1** requires that the original profits differential when there is no fixed cost (the first term on the right hand side of equation 21a) is big enough to cover the fixed cost F_1^*. For firm *2**, it will compare the DFI profit of $\hat{\pi}_2^* = (\hat{p}^2 - \gamma c_2^*)^2$ and the export profit of $\overline{\pi}_2^* = (\hat{p}^1 - c_2^* - t)^2$. The differential in profits from the two options is given by

$$\hat{\pi}_2^* - \overline{\pi}_2^* = \frac{n+2}{n+3}[t - (\gamma - 1)c_2^*][(\hat{p}^2 - \gamma c_2^*) + (\hat{p}^1 - c_2^* - t)] - F_2^* \qquad (21b)$$

Again the original switchover tariff $t^2 = (\gamma - 1)c_2^*$ can no longer induce firm *2** to switch to the DFI option. Thus the presence of the positive fixed set up costs will delay foreign firms' decisions of switching to DFI, as the new switchover tariffs would be higher.

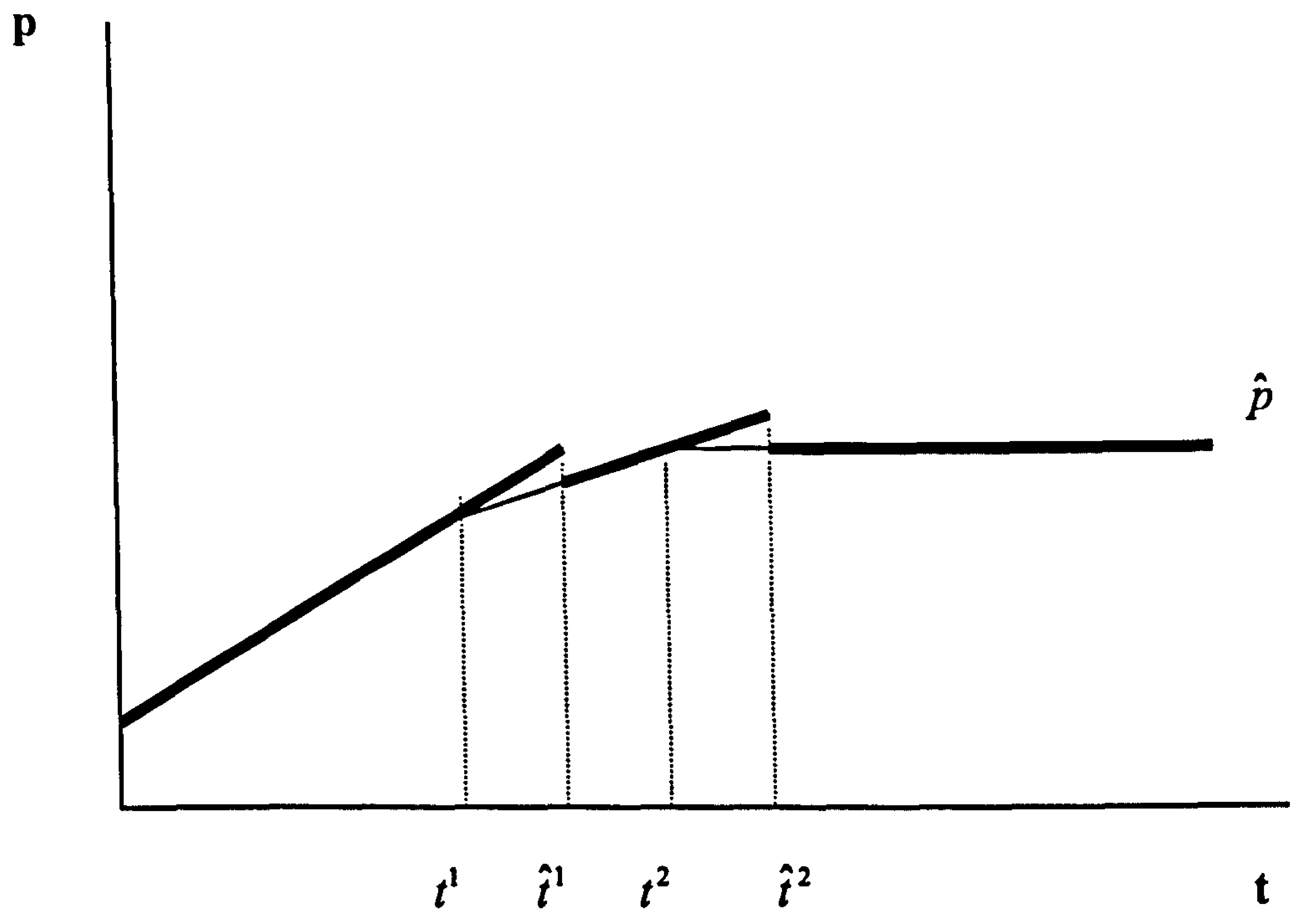

Figure 3b

The above figure shows the new schedule for DFI-induced price, $\hat{p}$. It demonstrates that t^1 is no longer the switchover tariff for firm *1**, if the DFI production incurs a fixed cost, F_1^*. Lets $\hat{t}^1$ be the new switchover tariff (i.e. a tariff that makes $\hat{\pi}_1^* - \bar{\pi}_1^* = 0$). Then for $t < \hat{t}^1$, firm *1** chooses the export option and the equilibrium price is given by $\bar{p} = p^F + \frac{2t}{n+3}$. When a tariff is just above the new switchover tariff, $\hat{t}^1$, there is a sudden drop in the equilibrium price when firm *1** switch its production to DFI. For $t > \hat{t}^1$ the equilibrium price is now $\hat{p}^1 = p^F + \frac{(\gamma-1)c_1^* + t}{n+3}$. The discontinuity in the equilibrium prices is confirmed by the fact that $\hat{p}^1 < \bar{p}$ for $t = \hat{t}^1 > (\gamma-1)c_1^*$.

Similarly a fixed cost F_2^* will delay firm *2**'s decision to switch to DFI production until $t = \hat{t}^2 > (\gamma - 1)c_2^*$. Again there is a downward jump in equilibrium prices at this tariff rate.

3.4.2 Quota

Now suppose that the home government imposes a quota instead of a tariff on imports. Like section 3.3 we assume that the quota allocation is in proportion to each foreign firm's sales in the home market under the free trade. And since the foreign firms' sales under the free trade are optimal, the quota is binding. Unlike the section 3.3, here we assume that there is no quota licence fee so that the analysis is also applicable to VER case.

Unlike the tariff case where a foreign firm has to choose either export or DFI options, the quota regime allows a foreign firm to choose both options. This is because, under the quota regime without a licence fee, the export option is always the least costly method of supplying the home market. However if the quota is too low, a foreign firm may gain from starting additional DFI production. Since the quota is binding, a foreign firm choose the DFI production output ($\tilde{s}_i^*$) to maximise profit. Thus the profit maximisation for each foreign firm is[19]

$$\underset{\tilde{s}_i^*}{Max}\,(\tilde{p} - c_i^*)qh_i^* + (\tilde{p} - \gamma c_i^*)\tilde{s}_i^* \tag{22}$$

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[19] If the quota were not binding, a foreign firm would maximize its profit with respect to both the production in the foreign country ($\tilde{h}_i^*$) and DFI production ($\tilde{s}_i^*$). That is

$$\underset{\tilde{h}_i^*,\tilde{s}_i^*}{Max}\,(\tilde{p} - c_i^*)\tilde{h}_i^* + (\tilde{p} - \gamma c_i^*)\tilde{s}_i^* \;\; s.t. \;\; \tilde{h}_i^* \leq qh_i^*.$$

where q, $0 \le q \le 1$, is a quota rate, h_i^* is the optimal free trade output of foreign firm i^*, and $\tilde{p}$ is the quota-induced equilibrium price. By taking $\frac{d\tilde{p}}{d\tilde{s}_i^*} = -1$, the profit maximisation implies that

$$\frac{\partial \tilde{\pi}_i^*}{\partial \tilde{s}_i} = 0 = \tilde{p} - \gamma c_i^* - q h_i^* - \tilde{s}_i^* \qquad \text{or} \qquad \tilde{s}_i^* = \tilde{p} - \gamma c_i^* - q h_i^* \tag{23}$$

The above condition implies that a foreign firm will start DFI production ($\tilde{s}_i^* > 0$), if

$$(\tilde{p} - \gamma c_i^*) - q h_i^* > 0 \tag{24}$$

The term $(\tilde{p} - \gamma c_i^*)$ reflects the optimal output for a foreign firm were it to choose the DFI option alone. If the permitted amount to export is less than that shadow DFI-only optimal output, the quota only option is no longer optimal. A foreign firm can then improve its profit by producing additional output via the DFI production.

If $(\tilde{p} - \gamma c_i^*) - q h_i^* \le 0$, then the additional DFI production would not benefit foreign firms. In such case each foreign firm only supplies $q h_i^*$ to the domestic market, while the optimal output each domestic firm is the usual $\tilde{h} = \tilde{p} - c$. Thus the no-DFI quota-induced equilibrium price is

$$\tilde{p} = \frac{A + nc - q(h_1^* + h_2^*)}{n+1} = p^F + \frac{(1-q)(h_1^* + h_2^*)}{n+1} \tag{25}$$

The above expression clearly shows that a quota raises the equilibrium price from the free trade level, and the smaller quota rate the higher equilibrium price. However a foreign firm may not stick to the production in the foreign country alone. For firm *1**, it will start DFI production ($\tilde{s}_i^* > 0$) if $(\tilde{p} - \gamma c_1^*) - q h_1^* > 0$. Lets q^1 be the quota rate that triggers firm *1** to start engaging in the DFI production. Since at $q = q^1$, we have $s_1^* = 0$, then we can use (23) and (25) to derive

$$q^1 = 1 - \frac{(n+1)(\gamma - 1)c_1^*}{(n+2)h_1^* + h_2^*} \tag{26}$$

Thus for a quota rate that is more restrictive than q^1 (i.e. for $q < q^1$), firm *1** starts engaging in the DFI production in addition to its original production in the foreign country. We can then check whether firm *2** would start DFI production at this quota rate by substituting $q = q^1$ into condition (23). We then find that at $q = q^1$

$$\tilde{p} - \gamma c_2^* - q^1 h_2^* = \frac{(\gamma - 1)}{(n+2)h_1^* + h_2^*}[c_1^*(h_1^* + (n+2)h_2^*) - c_2^*((n+2)h_1^* + h_2^*)] < 0$$

Thus at $q = q^1$, where firm *1** start the DFI production, it is not optimal for firm *2** to engage in the additional DFI production.

Now lets q^2 be the quota rate that triggers firm *2** to start engaging in the DFI production. Then a quota rate in a range of $q^1 > q > q^2$ induces only firm *1** to produce additional DFI output. The optimal outputs for firm *1** are $\tilde{h}_1^* = q h_1^*$ and $\tilde{s}_1^* = \tilde{p}^1 - \gamma c_1^* - q h_1^*$. It is worth noting that the total output of firm *1** ($\tilde{h}_1^* + \tilde{s}_1^* = \tilde{p}^1 - \gamma c_1$) is equivalent to the DFI-only optimal output. Each domestic firm produces the usual $\tilde{h} = \tilde{p}^1 - c$ and firm *2** only produces from its foreign production of $\tilde{h}_2^* = q h_2^*$. Then the equilibrium price in this case is given by

$$\tilde{p}^1 = \frac{A + nc + \gamma c_1^* + qh_2^*}{n+2} = p^F + \frac{(1-q)h_2^* + (\gamma - 1)c_1^*}{n+2} \tag{27}$$

The above expression implies that for $q^1 > q > q^2$, a DFI-inducing quota still affects the equilibrium price. Similar to the above method of finding the expression for q^1, we can substitute the expression for $\tilde{p}^1$ (27) into condition (23), and find that

$$q^2 = 1 - \frac{(\gamma - 1)[(n+2)c_2^* - c_1^*]}{(n+3)h_2^*} \tag{28}$$

Since $h_1^* > h_2^*$ and $c_1^* < c_2^*$, we can also confirm that $q^1 > q^2$ as

$$q^1 - q^2 = \frac{(\gamma-1)\{[(n+2)h_1^* + h_2^*][(n+2)c_2^* - c_1^*] - [(n+3)h_2^*][(n+1)c_1^*]\}}{[(n+3)h_2^*][(n+2)h_1^* + h_2^*]} > 0$$

That is, as the quota rate is lowered the more efficient foreign firm will engage in the DFI option before the less efficient foreign firm.

For $q < q^2$, both foreign firms engage in the additional DFI production and the optimal outputs are

$$\tilde{h} = \tilde{p}^2 - c;\ \tilde{h}_1^* = qh_1^*;\ \tilde{s}_1^* = \tilde{p}^2 - \gamma c_1^* - qh_1^*,\ \tilde{h}_2^* = qh_2^*,\ \tilde{s}_2^* = \tilde{p}^2 - \gamma c_2^* - qh_2^*$$

Then the equilibrium price is given by

$$\tilde{p}^2 = \frac{A + nc + \gamma c_1^* + \gamma c_2^*}{n+3} = p^F + \frac{(\gamma - 1)(c_1^* + c_2^*)}{n+3} \tag{29}$$

This price is identical to the equilibrium price where the two firms totally switch to the DFI production (and no exports).[20] Thus the change in the quota rate no longer affects the price.

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[20] But in this case the profits to the foreign firms must be higher since they still supply some outputs from the lower cost plants in the foreign country via the quotas.

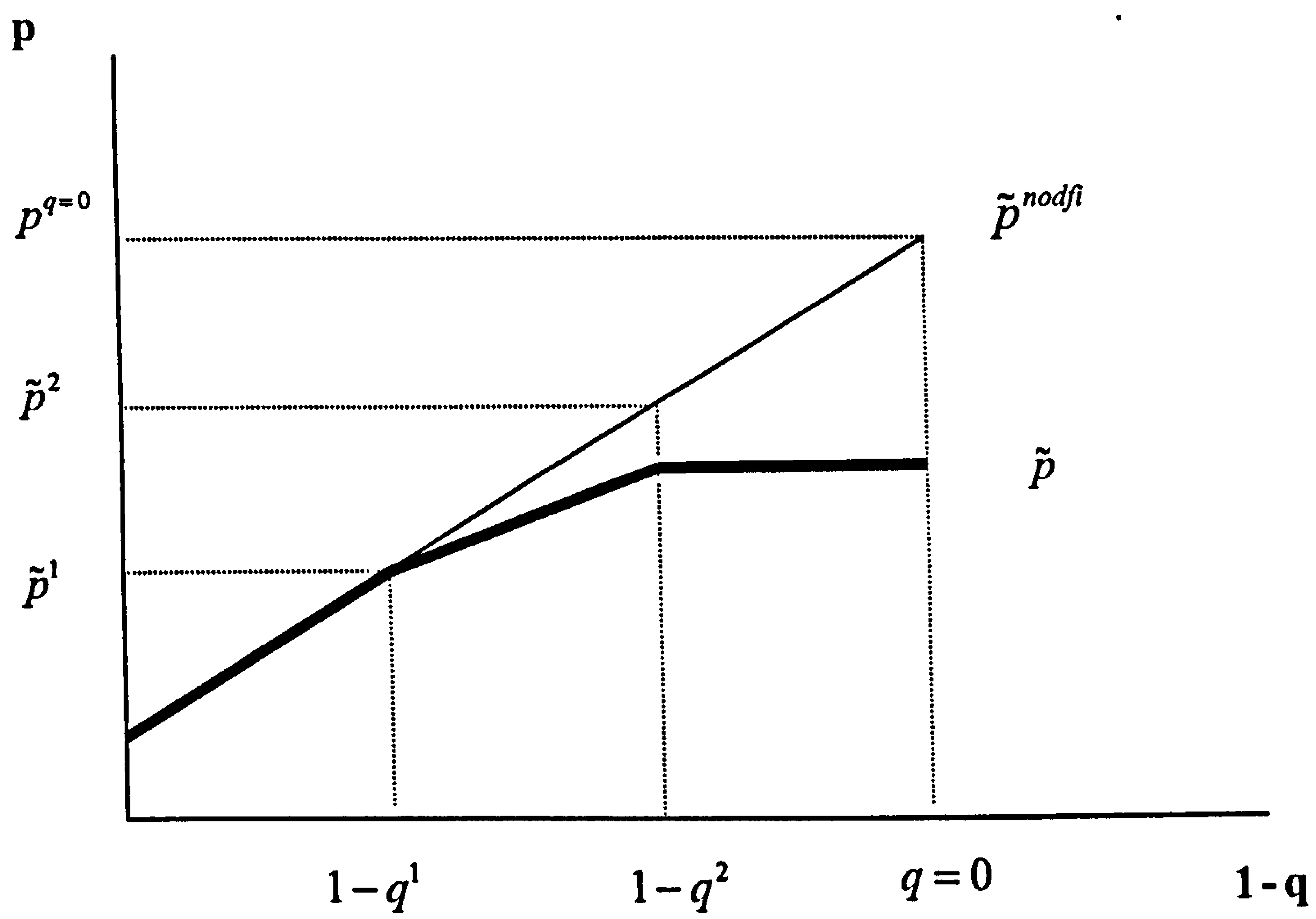

Figure 4

In the above diagrams we show the relationship between the rate of quota (shown as 1- q) and the equilibrium domestic price. The schedule $\tilde{p}^{nodfi}$ shows the case where DFI production is not possible. The equilibrium domestic price steadily increases as the quota rate becomes more restrictive until the quota rate is set at zero. The kinked schedule $\tilde{p}$ shows what happen to the equilibrium price when DFI production is possible. Like the tariff case, the quota-induced equilibrium prices when DFI production is possible are no higher than the no-DFI equilibrium prices, and $\tilde{p} < \tilde{p}^{nodfi}$ once there is some DFI production. At the quota rate $q = q^1$, there is a kink in schedule $\tilde{p}$, as firm *1** starts additional DFI production. A quota can no longer control the total output of firm *1**, but it is still an effective policy to control the total output of firm *2**. Thus for $q^1 > q > q^2$, a reduction in q still increases the equilibrium price. For quota rates that are less than q^2, both foreign firms will find it is optimal engage in additional DFI production. And in this range, a quota no longer affects the equilibrium price, since the total outputs of each foreign firm remain constant. However a quota still decides how much a foreign firm will produce the DFI output.

We can summarise equilibrium outcomes for each range of the quota rate by the following results.

[Q1] If $q > q^1$, $q^1 = 1 - \frac{(n+1)(\gamma-1)c_1^*}{(n+2)h_1^* + h_2^*}$, both foreign firms choose export-only.

a) The domestic price is $\tilde{p} = p^F + \frac{(1-q)(h_1^* + h_2^*)}{n+1}$ and $\frac{d\tilde{p}}{dq} = -\frac{h_1^* + h_2^*}{n+1} < 0$.

b) Total imports are $\tilde{M} = q(h_1^* + h_2^*)$ and $\frac{d\tilde{M}}{dq} = h_1^* + h_2^* > 0$.

c) Total domestic outputs are $\tilde{H} = nh + \frac{n(1-q)(h_1^* + h_2^*)}{n+1}$ and

$$\frac{d\tilde{H}}{dq} = -\frac{n(h_1^* + h_2^*)}{n+1} < 0$$

d) Profits are $\tilde{\pi} = (\tilde{p} - c)^2$, $\tilde{\pi}_i^* = (\tilde{p} - c_i^*)qh_i^*$ and

$$\frac{d\tilde{\pi}}{dq} = 2\tilde{h}\frac{d\tilde{p}}{dq} < 0,\ \frac{d\tilde{\pi}_1^*}{dq} = \frac{h_1^*}{n+1}(nh_1^* - h_2^*) > 0,\ \frac{d\tilde{\pi}_2^*}{dq} = \frac{h_2^*}{n+1}(nh_2^* - h_1^*).$$

[Q2] If $q^1 > q > q^2$, $q^2 = 1 - \frac{(\gamma-1)[(n+2)c_2^* - c_1^*]}{(n+3)h_2^*}$, firm *1** chooses export and DFI but firm 2* chooses export-only.

a) The domestic price is $\tilde{p}^1 = p + \frac{(1-q)h_2^* + (\gamma-1)c_1^*}{n+2}$ and $\frac{d\tilde{p}^1}{dq} = -\frac{h_2^*}{n+2} < 0$.

b) Total imports are $\tilde{M}^1 = q(h_1^* + h_2^*)$ and $\frac{d\tilde{M}^1}{dq} = h_1^* + h_2^* > 0$.

c) Total DFI production is $\tilde{S}^1 = \tilde{s}_1^* = \dfrac{[(1-q)[(n+2)h_1^* + h_2^*]] - [(n+1)(\gamma-1)]c_1^*}{n+2}$

and $\dfrac{d\tilde{S}^1}{dq} = -\dfrac{(n+2)h_1^* + h_2^*}{n+2} < 0.$

d) Total domestic outputs are $\tilde{H} = nh + \dfrac{n[(1-q)h_2^* + (\gamma-1)c_1^*]}{n+2}$ and

$$\frac{d\tilde{H}^1}{dq} = -\frac{nh_2^*}{n+2} < 0$$

e) Profits are $\tilde{\pi} = (\tilde{p}^1 - c)^2$, $\tilde{\pi}_1^* = (\gamma-1)c_1^* q h_1^* + (\tilde{p}^1 - \gamma c_1^*)^2$, $\tilde{\pi}_2^* = (\tilde{p}^2 - c_2^*)qh_2^*$

and $\dfrac{d\tilde{\pi}}{dq} = 2\tilde{h}^1 \dfrac{d\tilde{p}^1}{dq} < 0, \dfrac{d\tilde{\pi}_1^*}{dq} = (\gamma-1)c_1^* h_1^* + 2(\tilde{p}^1 - \gamma c_1^*)\dfrac{d\tilde{p}^1}{dq},$

$$\frac{d\tilde{\pi}_2^*}{dq} = \frac{h_2^*[(n+1)h_2^* + (\gamma-1)c_1^*]}{n+2} > 0.$$

[Q3] If $q < q^2$, both foreign firms choose export and DFI production.

a) The domestic price is $\tilde{p}^2 = p + \dfrac{(\gamma-1)(c_1+c_2)}{n+3}$ and $\dfrac{d\tilde{p}^2}{dq} = 0$.

b) Total imports are $\tilde{M}^2 = q(h_1^* + h_2^*)$ and $\dfrac{d\tilde{M}^2}{dq} = h_1^* + h_2^* > 0$.

c) Total DFI production is $\tilde{S}^2 = \tilde{s}_1^* + \tilde{s}_2^* = (1-q)(h_1^* + h_2^*) - \dfrac{n+1}{n+3}(\gamma-1)(c_1^* + c_2^*)$

and $\dfrac{d\tilde{S}^2}{dq} = -(h_1^* + h_2^*) < 0$.

d) Total domestic outputs are $\tilde{H}^2 = nh + \dfrac{n(\gamma-1)(c_1+c_2)}{n+3}$ and $\dfrac{d\tilde{H}^2}{dq} = 0$.

e) Profits are $\tilde{\pi} = (\tilde{p}^2 - c)^2$, $\tilde{\pi}_i^* = (\gamma-1)c_i^* q h_i^* + (\tilde{p}^2 - \gamma c_i^*)^2$ and

$$\frac{d\tilde{\pi}}{dq} = 2(\tilde{p}^2 - c)\frac{d\tilde{p}^2}{dq} = 0,\ \frac{d\tilde{\pi}_i^*}{dq} = (\gamma-1)c_i^* h_i^* > 0.$$

The presence of the set-up costs also affects the above equilibrium outcomes in the same way as in the tariff case. If there is a positive set up cost ($F_i^* > 0$), we need to compare a foreign firm's profit from the export and DFI option with a profit from the export-only option. For firm *1**, the profit from taking the additional DFI production together with the allowed export is now given by $\tilde{\pi}_1^* = (\tilde{p}^1 - c_1^*)qh_1^* + (\tilde{p}^1 - \gamma c_1^*)\tilde{s}_1^* - F$. If firm *1** chooses the export-only option, its profit is simply $\tilde{\pi}_1^* = (\tilde{p} - c_1^*)qh_1^*$. We can show that if foreign firm *1** starts engaging in additional DFI production at $q = q^1$ (i.e. $s_1^* \approx 0$ and $\tilde{p}^1 \approx \tilde{p}$), the profit from producing in two countries is now lower than the profit from exporting alone. Although the presence of the set up cost does not affect the optimal solution for the DFI production, the new switchover quota rates are now more restrictive than the original switchover quota rates ($q^1$and q^2).[21] That is the presence of a set up cost delays a foreign firm's decision on engaging in additional production in the home country. There would also be a downward jump in equilibrium prices once a foreign firm starts the additional DFI production. This is because a foreign firm, in this case, no longer starts producing DFI output from zero.

3.4.3 Tariff-quota equivalence when DFI production is possible

First consider the case where the DFI production is not possible and a tariff is not prohibitive to both foreign firms (i.e. $t < t^{P2}$). Hwang and Mai (1988) prove that in the case of Cournot competition we can find a tariff and quota

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[21] In this case a foreign firm switches from export-only option to export and DFI option.

that lead to the same volume of imports and consequently the same increase in the domestic price. Using the expressions for the no-DFI tariff-induced equilibrium price, $\bar{p}$ (from equation 18) and the expression for the no-DFI quota-induced equilibrium price, $\tilde{p}$ (from 25), we can find the condition for the equivalent tariff and quota regimes as

$$t = (1-q)(\frac{n+3}{2n+2})(h_1^* + h_2^*) \tag{30}$$

(It is worth noting that if $t^{P2} < t < t^{P1}$, only the foreign firm *1** exports to the home market. The condition for the equivalent regimes will be $t = [(1-q)(\frac{n+2}{n+1})(h_1^* + h_2^*)] - h_2^*)$. The sales of an individual foreign firm under the equivalent tariff and quota regimes are different. By substituting (30) into the expressions for optimal solutions under the tariff and the quota, we obtain

$$\bar{h}_i^* = qh_i^* + (1-q)[h_i^* - \frac{(h_1^* + h_2^*)}{2}] \tag{31}$$

which implies that firm *1** (the more efficient firm) exports relatively more under the equivalent tariff regime, and firm *2** (the less efficient firm) relatively less. The optimal outputs and profits of a home firm are the same under the two regimes that are equivalent in price. If the DFI option becomes available to the foreign firms, the condition(s) for equivalent tariff and quota regimes will become more complicated. And at some point we find that there is no tariff and quota that lead to the same amount of imports and the same domestic price.

<u>Price Equivalence</u>

Lets first focus our attention to the tariff and quota regimes that lead to the same domestic price. Recall that under the tariff regime, firm *1** switches from the export option to the DFI option at the tariff rate t^1, while firm *2** switches to the DFI (hence both foreign firms choose the DFI option) at t^2. Under the quota regime, firm *1** starts the DFI production together with the production in its original plant in a foreign country at the quota rate q^1, while firm *2** does the same when the quota equals to q^2. We can summarise the domestic prices and their corresponding tariff and quota rates at these points in the following table.

Table 1: Corresponding tariffs and quotas at certain prices

Price	Corresponding Tariff	Corresponding Quota
$p=\tilde{p}^{q1}$	$t^{q1}=[\frac{(n+3)(h_1^*+h_2^*)}{2[(n+2)h_1^*+h_2^*]}](\gamma-1)c_1^*$	$q^1=1-\frac{(n+1)(\gamma-1)c_1^*}{(n+2)h_1^*+h_2^*}$
$p=\bar{p}^{t1}$	$t^1=(\gamma-1)c_1^*$	$q^{t1}=1-\frac{(n+1)(\gamma-1)c_1^*}{(n+3)h_2^*}$
$p=\bar{p}^{t2}=\tilde{p}^{q2}$	$t^2=(\gamma-1)c_2^*$	$q^2=1-\frac{(\gamma-1)[(n+2)c_2^*-c_1^*]}{(n+3)h_2^*}$

where $\tilde{p}^{q1}=p+\frac{(\gamma-1)c_1^*[h_1^*+h_2^*]}{[(n+2)h_1^*+h_2^*]}$; $\bar{p}^{t1}=p+\frac{2(\gamma-1)c_1^*}{n+3}$;

$\bar{p}^{t2}=\tilde{p}^{q2}=p+\frac{(\gamma-1)(c_1^*+c_2^*)}{n+3}$.[22]

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[22] The corresponding tariff rate at $p=\tilde{p}^{q1}$ is obtained by equating $\tilde{p}^{q1}=p+\frac{(\gamma-1)c_1^*[h_1^*+h_2^*]}{[(n+2)h_1^*+h_2^*]}$ with the tariff-induced price that does not induce DFI,

By comparing $\bar{p}^{t1}$, $\tilde{p}^{q1}$, $\bar{p}^{t2}$ and $\tilde{p}^{q2}$ we can establish that $\tilde{p}^{q1} < \bar{p}^{t1} < \bar{p}^{t2}(= \tilde{p}^{q2})$ or equivalently $t^{q1} < t^1 < t^2$ and $q^1 > q^{t1} > q^2$.[23] In the following diagram we plot the tariff-induced equilibrium price and the shadow quota-induced equilibrium price against the tariff.

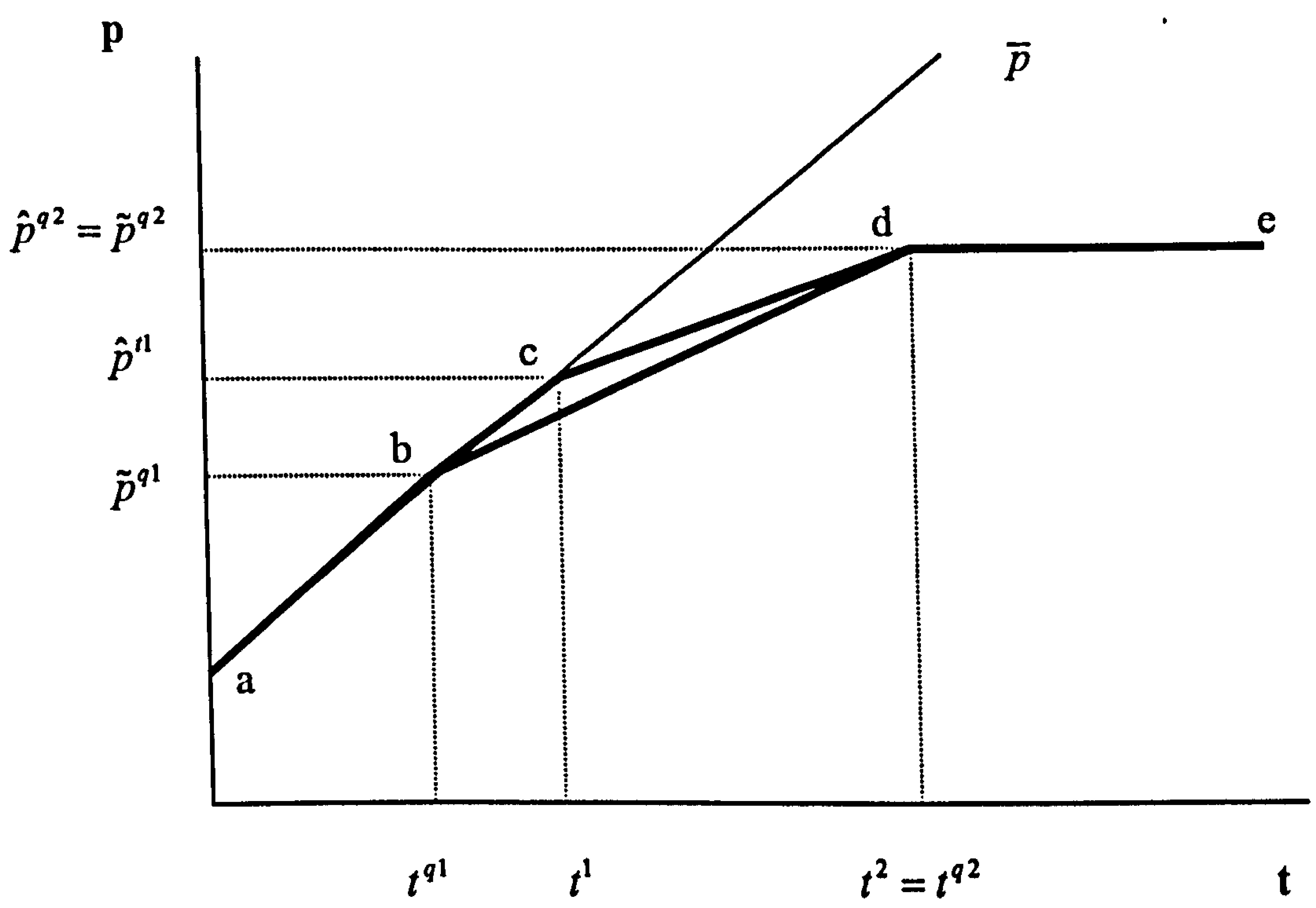

Figure 5

$\bar{p} = p + \frac{2t}{n+3}$; while the corresponding quota rate at $p = \bar{p}^{t1}$ is obtained by equating $\bar{p}^{t1} = p + \frac{2(\gamma - 1)c_1^*}{n+3}$ with the expression for quota-induced price when firm *1** also engages in the DFI option, i.e. $\tilde{p}^1 = p + \frac{(1-q)h_2^* + (\gamma-1)c_1^*}{n+2}$.

[23] Since $\bar{p}^{t1} - \tilde{p}^{q1} = \frac{[(n+1)(\gamma-1)c_1^*][h_1^* - h_2^*]}{[n+3][(n+2)h_1^* + h_2^*]} > 0$, then $\bar{p}^{t1} > \tilde{p}^{q1}$. For t^{q1} and t^1, we can show that $2[(n+2)h_1^* + h_2^*] > (n+3)(h_1^* + h_2^*)$, hence $[\frac{(n+3)(h_1^* + h_2^*)}{2[(n+2)h_1^* + h_2^*]}](\gamma - 1)c_1^* < (\gamma - 1)c_1^*$ or $t^{q1} < t^1$.

The schedule $\overline{p}$ shows the tariff-induced equilibrium price when DFI production is not possible (here we ignore the prohibitive tariffs). When DFI production is possible the kinked schedule **acde** represents the tariff-induced price, and the kinked schedule **abde** represents the shadow quota-induced price. The above diagram shows that under the quota regime firm *1** starts DFI production in additional to export production at the quota rate equivalent to t^{q1} (hence the kink of the shadow quota-induced price schedule at point **b**). Under the tariff regime, firm *1** starts switching from the export option to the DFI-only option at a tariff rate t^1 (the kink at point **c** of the tariff-induced price schedule). Once the tariff and the corresponding quota rates are more restrictive than $t^2 = t^{q2}$, both foreign firms engage in DFI production under both regimes. Then the conditions for price equivalent tariff and quota regimes are as follows:

[1] For $t < t^{q1}$ or $q > q^1$, which implies $p < \widetilde{p}^{q1}$, both foreign firms under both regimes supply the home market by exporting only (this can be represented by section **ab** in figure 5). The condition for equivalent tariff and quota regime is the one that we established in (30): $t = (1-q)(\frac{n+3}{2n+2})(h_1^* + h_2^*)$. The equivalent regimes in this range would lead to the same price and the same volume of imports.

[2] For $t^{q1} < t < t^1$ or $q^1 > q > q^{n1}$, which implies $\widetilde{p}^{q1} < p < \overline{p}^{n1}$, firm *1** under the quota regime produces both the outputs from its original plant in a foreign country (using a quota) and from the subsidiary plant (DFI production). However the corresponding equivalent tariff rates at this quota range are lower than the switchover tariff t^1, both foreign firms under the tariff regime choose

the export option (as shown by section **bc** of the tariff-induced price schedule). The condition for equivalent regimes can be obtained by equating the no-DFI tariff-induced equilibrium price, $\overline{p}$ (from equation 18) with the quota-induced price when firm *1** produces both DFI and export outputs (27), which gives

$$t = \frac{n+3}{2(n+2)}[(1-q)h_2^* + (\gamma - 1)c_1^*] \tag{32}$$

At the same level of price, the total outputs produced by the foreign firms under the two regimes must be the same. Thus the total imports under the quota regime are smaller than those under the price-equivalent tariff regime since firm *1** under the quota also produces DFI outputs from its subsidiary plant.

[3] For $t^1 < t < t^2$ or $q^{t1} > q > q^2$, which implies $\overline{p}^{t1} < p < \overline{p}^{t2} (= \tilde{p}^{q2})$, firm *1** engages in the DFI production under both regimes. Using (19) and (27) we obtain the condition for price equivalent regimes for this case as

$$t = \frac{1}{n+2}[(n+3)(1-q)h_2^* + (\gamma - 1)c_1^*] \tag{33}$$

In this case the DFI outputs produced by firm *1** are larger under the price equivalent tariff regime (since under the tariff we have $\hat{s}_1^* = \hat{p}^1 - \gamma c_1^*$, while under the quota we have $s_1^* = \tilde{p}^1 - \gamma c_1^* - qh_1^*$, and $\hat{p}^1 = \tilde{p}^1$ for equivalent regimes). Therefore there are more total imports under the price equivalent quota regime (so that the total outputs produced by foreign firms are the same).

[4] For $t > t^2$ or $q < q^2$, which implies $p = \overline{p}^{t2} = \tilde{p}^{q2}$, both foreign firms under both regimes engage in the DFI option. Thus any tariff and quota rates are equivalent in price. However the two regimes are different in terms of the composition of the total outputs by the foreign firms. There is no import under

the tariffs, but there are some imports under the quotas unless $q=0$. Conversely the DFI production is larger under the tariff regime.

Imports Equivalence

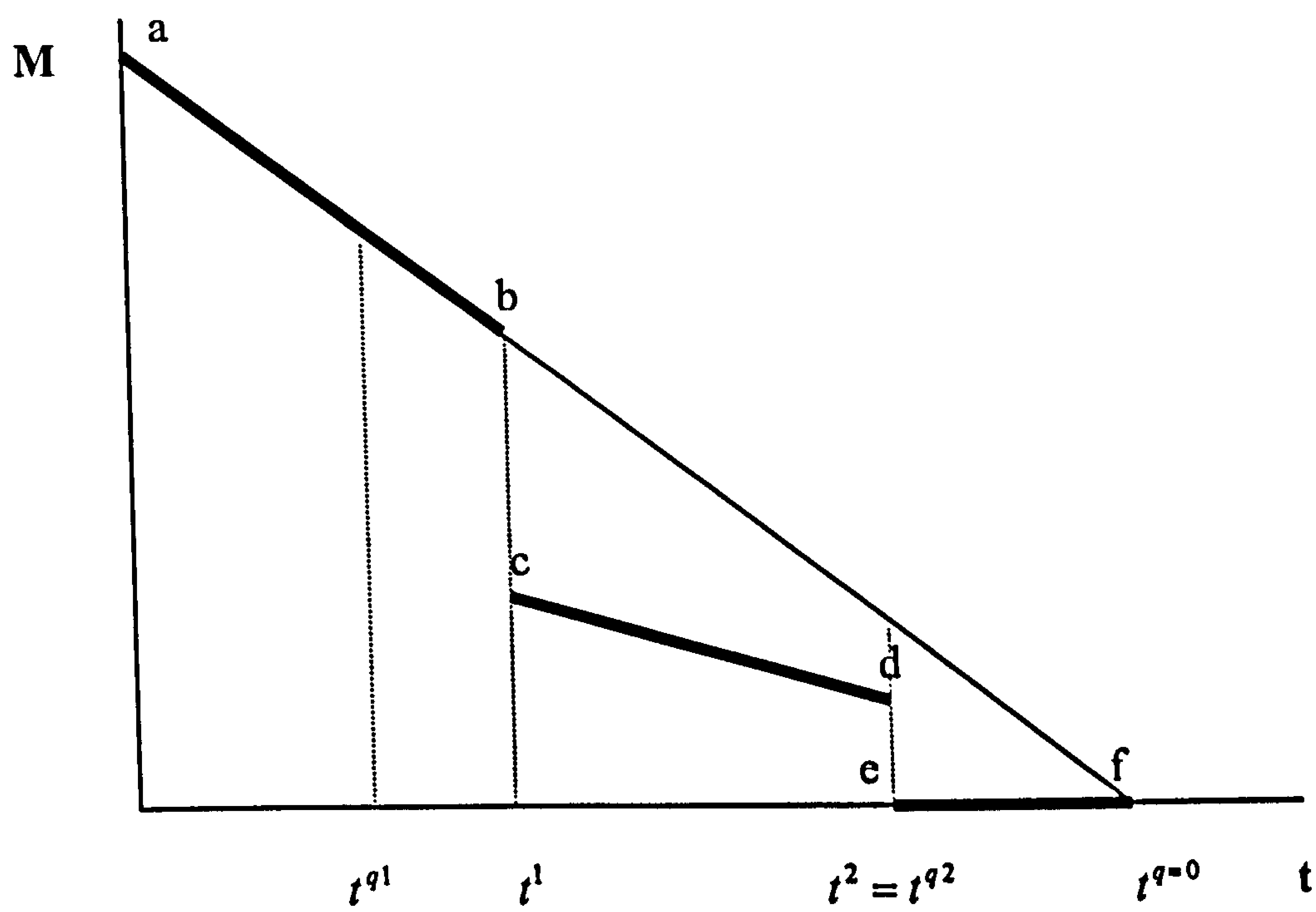

Figure 6

In the above figure we show the level of total imports (M) under the tariff regime, and the shadow level of total imports under the quota regime. Under the quota regime, the quota constraint is always binding, i.e. a foreign firm always exports to the home country. Thus the volume of imports $(q(h_1^* + h_2^*))$ declines steadily as the quota rate becomes smaller. This can be represented by schedule **af** which shows a steady decline of the total imports as a quota, which is represented in the diagram by the corresponding equivalent tariff, becomes more restrictive. There would be no imports if the quota rate were set to zero.

Under the tariff regime, a foreign firm may not always choose the export option. The total imports under the tariff regime can be represented by the discontinued schedule **ab-cd-ef** in the above diagram. For $t < t^1$, we would observe a steady decline in imports as a tariff rate become higher (section **ab**). Then there would be a sudden drop in imports at $t = t^1$, after which we would see a further steady decline in imports until $t = t^2$ (section **cd**), and there would be no import if $t > t^2$ (section **ef**).

Thus for $t < t^1$, the condition for the imports equivalent regimes is

$$t = (1-q)(\frac{n+3}{2n+2})(h_1^* + h_2^*) \qquad (34)^{24}$$

This is the same as the usual equivalence condition (30). Noting that for $t^{q1} < t < t^1$, the domestic price under the imports equivalent quota regime will be lower than the price under the tariff regime. This is because, under the quota regime, firm *1** is now starting to produce DFI outputs in additional to the usual export outputs.

For $t^1 < t < t^2$, the condition for the imports equivalent regimes becomes

$$t = \frac{n+3}{n+2}[(1-q)h_2^* - qh_1^*] + \frac{1}{n+2}(\gamma - 1)c_1^* \qquad (35)^{25}$$

For $t > t^2$, there is no import under the tariff regime, and we need $q = 0$ under the quota regime to reach the same result. It is worth noting for a given tariff

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[24] This condition is obtained by equating the volume of imports under the tariff, $\overline{M} = h_1^* + h_2^* - \frac{2n+2}{n+3}t$, with the volume of imports under the quota, $q(h_1^* + h_2^*)$.

[25] Similarly we equating the volume of imports under the tariff, $\hat{M}^1 = h_2^* - \frac{(n+2)t - (\gamma-1)c_1^*}{n+3}$, with the volume of imports under the quota, $q(h_1^* + h_2^*)$.

we can find an imports equivalent quota, but for some quotas it is not possible to find the corresponding tariff rate that lead to the same volume of imports.

Tariff v Quota: The effects on DFI production

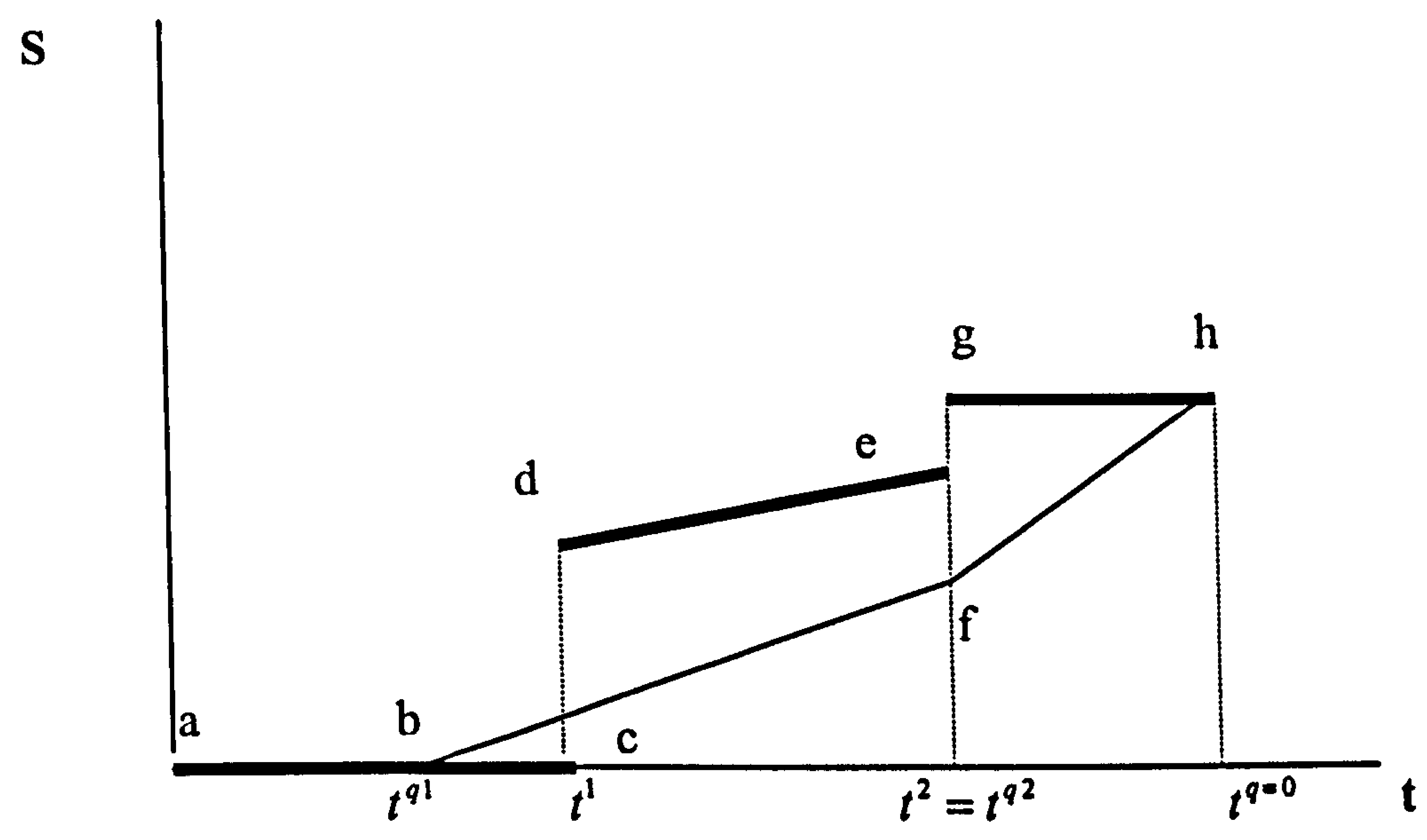

Figure 7

We show how the tariffs and the quotas affect DFI production (S) in the above diagram. The discontinued schedule **ac-de-gh** represents the total DFI outputs under the tariff regime and the kinked schedule **bfh** represents the total DFI outputs under the quota regime (again we convert the quota rates into the corresponding (no-DFI) equivalent tariff rate). Under the tariff regime, there is no DFI production if tariffs are less than t^1 (represented by section **ac** in figure 7). Once the more efficient foreign firm switches to the DFI option ($t^1 < t < t^2$), DFI outputs take a big jump and then increase steadily as the tariff increase (section **de**). However once both foreign firms switch to the DFI option

($t > t^2$), tariffs no longer affect the DFI production (section **gh**). Under the quota regime, when the more efficient foreign firm produces both export and DFI outputs (for $q^1 > q > q^2$ or equivalently $t^{q1} < t < t^2$), DFI production increases from zero and rises steadily as the quota rates become more restrictive (section **bf**). For the quota rates that are more restrictive than q^2, or equivalently $t > t^{q2} = t^2$, both foreign firms produce both export and DFI outputs. Unlike the tariffs, the quotas in this range still affect DFI production (section **fh**). The above diagram also shows that, with the exception of the quotas in the range $q^1 > q > q^2$ or equivalently $t^{q1} < t < t^2$, the total DFI production is larger under the tariff regime.

Tariff v Quota: Foreign firms' profits

Tariff/ Quota	Profits under the tariff	Profits under the quota
$t < t^{q1} / \ q > q^1$	$\bar{\pi}_i^* = (\bar{p} - c_i^* - t)^2$ $\frac{d\bar{\pi}_i^*}{dt} < 0$	$\tilde{\pi}_i^* = (\tilde{p} - c_i^*)qh_i^*$ $\frac{d\tilde{\pi}_1^*}{dq} > 0, \ \frac{d\tilde{\pi}_2^*}{dq} >=< 0$
$t^{q1} < t < t^1 /$ $q^1 > q > q^{t1}$	As above	$\tilde{\pi}_1^* = (\gamma - 1)c_1^* qh_1^* + (\tilde{p}^1 - \gamma c_1^*)^2$ $\tilde{\pi}_2^* = (\tilde{p}^2 - c_2^*)qh_2^*$ $\frac{d\tilde{\pi}_1^*}{dq} >=< 0, \ \frac{d\tilde{\pi}_2^*}{dq} > 0$
$t^1 < t < t^2 /$ $q^{t1} > q > q^2$	$\hat{\pi}_1^* = (\hat{p}^1 - \gamma c_1^*)^2, \ \hat{\pi}_2^* = (\hat{p}^1 - c_2^* - t)^2$ $\frac{d\hat{\pi}_1^*}{dt} > 0, \ \frac{d\hat{\pi}_2^*}{dt} < 0$	As above

$t > t^2 / q < q^2$	$\hat{\pi}_i^* = (\hat{p}^2 - \gamma c_i^*)^2$ $\frac{d\hat{\pi}_i^*}{dt} = 0$	$\tilde{\pi}_i^* = (\gamma - 1)c_i^* q h_i^* + (\tilde{p}^2 - \gamma c_i^*)^2$ $\frac{d\tilde{\pi}_i^*}{dq} > 0$

Table 2: Foreign firms' profits under tariff and quota regimes

In table 2 we summarise the equilibrium results of foreign firms' profits under the tariff and the quota regimes and the effects of a small change in trade policies on these profits. Since we assume that there is no quota licence fee, the total profits to both foreign firms under the quotas are higher than those under the price-equivalent tariffs. However the results of the effects of a small change in a tariff/ a quota rate on foreign firms' profits are more interesting. Normally a rise in a tariff will hurt foreign firms' profits, but an increase in a tariff can increase the profit of a foreign firm if it has already switched to the DFI option, while the other foreign firm chooses the export option. If both foreign firms switch to the DFI option, their profits are no longer affected by a tariff.

The effects of a decrease in a quota rate on foreign firms' profits are more complicated. In the case where both foreign firms export (under the quota), a reduction in a quota harms the more efficient firm's profit, but its effect on the less efficient firm's profit is ambiguous as $\frac{d\tilde{\pi}_2^*}{dq} = \frac{h_2^*}{n+1}(nh_2^* - h_1^*)$. A reduction in a quota can increase the profit of the less efficient firm, if, for example, there is only one home firm. This can be explained by the fact that a smaller quota may shift firm *2**'s output to the collusive optimal. But once firm *1**'s produce both export and DFI outputs, a smaller quota rate will definitely reduce firm

*2**'s profit. This could be the result of a smaller price effect of a quota. Once firm *1** engages in both export and DFI production, its optimal total outputs are the same as the optimal output of DFI-only production. Thus the profit to firm *1** ($\tilde{\pi}_1^* = (\gamma - 1)c_1^* q h_1^* + (\tilde{p}^1 - \gamma c_1^*)^2$) is equal to the profit were it to choose DFI-only production plus the cost saving from the export production. A reduction in a quota rate in this range, $q^1 > q > q^2$, increases the DFI-only profit but reduces the cost saving, thus its net effect on firm *1**'s total profit is ambiguous. In the case where both foreign firms engage in both export and DFI production, a reduction in a quota will reduces both firms' profits by reducing the cost saving benefits (since in this range, a quota no longer affects the equilibrium price and consequently $(\tilde{p}^2 - \gamma c_i^*)^2$).

3.5 Conclusions

In this chapter we have investigated the equivalence of tariff and quota when foreign firms have the option of direct investment abroad. A simple partial equilibrium Cournot model was used to analyse this issue. We examined the decisions of two asymmetric foreign firms who can choose the export option, which is subjected to a tariff or a quota, and the direct investment option, which leads to the production in the home market at the higher marginal cost. We illustrated how the home market entry decisions of the two foreign firms affect the equilibrium outcomes. With the assumptions of linear demand and constant marginal cost we were able to compare the two regimes explicitly.

If the tariff rises above certain levels, it will induce a foreign firm to switch from the export option to the DFI option. Under the quota regime, a certain restrictive quota will also induce a foreign firm to engage in the DFI option, however a foreign firm will not give up production from its original plant as long as the quota rate is more than zero. With the assumption that the new marginal cost for the DFI option depends on the technologies of the firm, the more efficient foreign firm will start producing DFI outputs before the less efficient firm as the trade policies become more restrictive.

We can find the price equivalent quota for any tariff and vice versa. However the relevant formula for the price equivalent regimes will depend on the size of the tariff or quota. When the trade policies are not too restrictive (such that DFI production is not provoked), the equivalent tariff and quota regimes are equivalent both in price and in imports volume. But once one or both policies start provoking DFI production, we may find tariffs and quotas that lead to the same equilibrium price but different volume of imports.

The quota rate that starts provoking the more efficient foreign firm to produce the DFI outputs is less restrictive than the switchover tariff that induces DFI production. But once a tariff induces the more efficient foreign firm to switch to DFI production, the DFI outputs are generally larger under the tariff (as a foreign firm will abandon the entire production in its original plant). And once both policies induce both foreign firms to produce DFI outputs, both policies no longer affect the equilibrium price. However the two price-equivalent trade policies have different effects on the sizes of DFI production and imports.

For the import equivalence, we cannot always find the equivalent regimes. For any given tariff rate we can find the import equivalent quota, however for some quota we cannot find the import equivalent tariff. This is because the foreign firms always supply the home market via the export option under the quota, while the imports level under the tariff will drop down once a foreign firm switches to the DFI option and it will drop to zero once both foreign firms choose the DFI option.

Unlike the Levinsohn (1989) model which concludes that the tariff and the quota are equivalent as the two would be set optimally at the same level (the most restrictive level which does not induce foreign firms to choose the DFI option), we broaden the comparison to include the case of DFI-inducing trade policies. The existence of multinational firms lead us to believe that it would be more useful to compare these two trade regimes across the whole range. The evidence from this model suggests that the two regimes are not always equivalent.

Moreover the Levinsohn's equivalence of optimal tariff and quota policies does not hold anyway in our model of heterogeneous foreign firms. If the no-DFI optimal tariff is profitably jumped, the cum-DFI optimal trade policies can be found by comparing the (conventional) welfare levels of a) a policy that induces no DFI, b) an optimal policy that induces the more efficient foreign firm to engage in DFI and c) (if b is not possible) a policy that just deters the less efficient foreign firm from engaging in DFI. Our results show that tariffs and quotas are not equivalent (in price, imports and domestic welfare) in these three cases.

There are several interesting policy implications arising from the above analysis. Firstly the possibility of DFI production can limit the ability of tariffs and quotas to control foreign firms' outputs and equilibrium price, and it will affect the two policies differently. The range of quotas that have maximum effect on the domestic price is shorter than the range of the equivalent tariffs. A quota is a more effective tool in controlling foreign imports, but at some range foreign firms can produce addition DFI outputs, such that a quota has little or no effects on domestic price. Secondly, if there is a large positive welfare benefit to the domestic country from DFI production (for example, larger DFI production leads to larger employment in the home country), then the home government may prefer a DFI-inducing tariff policy to a DFI-inducing quota policy. This is because in general tariffs can induce larger DFI production than the corresponding price-equivalent quotas (because foreign firms always use the quotas fully). However there is an exception when the quotas induce the more efficient foreign firm to start DFI production but the corresponding price-equivalent tariffs are not high enough to induce the more efficient foreign firm to switch to the DFI-only option. Thirdly, if the welfare benefits of DFI is largely in a form of a one-off spillover of superior technology and it does not depend on the size of the DFI outputs, then the quota needed to induce the more efficient foreign firm to invest in the domestic country is less restrictive than the DFI-inducing tariff.

CHAPTER 4

OPTIMAL TARIFF AND THE FOREIGN FIRMS' CHOICE OF MARKET ENTRY

4.1 Introduction

During the last few decades when there has been spectacular growth of international trade flows, we also have witnessed the equally dramatic growth of foreign direct investment (FDI) activities. UNCTAD (1994) data reveal that a 26-fold increase in the total value of world exports during 1961-1990 was matched by a 25-times increase in the total value of world stock of FDI. The implications of FDI and multinational firms on international trade cannot be ignored. The world economy is increasingly dominated by big multinational firms. One of these firms' obvious strategic decisions is whether to serve their target markets by exporting or taking up production in the protected markets via foreign direct investment (FDI). A multinational firm's decision will have important implications on trade flows, technology transfer, and of course the welfare of countries concerned.

There exists a considerable literature which try to answer the question of why a firm chooses to become a multinational rather than an exporting firm. One of the most popular approaches to answer the above question is the OLI frame work developed by Dunning (1977 and 1981).[1] The OLI stands for ownership, location and internalisation advantages. This framework suggests that FDI will arise when three conditions are satisfied. The ownership advantages (such as superior technology) allow firms to overcome the disadvantage of a foreign location. The location advantages (such as high trade barriers and large market size) make it more profitable to serve overseas market by local production rather than exporting. The internalisation advantages allow firms to exploit their ownership advantages internally rather than to deal with foreign partners via licensing or joint venture.

Since the introduction of the OLI framework there have been plenty of alternative theoretical approaches. Significant alternative approaches include models of MNEs and trade in general equilibrium[2], the internalisation aspect of MNEs[3] and the game theoretic approach of MNEs.[4] The advantage of the game theoretic approach is that it shows the strategic role of FDI. Smith (1987) uses a simple sequential game in a partial equilibrium framework to analyse the strategic interaction between a (potential) multinational foreign firm and a (potential) firm in the home country. The foreign firm (which can always make positive profits as an exporter) decides between the export option, which is subjected to a specific tariff and a transport cost, and the foreign investment option (i.e. becomes a MNE), which incurs a positive set up cost but goods are produced at the same marginal cost. The potential home firm decides between entering the market, which incurs the same set up cost as the MNE and an additional fixed cost (but it can produce goods at the same marginal cost as the

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[1] Similar themes are also found in Buckley and Casson (1976) and Rugman (1981).

[2] For examples Helpman (1984) and Helpman and Krugman (1985) consider the case of vertically integrated MNEs in general equilibrium. While Markusen and Venables (1995) model horizontally integrated MNEs and the issue of transport costs.

[3] For examples Horstmann and Markusen (1987) analyses the option of direct investment versus licensing and Horstmann and Markusen (1996) compare direct investment with contractual relations (contract initially with local agent and possibly invest later).

foreign firm), and not entering the home market. There are four possible outcomes: a foreign exporter as a monopolist, an exporter as a duopolist, a multinational as a monopolist and a multinational as a duopolist. Depending on the values of various parameters (among other things – the set up cost, the firm specific fixed cost and the transport cost) and who is the first mover, the tariff policy by the home government may alter a foreign firm's investment decision (but there is no simple relation), or it may change the balance of power in favour of the home firm (i.e. higher tariff reduces a foreign firm's profits), or in some case it may have the indirect effect of reducing competition (i.e. it induces a foreign firm to invest but by doing so, it deter the entry of a home firm).

Motta (1992) is the extension of Smith's (1987) model. Set in a sequential game between a foreign firm and a home firm, Motta's model also emphasises the size of the domestic market and the information cost incurred by a foreign firm when it sets up a plant in the domestic country. Like Smith's result, Motta's model also shows that the tariff (and also the market size) has no definite impact on the choice of the foreign firm between exports and FDI. This is because the tariff not only increases the cost of exporting, but it may also change the nature of competition. When the nature of competition changes a foreign firm may find it is more profitable to switch back to export even though the tariff has increased). In addition Motta also finds that the tariff-jumping FDI could be welfare improving if no home firm would have entered the market under the free trade.

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[4] Apart from Smith (1987) and Motta (1992) which we discussed, other works using this

Although Smith (1987), Motta (1992) and similar work by Campa et al (1998) introduce a more subtle approach to the understanding of multinational foreign firms than a traditional analysis, we notice that these models ignore the active role of the welfare maximising government of the domestic country. The work in this chapter is aimed to explore this missing link by analysing the interaction between the potential multinational foreign firm and the welfare maximising government of the home country. This is done by using a simple sequential game to find out how the optimal tariff set by the government of the domestic country affects the foreign firm's direct investment decision and vice versa. Furthermore we investigate how the relative efficiency of the foreign firm affects the equilibrium outcome of the game.

This chapter is organised in the following way. In section 4.2 we introduce a model of international oligopoly where a foreign firm and domestic firms competing to supply the domestic market in the Cournot fashion, while the domestic government uses a tariff policy to maximise the domestic welfare. Then we consider two sequential games, first where the foreign firm decides the home market entry mode before the home government setting the tariff and the second case, where the domestic government moves first. In section 4.3 we extend the game by having two asymmetric foreign firms. Finally concluding remarks are given in section 4.4.

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approach are Horstmann and Markusen (1987a), Dei (1990) and Campa et al (1998).

4.2 The Model

We consider a model of international Cournot oligopoly with n home firms and 1 foreign firm producing a homogeneous commodity to be sold in the home market, which has a linear demand given by $D = A - p$, where A is a positive constant. New entry is not allowed but we will investigate the implications of the number of the home firms (n) on the results of the model. Each firm has different technology given by different constant marginal cost. The foreign firm's (firm *1**) marginal cost is c_1^*, the domestic firms' (firm 1 to n) marginal costs are $c_1, \ldots, c_n$. Furthermore we make a special assumption that the average of the home firm marginal costs ($\bar{c} = \frac{1}{n}\sum_{i=1}^{n} c_i$) is constant. Although this assumption is not essential to the model, it will simplify the interpretation of some of the results greatly. We also assume that all firms produce positive outputs under free trade. The government of the home country imposes a specific tariff of t per unit on imports. The foreign firm has two options for supplying the home market: the export option which is subjected to the tariff or the direct foreign investment (DFI) option which involves moving production to the home country and operating at a higher marginal cost (reflecting the additional cost due to unfamiliar production condition) of γc_1^* where $\gamma > 1$.[5] To simplify the analysis we shall assume that the cost of setting up a subsidiary plant is negligible and equal to zero.

4.2.1 A foreign firm as a first mover

In this sub-section we consider the case where the foreign firm makes a decision of (home) market entry option before the home government chooses a tariff. The sequence of action in this case is (1) the foreign firm chooses (irreversible decision) between export and DFI, (2) the domestic government decides the tariff level, and (3) foreign and domestic firms decide the level of output. The following diagram shows a simple representation of this sequential game:

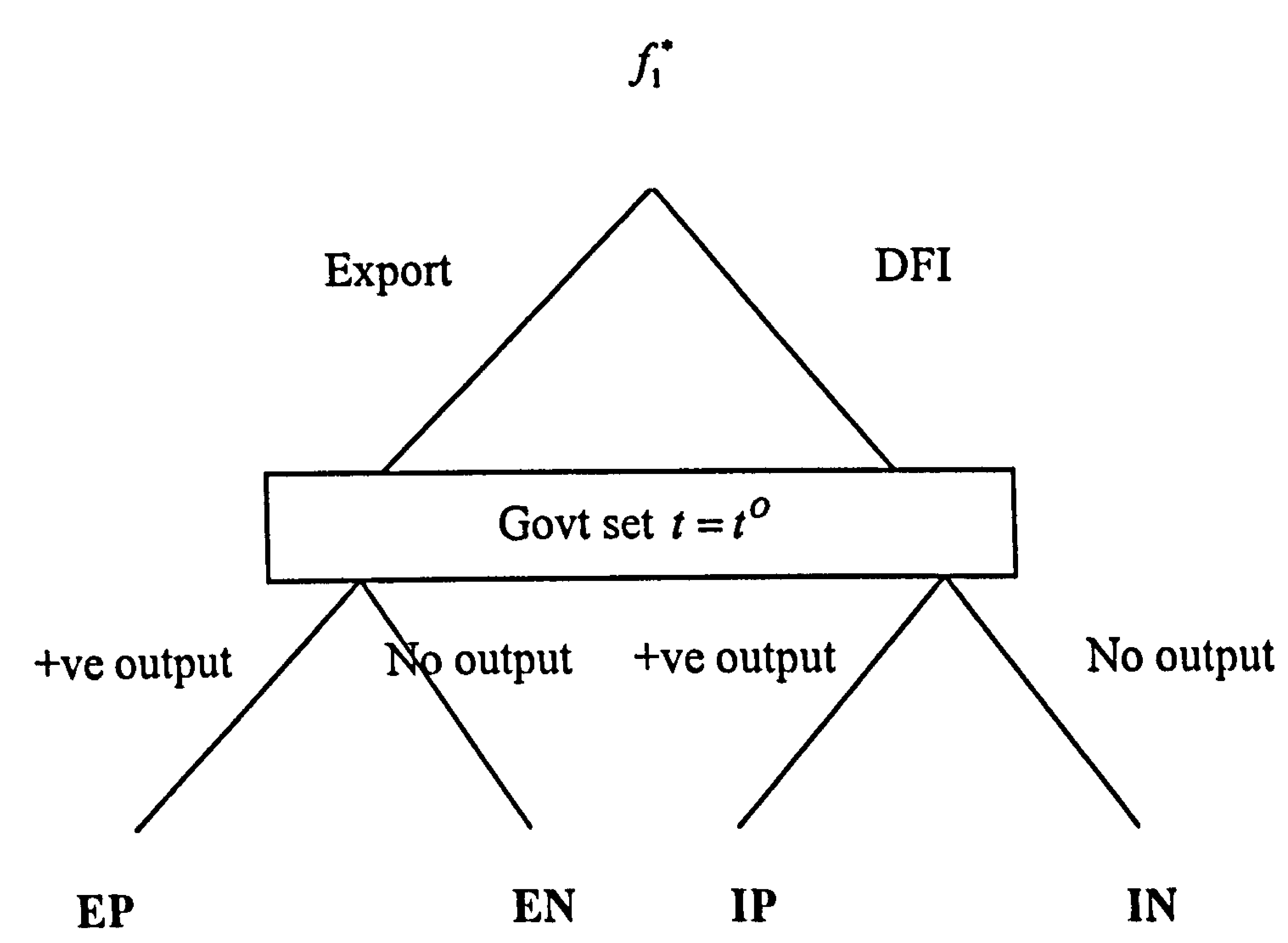

Fig. 1: A foreign firm moves first

It is worth noting that all the home firms still produce positive outputs in all four equilibriums since the tariff and the DFI option increase the price in the

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[5] The 'direct investment' in this context is the setting up of a subsidiary in the protected market; it is one of the components of FDI activities. FDI include other activities such as acquiring a substantial control of firm(s) in the protected market.

home market from the free trade level but they do not increase the production costs of the home firms. Then this sequential game has four possible outcomes. **(EP)** is the case where the foreign firm chooses the export option, the domestic government sets the optimal tariff, and the foreign firm produces positive output. **(EN)** is the case where the foreign firm chooses the export option, the domestic government sets the optimal tariff, and the foreign firm produces no output. **(IP)** is where the foreign firm chooses the DFI option, the domestic government sets the tariff (which is virtually ineffective), and the foreign firm produces positive output. And **(IN)** is the case where the foreign firm chooses the DFI option, the domestic government sets the tariff (which is virtually ineffective), and the foreign firm produces no output.

We solve this game theoretical problem by working backward. In the **final stage**, if the foreign firm chooses the export option, each unit of imports is subjected to a tariff of t. Then the foreign firm's profit function is $\pi_1^* = (p - c_1^* - t)h_1^*$, where h is the sale in the home market. Taking $dp/dh_1^* = -1$ (the Cournot conjecture), the foreign firm's optimal output in this case is $h_1^* = p - c_1^* - t$. The profit function for each domestic firm is $\pi_i = (p - c_i)h_i$, which gives the optimal output of $h_i = p - c_i$. Then the equilibrium domestic price is

$$p = \frac{A + C + c_1^* + t}{n + 2} \tag{1}$$

where $C = \sum_{i=1}^{n} c_i$. In this final stage the foreign firm decides the level of output for exporting to the home market. If the foreign firm produces positive output in the final stage, then its payoff is $\pi_1^*(t) = (p - c_1^* - t)^2$, where t is the chosen tariff. However the foreign firm will not produce any output to export to the home country if the tariff set by the home country happens to be a prohibitive tariff, in such case the foreign firm's payoff will be zero. By examining its profit function, we find that the foreign firm will be better off by not producing if the price it gets from a unit sale is less than the per unit cost of producing and exporting to the home market, or $p - c_1^* - t < 0$. By substituting the expression for the tariff induced price in (1) into the inequality, we obtain the prohibitive tariff rate (t^P) which discourages the foreign firm from producing positive output as

$$t^P = \frac{A+C}{n+1} - c_1^* \tag{2}$$

Equation (2) implies that the size of the home market and the efficiencies of the home firms have a positive effect, while the number of the home firm and the efficiency of the foreign firm have a negative effect on the value of the prohibitive tariff.[6] The larger the market size the higher the price, and the higher margin for the foreign firm at a given tariff level, thus the higher level of tariff is needed to discourage the foreign firm from exporting to the home market. The higher costs of domestic firms also help to increase the price and thus have the same effect on t^P as the market size. On the other hand the increase in the number of home firms leads to price reduction as there is more

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[6] $\frac{dt^P}{dA} = \frac{1}{n+1} > 0$; $\frac{dt^P}{dc_i} = \frac{1}{n+1} > 0$; $\frac{dt^P}{dc_1^*} = -1 < 0$. For the effect of the change in n on t^P we held C constant and write $C = n\bar{c}$ where $\bar{c}$ is the average of home firms' marginal costs, then we have

$$\frac{dt^P}{dn} = \frac{(n+1)\bar{c} - (A - n\bar{c})}{(n+1)^2} = -\frac{(A-\bar{c})}{(n+1)^2} < 0, \text{ as } A - \bar{c} > 0.$$

competition, and hence helps to lower the prohibitive tariff level. The higher marginal cost of the foreign firm contributes to the increase in price, but it contributes more to the increase in the foreign firm's cost of production, thus leads to lower prohibitive tariff level.

Next consider the case where the foreign firm chooses the DFI option. If the foreign firm wants to pre-empt the tariff by choosing the DFI option, its marginal cost becomes γc_1^* (where $\gamma > 1$). Then the foreign firm's profit function in the equilibrium is $\tilde{\pi}_1^* = (\tilde{p} - \gamma c_1^*)\tilde{h}_1^*$. The optimal output for the foreign firm from its subsidiary plant in the home country is $\tilde{h}_1^* = \tilde{p} - \gamma c_1^*$, while the optimal output for each domestic firm is $\tilde{h}_i = \tilde{p} - c_i$. Then the equilibrium domestic price when the foreign firm chooses the DFI option is

$$\tilde{p} = \frac{A + C + \gamma c_1^*}{n+2} \tag{3}$$

And the payoff for the foreign firm if it produces positive output is $\tilde{\pi}_1^* = (\tilde{p} - \gamma c_1^*)^2$.

After choosing the DFI option, the foreign firm may produce nothing if $\tilde{p} - \gamma c_1^* < 0$, i.e. per unit cost of producing at the subsidiary plant is higher than the equilibrium price. By substituting the expression for $\tilde{p}$ from (3) into the inequality, we can find the lowest value of γ at which the foreign firm stops producing output from its subsidiary plant as[7]

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[7] From $\tilde{h}_1^* = \tilde{p} - c_1^* = \dfrac{A+C}{n+2} - \left[\dfrac{n+1}{n+2}\right]\gamma c_1^*$. We have $\tilde{h}_1^* > 0$ if $\gamma < \gamma^P$, where $\gamma^P = \dfrac{A+C}{(n+1)c_1^*}$.

$$\gamma^P = \frac{A+C}{(n+1)c_1^*} \tag{4}$$

Thus for $\gamma > \gamma^P$, it is no longer profitable for the foreign firm to produce from its subsidiary plant in the home country. Again an increase in the home market size and an increase in a home marginal cost raise the prohibitive level of the efficiency factor γ^P, while the increase in the marginal cost of the foreign firm and the increase in the number of home firms lower the value of γ^P.[8]

In the **second stage** of the game, the home government chooses the level of tariff.[9] The domestic government sets the tariff level optimally so that total domestic welfare is maximised. The total domestic welfare is the sum of consumer's surplus, total domestic firm profits, and tariff revenue, that is

$$W = \frac{(A-p)^2}{2} + \sum_{i=1}^{n} h_i^2 + th_1^* \tag{5}$$

where $\frac{(A-p)^2}{2} = \frac{(D)^2}{2}$ is the consumer's surplus. Then the total derivative of domestic welfare with respect to the tariff is given by

$$\frac{dW}{dt} = -D\frac{dp}{dt} + \sum_{i=1}^{n} 2h_i\frac{dp}{dt} + h_1^* + t(\frac{dp}{dt} - 1) \tag{6a}$$

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[8] $\frac{d\gamma^P}{dA} = \frac{1}{c_1^*(n+1)} > 0$; $\frac{d\gamma^P}{dc_i} = \frac{1}{c_1^*(n+1)} > 0$; $\frac{d\gamma^P}{dc_i^*} = -\frac{A+C}{(n+1)(c_1^*)^2} < 0$;
$\frac{d\gamma^P}{dn} = -\frac{(A-\bar{c})}{c_1^*(n+1)^2} < 0$

[9] Note that the tariff set by the domestic government is actually effective only if the foreign firm chooses the export option. But the optimal tariff level is needed to impose in either case, otherwise the action of the government would not be credible.

Since a tariff raises the domestic price ($\frac{dp}{dt}=\frac{1}{n+2}>0$), it unambiguously reduces the consumer surplus component ($-D\frac{dp}{dt}<0$). For the domestic firms, a tariff increases their profits ($\sum_{i=1}^{n}2h_i\frac{dp}{dt}>0$) because the price is higher and each home firm produces more output in response to the initial increase in price. For the revenue component, there are two opposing effects of the tariff. Higher tariff increases the revenue for a given level of imports, but it reduces the volume of imports ($h_1^*>0$, but $t(\frac{dp}{dt}-1)<0$), i.e. the effect of tariff on revenue has ambiguous sign. Thus the total effect of an increase in tariff on domestic welfare has ambiguous sign.

In equilibrium the market is cleared, the total consumption equals to the total sales by both domestic and foreign firm, i.e. $D=H+h_1^*$, where $H=\sum h_i$ is the total sales by domestic firms. Then we can rewrite (6a) as

$$\frac{dW}{dt}=(2H+t-H-h_1^*)\frac{dp}{dt}+(h_1^*-t)=\frac{H}{n+2}+(h_1^*-t)\frac{(n+1)}{(n+2)} \tag{6b}$$

Before we continue with the derivation of the optimal tariff, it is worth spending time looking at the three components of welfare more closely. Firstly, since the revenue function

$$R=th_1^*=t(p-c_1^*-t)=t\left[\frac{A+C}{n+2}-\frac{n+1}{n+2}c_1^*-\frac{n+1}{n+2}t\right] \tag{7}$$

is continuous and concave in t (as the second order condition is negative[10]), we can find the unique revenue maximising tariff by equating the first order condition to zero, which yields[11]

$$t^R = \frac{A+C}{2(n+1)} - \frac{c_1^*}{2} = \frac{t^P}{2} \tag{8}$$

The above result shows that the revenue maximising tariff is a half of the prohibitive tariff. Secondly, for the consumer's surplus and the home firms' profits components we find that there is no tariff that maximises these two components since we have a positive second order condition.[12] The derivative of $(CS+\Pi)$ with respect to t is given by

$$\frac{d(CS+\Pi)}{dt} = -D\frac{dp}{dt} + 2H\frac{dp}{dt} = \frac{1}{n+2}[H - h_1^*] \tag{9}$$

The sign of $\frac{d(CS+\Pi)}{dt}$ depends on the sales of the home and foreign firms. We can evaluate this derivative at $t=0$ for different values of n and find that $\left.\frac{d(CS+\Pi)}{dt}\right|_{t=0} > 0$ if there is at least one home firm and the total sales under the free trade are larger than the (free trade) sales of the foreign firm.[13] Thus

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[10] The second order condition is given by $\frac{d^2R}{dt} = -\frac{2[n+1]}{n+2} < 0$.

[11] The first order condition is $\frac{dR}{dt} = \frac{A+C}{n+2} - \frac{n+1}{n+2}c_1^* - \frac{2[n+1]}{n+2}t$.

[12] $CS + \Pi = \frac{D^2}{2} + \sum (h_i)^2$, then we have

$$\frac{d^2(CS+\Pi)}{dt^2} = \left[n\frac{dp}{dt} - [\frac{dp}{dt} - 1]\right]\frac{dp}{dt} = \frac{2n+1}{[n+2]^2} > 0.$$

[13] If there is no home firm $(n = 0)$, any positive tariff yields less welfare benefits for these two components (CS is decreased as the price rises and there is no domestic profits). If there is

the positive tariff will increase the net welfare benefits of consumer's surplus and total home firms' profits if the home country has a domestic industry that is big enough – so that the potential gain from the increase in profits outweighs the potential loss in consumer's surplus.

For the optimal tariff that maximises the total home welfare, we obtain by equating the first order condition (6b) to zero.[14] That is

$$h_1^* - t + \frac{H}{n+1} = 0$$

Next we substitute $h_1^* = p - c_1^* - t$; $H = np - C$; $p = \frac{A + C + c_1^* + t}{n+2}$ into the above equation to obtain

$$t^O = \frac{(2n+1)}{(2n^2+4n+3)}A + \frac{(n-1)}{(2n^2+4n+3)}C - \frac{(n^2+n+1)}{(2n^2+4n+3)}c_1^* \text{ or}$$

$$t^O = \frac{(2n+1)}{(2n^2+4n+3)}[A - c_1^*] + \frac{n(n-1)}{(2n^2+4n+3)}[\bar{c} - c_1^*] \qquad (10)$$

The above expression for t^O shows a formula for the tariff that maximise domestic welfare, as a function of a market size (A), number of home firms (n), technology of home and foreign firms (C and c_1^*). It is worth noting that the lower the foreign firm's marginal cost the higher the marginal tariff, i.e. the home government will tax the foreign firm more if it is more efficient.

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one home firm $(n = 1)$, we have $\left.\frac{d(CS + \Pi)}{dt}\right|_{t=0} = \frac{c_1^* - c_1}{n+2} \gtrless 0$, it is negative (positive) if the foreign firm is more (less) efficient than the home firm. If we have at least two home firms $(n \geq 2)$, $\left.\frac{d(CS + \Pi)}{dt}\right|_{t=0}$ also has ambiguous sign – it is positive if $H > h_1^*$ at $t = 0$.

[14] This is because we have negative SOC, $\frac{d^2W}{dt^2} = -\frac{2n^2+4n+3}{(n+2)^2} < 0$.

The effect of the change in the number of home firms on the level of optimal tariff is given by[15]

$$\frac{dt^O}{dn} = -\frac{(2n^2+2n-1)}{(2n^2+4n+3)^2}\left[2(A-\bar{c})+(c_1^*-\bar{c})\right] \quad (11)$$

The above derivative has ambiguous sign. An increase in the number of home firms might lower the level of optimal tariff ($dt^O/dn < 0$) if $c_1^* \geq \bar{c}$ or the magnitude of $(c_1^* - \bar{c})$ is small. In these cases the revenue component is relatively small, an increase in a number of home firms will consequently reduce a domestic price, and then the optimal policy for the home government would be to increase the consumer's surplus part by lowering the tariff. However if $c_1^* < \bar{c}$ and the difference in technology between the two countries is large enough (such that $3\bar{c} - c_1^* > 2A$), an increase number of home firms raises the level of optimal tariff. In this case the revenue part will be relatively large, and the welfare will be improved by raising the tariff in order to counter the loss in revenue as a result of a price decrease.

It is interesting to compare this welfare maximising tariff with the revenue maximising tariff. We find that

$$t^O - t^R = \frac{[2n^2+2n-1][A-\bar{c}]-[2n^2+3n+1][\bar{c}-c_1^*]}{2[n+1][2n^2+4n+3]} \quad (12)$$

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$$\frac{dt^O}{dn} = \frac{[2n^2+4n+3][2A+(2n-1)\bar{c}-(2n+1)c_1^*]-[(2n+1)A+(n^2-n)\bar{c}-(n^2+n+1)c_1^*][4n+}{[2n^2+4n+3]^2}$$

$$= -\left[\frac{(4n^2+4n-2)A+(2n^2+2n-1)c_1^*-(6n^2+3n-3)\bar{c}}{(2n^2+4n+3)^2}\right]$$

We find that if there is no home firm, $t^R > t^O$.[16] In this case there is no home firm's profit and the loss in consumer's surplus is minimised at $t = 0$ (but there is no revenue here), thus the optimal tariff that takes into account of both revenue and consumer's surplus lies between zero and t^R. For the cases where there is at least one home firm, the sign of $(t^R - t^O)$ is ambiguous in general.[17] If the foreign firm is not more efficient than the average home firm, then the welfare maximising tariff is higher than the revenue maximising tariff. This is because the revenue component is relatively small (as the foreign firm is relatively small), while the home firms' profits component is relatively large. Thus at t^R the home welfare can be improved by raising the tariff until $t = t^O$ to increase the net gain from the $CS + \Pi$ component[18] which is larger than the welfare loss from the tariff revenue (as the tariff departs from the revenue maximising level). If the foreign firm is more efficient than the average home firm, then the sign of (12) is ambiguous but a small difference in technologies between the average home firm and the foreign firm and a large market size are likely to make $t^R < t^O$.

We have established that any tariff that is above the prohibitive tariff induces a foreign firm to produce nothing at the final stage. We can now compare the level of the optimal tariff and the prohibitive tariff and show that

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[16] For $n = 0$, $t^R = \dfrac{A - c_1^*}{2}$ and $t^O = \dfrac{A - c_1^*}{3}$, thus $t^O - t^R = -\dfrac{[A - c_1^*]}{6} < 0$.

[17] Since $A - \bar{c} > 0$ (since $A > p$ - otherwise there is no demand and $p > c_i$ as all home firms produce positive outputs), then the sing of (12) depends on the sign and the magnitude of $c_1^* - \bar{c}$.

$$t^P - t^O = \frac{[n+2][A-\bar{c}]+[n^3+4n^2+5n+2][\bar{c}-c_1^*]}{[n+1][2n^2+4n+3]} \tag{13}$$

The above equation implies that if the foreign firm's technology is not inferior to the average home firm's ($c_1^* \le \bar{c}$), then the optimal tariff is not prohibitive ($t^P - t^O > 0$).In such case the outcome of the foreign firm producing no output (EN) in the final stage (after the export option has been chosen and the optimal tariff has been set) is not possible.

If the foreign firm is less efficient than the average home firm ($c_1^* > \bar{c}$), (13) has ambiguous sign and could be negative. Although the larger foreign firm's marginal cost reduces the optimal tariff level, it lowers the prohibitive tariff level more. We might end up in a case that the foreign firm is too inefficient, a trade cost (although set optimally) will prevent it from supplying the home market. If the foreign firm does not have the DFI option, the home government needs to make a welfare comparison between the case where it allows the foreign firm to produce positive output by setting the tariff just below t^P and the case where it prevents the foreign firm from supplying the home market (by setting the tariff above t^P). It is possible that getting rid of the inefficient foreign firm may improve welfare. This is because a small foreign firm contributes relatively small tariff revenue and the entering of a relatively inefficient foreign firm does not lower the domestic price much. In such case it might be better for the home country to exclude the foreign firm so

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[18] We have showed that $\frac{d(CS+\Pi)}{dt} > 0$ if the total sales of home industry are larger than the foreign firm's sales.

that the price is raised and the increases in profits are distributed exclusively among the domestic firms.[19]

Next we examine the **first stage** where the foreign firm makes a decision on the mode of home market entry. Anticipating that the home government will set a tariff at the optimal level (t^O), the foreign firm prefers the export option to the DFI option if the export option leads to higher profits. The profit from the export option is given by $\pi_1^* = (h_1^*)^2$ - (case EP), or zero (EN), while the profit from the DFI option is given by $\tilde{\pi}_1^* = (\tilde{h}_1^*)^2$ - (IP), or zero (IN). Then the difference in profits from the two options if the foreign firm produces positive output in both options is given by

$$\pi_1^* - \tilde{\pi}_1^* = (h_1^* - \tilde{h}_1^*)(h_1^* + \tilde{h}_1^*)$$

which is positive if $(h_1^* - \tilde{h}_1^*) > 0$. And the difference in quantities sold from the two options can be expressed as[20]

$$h_1^* - \tilde{h}_1^* = \frac{n+1}{n+2}\left[(\gamma - 1)c_1^* - t^O\right]$$

From the above equation we can determine the switchover tariff:

$$t^I = (\gamma - 1)c_1^* \tag{14}$$

If the tariff rate is higher than t^I, the foreign firm is better off by choosing the DFI option as it yields larger profit. It is also worth noting that in the case

[19] Lahiri and Ono (1988) show that under Cournot oligopoly, national welfare increase if a firm with a sufficient low share is removed from the market.

[20]

$$h_1^* - \tilde{h}_1^* = p - c_1^* - t^O - (\tilde{p} - \gamma c_1^*) = -\frac{(\gamma-1)c_1^* - t^O}{n+2} + (\gamma-1)c_1^* - t^O = \frac{n+1}{n+2}\left[(\gamma-1)c_1^* - t^O\right]$$

.

where efficiency factor of the DFI option is prohibitive i.e. $\gamma = \gamma^P$, the switchover tariff equals the prohibitive tariff.[21]

Next we investigate the necessary conditions for each outcome to be the Nash-equilibrium, which are given in the following table.

Equilibrium Solutions	Conditions
EP	(i) $t^O < t^I < t^P$ and $\gamma < \gamma^P$, or (ii) $t^O < t^P$ and $\gamma > \gamma^P$
IP	(i) $t^I < t^O < t^P$ and $\gamma < \gamma^P$, or (ii) $t^O > t^P$ and $\gamma < \gamma^P$
EN and IN	$t^O > t^P$ and $\gamma > \gamma^P$
EP and IP	$t^O < t^P$, $\gamma < \gamma^P$ and $t^O = t^I$

Table 1: Conditions for Nash-equilibrium solutions

Let first consider the case where the foreign firm is not less efficient than the average home firm ($c_1^* \le \bar{c}$). In this case the optimal tariff is less than the prohibitive tariff ($t^O < t^P$), thus we can rule out the cases where the foreign firm produce no output in the final stage (cases EN and IN). Then either the case where optimal tariff is lower than the switch-over tariff ($t^O < t^I$) or the case where DFI option is prohibitive ($\gamma > \gamma^P$), will lead to the EP case as the

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[21] $t^I = \left[\dfrac{A+C}{(n+1)c_1^*} - 1\right]c_1^* = t^P$

Nash-equilibrium. In this case the foreign firm chooses the export option when it anticipates that the optimal tariff will be set at a rate lower than the switch-over tariff, or in a trivial case where the alternative DFI option is prohibitive from the start. However if the foreign firm anticipates that the optimal tariff is higher than the switch-over tariff ($t^O > t^I$) and the DFI option is not prohibitive ($\gamma < \gamma^P$), then the case **IP** is the Nash-equilibrium outcome. In this case the foreign firm does not choose to produce at its most efficient plant because the anticipated cost of export is so high and it can get larger profit by producing in the home market. In the case where $t^O = t^I$ (provided that $\gamma < \gamma^P$), both **EP** and **IP** are the Nash-equilibria, i.e. the foreign firm is indifferent between the two options.

If the foreign firm is less efficient than the average home firm ($c_1^* > \bar{c}$), we cannot rule out the cases where the foreign firm produces no output in the final stage. In this case the optimal tariff set by the home government can be prohibitive and if it is anticipated to be prohibitive the foreign firm can pre-empt the home government by choosing the DFI option and produce positive output as long as $\gamma < \gamma^P$, then **IP** is the Nash-equilibrium. If both the optimal tariff is expected to be prohibitive and the DFI option is prohibitive, then the foreign firm is indifferent between **EN** and **IN** – it produces no output and gets zero payoff in either case. If the difference in the foreign firm's technology and that of the average home firm is not large, the optimal tariff may be lower than the prohibitive tariff. Then the Nash-equilibrium outcome depends on the rate of the optimal tariff relative to the switch-over tariff (provided that $\gamma < \gamma^P$, we get **EP** if $t^O < t^I$; **IP** if $t^O > t^I$; **EP** and **IP** if $t^O = t^I$).

4.2.2 A home government as a first mover

In this sub-section we consider the case where the home government moves before the foreign firm. The domestic government sets the tariff level in the first stage, and then the foreign firm will decide between export and DFI options, and then choose the level of output accordingly. In this case the home government makes a decision based on the anticipation that the foreign firm will respond optimally to its tariff. Let us first consider the case where the foreign firm is not less efficient than the average home firm (so that $t^O < t^P$ and $\gamma < \gamma^P$). By using the results from the previous sub-section we can easily work out the solutions for this game.

If $t^O < t^I$, the home government can maximize the home welfare by setting the tariff at t^O. The foreign firm will then choose export option and produce at $h_1^*(t^O)$. If $t^O > t^I$, the optimal tariff, t^O, is too high for the foreign firm to choose the export option. The domestic government needs to make a welfare comparison between the case where a foreign firm chooses the export option and the case where a foreign firm choose the DFI option. Note that if the foreign firm chooses the DFI option there is only one equilibrium price, and hence there is only one welfare level. It is clearer if we consider the marginal case where a tariff is set at $t = t^I$ (i.e. the foreign firm is indifferent between the two options). The domestic welfare is

$$W = \frac{(A-p)^2}{2} + \sum_{i=1}^{n} h_i + th_1^* \tag{15}$$

when the export option is chosen, and it is

$$\tilde{W} = \frac{(A-\tilde{p})^2}{2} + \sum_{i=1}^{n} \tilde{h}_i \tag{16}$$

when the DFI option is chosen. Since at $t = t^I$, we have $p = \tilde{p}$ and $h_i = \tilde{h}_i$. Then it is obvious that the domestic welfare under the export option is greater than the welfare under DFI option as a result of the extra component of tariff revenue. Thus at $t = t^I$ the domestic government prefers the foreign firm to choose the export option. Next we can check that the welfare at $t = t^I$ is higher than the welfare at any other lower tariff rates. Since the welfare function (when the foreign firm chooses the export option) is concave in t (as the second order condition is negative – see footnote 14), dW/dt evaluated at any tariff lower than t^O is positive. Then the welfare at t^I is higher than any other welfare at $t < t^I$. The domestic government needs to set the tariff just below t^I to make sure that the DFI option is not chosen. Thus there would be no direct foreign investment if the domestic government moves first.

Given our definition of the total welfare this result is not surprising, since the home government can only extract a foreign firm's profit under the export option. Unless there is other welfare benefits from DFI (perhaps a transfer of technology, a capital tax revenue from investment, or a tax revenue from profits of the multinational firm based in the home country), the home government will not try to induce direct foreign investment. It is also worth considering the case where the optimal tariff is prohibitive ($t^O > t^P$) and the home government finds that it is welfare-improving to get rid of the inefficient foreign firm. However we would find that the home government cannot effectively use the prohibitive tariff to prevent the foreign firm from supplying the home market as the foreign firm has the alternative DFI option. In this case the next best thing for the home government is also setting the tariff just below t^I as in the above case.

4.3 Extension of the Model

In this section we extend the basic model to include a second foreign firm. With two foreign firms, the interaction of the game includes the independent (home market entry) decisions of the two foreign firms as well as the optimal tariff setting of the domestic government. We assume that firm *1** is more efficient than firm *2** i.e. $c_1^* < c_2^*$. Also assume that the marginal costs of the two foreign firms are not bigger than the average marginal cost of the home firm, so that the optimal tariff is not prohibitive for the two foreign firms. Consider the case where the two **foreign firms move first**. In this case the two foreign firms must first choose between the export option and the DFI option, and then the domestic government will choose the optimal tariff level accordingly, and then the two foreign firms set their production level in the final stage.

Again we are analysing this problem by working backward. Given that we rule out the cases where the two foreign firms produce zero output in the **final stage**, the following table show the payoffs for the two foreign firms:

	Firm 2*	
Firm 1*	Export	DFI
Export	π_1^{*A}, π_2^{*A} or	π_1^{*B}, $\tilde{\pi}_2^{*B}$ or

	$(p^A - c_1^* - t^A)^2, (p^A - c_2^* - t^A)^2$	$(p^B - c_1^* - t^B)^2, (p^B - \gamma c_2^*)^2$
DFI	$\tilde{\pi}_1^{*C}$, π_2^{*C} or $(p^C - \gamma c_1^*)^2, (p^C - c_2^* - t^C)^2$	$\tilde{\pi}_1^{*D}$, $\tilde{\pi}_2^{*D}$ or $(p^D - \gamma c_1^*)^2, (p^D - \gamma c_2^*)^2$

Table 2: Foreign firms' payoffs from home market entry decisions

There are four scenarios, A - (export, export), B - (export, DFI), C - (DFI, export), and D - (DFI, DFI). The equilibrium domestic prices for the four scenarios in the final stage are

$$p^A = \frac{A + C + c_1^* + c_2^* + 2t^A}{n+3} = p^F + \frac{2t^A}{n+3} \qquad (17a)$$

$$p^B = \frac{A + C + c_1^* + \gamma c_2^* + t^B}{n+3} = p^F + \frac{t_2 + t^B}{n+3} \qquad (17b)$$

$$p^C = \frac{A + C + \gamma c_1^* + c_2^* + t^C}{n+3} = p^F + \frac{t_1 + t^C}{n+3} \qquad (17c)$$

$$p^D = \frac{A + C + \gamma(c_1^* + c_2^*)}{n+3} = p^F + \frac{t_1 + t_2}{n+3} \qquad (17d)$$

Where $p^F = \frac{A + C + c_1^* + c_2^*}{n+3}$ is the free trade price, $t_1 = (\gamma - 1)c_1^*$ is the lowest tariff that will induce firm *1** to switch to the DFI option, and $t_2 = (\gamma - 1)c_2^*$ is the lowest tariff that will induce firm *2** to switch to the DFI option. We note that $t_2 - t_1 = (\gamma - 1)(c_2^* - c_1^*) > 0$.

In the **second stage** the home government sets a tariff to maximise the home welfare. We show the full derivations of the optimal tariff for each scenario in appendix A1. In the following table we show the home welfare and the relevant optimal tariff for each scenario :

Case	Home Welfare	Optimal Tariff
A (E,E)	$W^A = \frac{(A-p^A)^2}{2} + \sum_{i=1}^{n}(h_i^A)^2 + tM^A$	$t^A = \frac{(n+3)[2H^F + (n+1)(h_1^{*F} + h_2^{*F})]}{4[(n+1)(n+3)-(2n+1)]}$
B (E,I)	$W^B = \frac{(A-p^B)^2}{2} + \sum_{i=1}^{n}(h_i^B)^2 + th_1^{*B}$	$t^B = \frac{(n+3)[H^F + (n+2)h_1^{*F} - h_2^{*F}] + (3n+4)t_2}{2(n+2)(n+3)-(2n+1)}$
C (I,E)	$W^C = \frac{(A-p^C)^2}{2} + \sum_{i=1}^{n}(h_i^C)^2 + th_2^{*C}$	$t^C = \frac{(n+3)[H^F + (n+2)h_2^{*F} - h_1^{*F}] + (3n+4)t_1}{2(n+2)(n+3)-(2n+1)}$
D (I,I)	$W^D = \frac{(A-p^D)^2}{2} + \sum_{i=1}^{n}(h_i^D)^2$	No optimal tariff

Where $M = h_1^* + h_2^*$, H^F and $h_1^{*F} + h_2^{*F}$ are the total sales under free trade of the home firms and those of the two foreign firms, $t_1 = (\gamma - 1)c_1^*$ and $t_2 = (\gamma - 1)c_2^*$.

Table 3: Home welfare and the optimal tariffs

The home government sets the relevant optimal tariff by taking into account the home market entry decisions of the two foreign firms. For scenario D (DFI, DFI) where both foreign firms pre-empt the home government by choosing the DFI option, the tariff is virtually ineffective. By comparing the three optimal tariffs we can show that $t^B > t^C$.[22] The comparisons between t^A and the other two tariffs are more complicated but it is reasonable to presume that

$t^A < t^C < t^B$.[23] The possible reasons behind this result are that there are more imports and the effect of a small change in tariff on the domestic price is greater in scenario A. Thus a smaller tariff is needed to capture the net welfare gains optimally.

Given that the home government will set the tariff optimally for each potential scenario, each foreign firm will make its market entry decision in the **first stage** by taking into account of these optimal tariffs. To find the dominant strategy for each firm, we need to compare the payoffs. Referring to the payoff matrix presented in table 1, we can show that export option will be the dominant strategy for firm 1* if $\pi_1^{*A} - \tilde{\pi}_1^{*C} > 0$ and $\pi_1^{*B} - \tilde{\pi}_1^{*D} > 0$. But the DFI option will be the dominant strategy for firm 1* if $\pi_1^{*A} - \tilde{\pi}_1^{*C} < 0$ and $\pi_1^{*B} - \tilde{\pi}_1^{*D} < 0$. For firm 2*, the export option will be the dominant strategy if

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[22] Since $t^B - t^C = \dfrac{[(n+3)^2 + (3n+4)(\gamma - 1)](c_2^* - c_1^*)}{2(n+2)(n+3) - (2n+1)} > 0$.

[23] For t^A and t^B, we can show that

$$t^B - t^A = \Omega[(2n+1)H^F + (3n^3 + 19n^2 + 35n + 20)h_1^{*F} - (n^3 + 5n^2 + 10n + 3)h_2^{*F}] + \Psi t_2$$

where $\Omega = \dfrac{2(n+3)}{[4(n+1)(n+3) - 2(2n+1)][2(n+1)(n+3) - 2(2n+1)]} > 0$, and

$\Psi = \dfrac{3n+4}{2(n+1)(n+3) - 2(2n+1)} > 0$. Since $h_1^{*F} > h_2^{*F}$ (as firm 1* is more efficient), we have $t^B - t^A > 0$. For t^A and t^C, we can show that

$$t^C - t^A = \Omega[(2n+1)H^F + (3n^3 + 19n^2 + 35n + 20)h_2^{*F} - (n^3 + 5n^2 + 10n + 3)h_1^{*F}] + \Psi t_1$$

Although the above equation has ambiguous sign in general, we expect $t^C - t^A > 0$ as the multiplier on the positive term h_2^{*F} is very large comparing to the multiplier on the negative term h_1^{*F}. Unless the foreign firm 1* is extremely large, the foreign firm 2* is extremely small and the home firm industry is very small, we expect t^A to be smaller than t^C.

$\pi_2^{*A} - \tilde{\pi}_2^{*B} > 0$ and $\pi_2^{*C} - \tilde{\pi}_2^{*D} > 0$. The DFI option will be the dominant strategy for firm 2* if $\pi_2^{*A} - \tilde{\pi}_2^{*B} < 0$ and $\pi_2^{*C} - \tilde{\pi}_2^{*D} < 0$.

We present the full derivation of the necessary conditions for the Nash-equilibrium in appendix A2. We find that scenario B (export, DFI) will not happen. This is because the marginal cost of production for the DFI option also depends on the foreign firms' efficiency, if firm 2* (which is less efficient) just finds it profitable to switch to the DFI option, firm 1* (which is more efficient) must have switched to the DFI option already. The relevant necessary conditions for the other three scenarios to be the Nash-equilibrium are:

If $t_1 > \dfrac{(n+1)t^A + t^C}{n+2}$ and $t_2 > t^C$, then A (export, export) is the Nash-equilibrium.

If $t_1 < \dfrac{(n+1)t^A + t^C}{n+2}$ and $t_2 > t^C$, then C (DFI, export) is the Nash-equilibrium.

If $t_1 < \dfrac{(n+1)t^A + t^C}{n+2}$ and $t_2 < t^C$ then D (DFI, DFI) is the Nash-equilibrium.

Thus the foreign firms will make their market entry decisions based on the positions of the expected optimal tariffs relative to those of the switch-over tariffs. We also find that the foreign firms are switching to the DFI option in order of their efficiencies.

In the case where the **home government moves first,** the analysis is similar to the previous case of a single foreign firm. The welfare function is given by

$$W = \frac{(A-p)^2}{2} + \sum_{i=1}^{n} h_i^2 + tM$$

The home government will set the tariff optimally by taking into account the response of the two foreign firms. From the previous analysis, we find that there are three possible outcomes A (export, export), C (DFI, export), D (DFI, DFI). Thus there will be three welfare functions for the home government to consider

$$W^A = \frac{(A-p^A)^2}{2} + \sum_{i=1}^{n} (h_i^A)^2 + t(h_1^{*A} + h_2^{*A}) \tag{18a}$$

$$W^C = \frac{(A-p^C)^2}{2} + \sum_{i=1}^{n} (h_i^C)^2 + th_2^{*C} \tag{18c}$$

$$W^D = \frac{(A-p^D)^2}{2} + \sum_{i=1}^{n} (h_i^D)^2 \tag{18d}$$

The home government would ideally want to maximise the three components of the welfare function fully. Thus scenario A (export, export) offers the highest potential welfare for the home country. If $t^A < t_1$, then the home government will set the tariff at t^A and both the foreign firms will choose the export option. In this case there is no constraint on the tariff policy since both foreign firms are not induced to switch to the DFI option. If however t^A induces firm 1* (but not firm 2*) to switch to the DFI option, then t^A is no longer at its optimal level since it is designed on the assumption of both foreign firms choosing the export option. The relevant tariff in this case is

t^C (provided that t^C is less than t_2). The home government will need to compare the welfare W^A evaluated at t_1 with the maximum welfare of W^C.[24] It is possible that the non-optimised welfare W^A at t_1 is larger than the optimised welfare W^C if the tariff revenue from the more efficient foreign firm is relatively large. In such case the home government will set the tariff just below t_1 to prevent firm 1* from switching to the DFI. If t^C induces firm 2* to choose the DFI option then the home government needs to compare the welfare W^A evaluated at t_1 with the welfare W^C evaluated at t_2. The home firms' profits are higher (as the price is higher) at t_2 but the consumer's surplus loss is smaller and the tariff revenue is likely to be larger at t_1. It is worth noting that the welfare W^C evaluated at t_2 is larger than W^D (which has only one value) since at t_2 the prices are the same but W^C has the gain from tariff revenue while W^D has not. Thus for the home government there are effectively four tariff rates to consider: t^A, t_1, t^C and t_2. The tariff t^A is the first best option if it is possible, if not the home government needs to compare the welfare levels at t_1, t^C (not always possible) and t_2.

4.4 Conclusions

In this chapter we consider the issue of foreign market entry decision (export vs. direct foreign investment) by using the game theoretic approach. In particular we investigate the interaction between the potential multinational

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[24] At t_1 the welfare under W^A function is higher than the welfare under W^C function by the

foreign firm and the welfare maximising home government in a sequential game. We find that the identity of the first mover is important. If the home government moves first, it will set a tariff that does not induce the foreign firm to switch to the DFI option. The tariff set may yield maximum welfare if it does not induce the foreign firm to switch to the DFI option. However if the optimal tariff level induces the foreign firm to switch to the DFI option, the second best option for the home country is to set the tariff just below the switch-over level. If the foreign firm moves first, the outcome of the foreign firm choosing the DFI option is also possible. If the foreign firm expects the optimal tariff to be higher than the switch-over level, it will be more profitable for the foreign firm to pre-empt the home government by switching to the DFI option in the first place.

We also find that the relative efficiency of the foreign firm and the number of home firms also affect the outcomes of the game. If the foreign firm is very inefficient compared to the home firms and the home industry is large, the optimal policy for the home government might be to get rid of the foreign firm by setting the tariff at the prohibitive level. This is because the increase in home firms' profits might outweigh the losses in the small tariff revenue and the consumer's surplus. However the presence of the alternative DFI option for the foreign firm will make the prohibitive tariff policy by the home firm ineffective since the foreign firm can either (if moves first) pre-empt the government action or (if move second) just switch to the DFI option.

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distance equals to $t_1 h_1^{*A}$.

If there are more than one asymmetric foreign firm, the home market entry decisions may not be unified. In our model we find that as the tariff rises the more efficient foreign firm will switch to the DFI option before the less efficient foreign firm. For the home government, it needs to set the optimal tariff according to the combination of the foreign firms' market entry decisions or (if it moves first) it needs to compare the potential welfares from various scenarios. It is possible that the non-optimised tariff that does not induce both foreign firms to switch to the DFI option may yield higher welfare than the optimal tariff calculated on the assumption that only one foreign firm chooses the DFI option.

Some results from this model may seem to be extreme. This is because we do not include the potential welfare gain from the DFI activity. The DFI activity may increases the home welfare via the spill-over of technologies, the tax revenue from profits of the multinationals or the increase in employment. If these factors are taken into account the government may not always want to prevent the foreign firms from switching to the DFI option.

Appendix

A1 <u>Derivations of optimal tariff for each scenario</u>

For **scenario A** (export, export), the welfare is

$$W = \frac{(A - p^A)^2}{2} + \sum_{i=1}^{n} h_i^2 + tM$$

where $M = h_1^{*A} + h_2^{*A}$ is the total imports, then

$$\frac{dW}{dt} = -D\frac{dp^A}{dt} + \sum_{i=1}^{n} 2h_i \frac{dp^A}{dt} + M + 2t(\frac{dp^A}{dt} - 1)$$

We can substitute the total demand, $D = H + M$ to get

$$\frac{dW}{dt} = H\frac{dp}{dt} + (M - 2t)(1 - \frac{dp}{dt})$$

Note that $\frac{dp^A}{dt} = \frac{2}{n+3}$, we have $\frac{d^2W}{dt^2} = -\frac{2(n^2+4n+5)}{(n+3)^2} < 0$. Then we can find the optimal tariff by setting $\frac{dW}{dt} = 0$, which gives

$$2H + (n+1)(M - 2t^A) = 0$$

We can write $h_i = h_i^F + (p - p^F)$ and $h_i^{*A} = h_i^{*F} + (p - p^F - t^A)$, then the above equation becomes

$$2H^F + 2n(p - p^F) + (n+1)[M^F + 2(p - p^F - t^A) - 2t^A] = 0$$

Since $p - p^F = \frac{2t^A}{n+3}$, the optimal tariff for this scenario is

$$t^A = \frac{(n+3)[2H^F + (n+1)(h_1^{*F} + h_2^{*F})]}{4[(n+1)(n+3) - (2n+1)]}$$

For **scenario B** (export, DFI), the home government will respond by maximising the domestic welfare which is given by

$$W = \frac{(A - p^B)^2}{2} + \sum_{i=1}^{n} h_i^2 + th_1^{*B}$$

Similar to the above analysis, we can find the optimal tariff by setting $\frac{dW}{dt} = 0$

which gives (note that in this case $\frac{dp^B}{dt} = \frac{1}{n+3}$)

$$(H-\tilde{h}_2^{*B})+(n+2)(h_1^{*B}-t^B)=0$$

Substituting $h_i=h_i^F+(p-p^F)$, $h_1^{*B}=h_1^{*F}+(p-p^F-t^B)$,

$\tilde{h}_2^{*B}=h_2^{*F}+(p-p^F)-t_2$ into the above equation, we get

$$H^F-h_2^{*F}+(n+2)h_1^{*F}+[n-1+n+2](p-p^F)+t_2-2(n+2)t^B=0$$

Since $p-p^f=\dfrac{t_2+t^B}{n+3}$ for case B, the optimal tariff is given by

$$t^B=\frac{(n+3)[H^F+(n+2)h_1^{*F}-h_2^{*F}]+(3n+4)t_2}{2(n+2)(n+3)-(2n+1)}$$

And by using similar calculation as in case B, the optimal tariff for **scenario C** (DFI, export) is given by

$$t^C=\frac{(n+3)[H^F+(n+2)h_2^{*F}-h_1^{*F}]+(3n+4)t_1}{2(n+2)(n+3)-(2n+1)}$$

A2 <u>Conditions for dominant strategies for the two foreign firms</u>

Recalling the payoffs matrix for the two foreign firms

	Firm 2*	
Firm 1*	Export	DFI
Export	π_1^{*A}, π_2^{*A} or $(p^A-c_1^*-t^A)^2,(p^A-c_2^*-t^A)^2$	π_1^{*B}, $\tilde{\pi}_2^{*B}$ or $(p^B-c_1^*-t^B)^2,(p^B-\gamma c_2^*)^2$
DFI	$\tilde{\pi}_1^{*C}$, π_2^{*C} or $(p^C-\gamma c_1^*)^2,(p^C-c_2^*-t^C)^2$	$\tilde{\pi}_1^{*D}$, $\tilde{\pi}_2^{*D}$ or $(p^D-\gamma c_1^*)^2,(p^D-\gamma c_2^*)^2$

In order to determine the dominant strategy for each firm, we need to compare four pairs of profits:

(I) the sign of $\pi_1^{*A}-\tilde{\pi}_1^{*C}$ depends on the sign of $h_1^{*A}-\tilde{h}_1^{*C}$, and

$$h_1^{*A} - \tilde{h}_1^{*C} = \frac{(n+2)t_1 - (n+1)t^A - t^C}{n+3}$$

(II) the sign of $\pi_1^{*B} - \tilde{\pi}_1^{*D}$ depends on the sign of $h_1^{*B} - \tilde{h}_1^{*D}$, and

$$h_1^{*B} - \tilde{h}_1^{*D} = \frac{(n+2)(t_1 - t^B)}{n+3}$$

(III) the sign of $\pi_2^{*A} - \tilde{\pi}_2^{*B}$ depends on the sign of $h_2^{*A} - \tilde{h}_2^{*B}$, and

$$h_2^{*A} - \tilde{h}_2^{*B} = \frac{(n+2)t_2 - (n+1)t^A - t^B}{n+3}$$

(IV) the sign of $\pi_2^{*C} - \tilde{\pi}_2^{*D}$ depends on the sign of $h_2^{*C} - \tilde{h}_2^{*D}$, and

$$h_2^{*C} - \tilde{h}_2^{*D} = \frac{(n+2)(t_2 - t^C)}{n+3}$$

Noting that $t_2 > t_1$ and $t^B > t^C > t^A$. Then

Scenario A (export, export) will be the Nash-equilibrium if both firms' dominant strategies are exports which require

$t_1 > \frac{(n+1)t^A + t^C}{n+2}$ (from I), $t_1 > t^B$ (II), $t_2 > \frac{(n+1)t^A + t^B}{n+2}$ (III) and $t_2 > t^C$ (IV)

Scenario B (export, DFI) will be the Nash-equilibrium if firm *1**'s dominant strategy is export and firm *2**'s dominant strategy is DFI. In this case we need

$t_1 > \frac{(n+1)t^A + t^C}{n+2}$ (I), $t_1 > t^B$ (II), $t_2 < \frac{(n+1)t^A + t^B}{n+2}$ (III) and $t_2 < t^C$ (IV)

Since we establish that $t_2 > t_1$ and $t^B > t^C$, then $t_1 > t^B$ and $t_2 < t^C$ cannot be both true. Thus scenario B (export, DFI) cannot be the Nash-equilibrium. This result is not surprising since we expect the more efficient firm (firm *1**) to switch to the DFI option before firm *2**.

For **scenario C** (DFI, export) to be the Nash-equilibrium, we need firm *1**'s dominant strategy to be export and firm *2**'s dominant strategy to be DFI, i.e.

$$t_1 < \frac{(n+1)t^A + t^C}{n+2} \text{ (I)}, \; t_1 < t^B \text{ (II)}, \; t_2 > \frac{(n+1)t^A + t^B}{n+2} \text{ (III) and } t_2 > t^C \text{ (IV)}$$

And **for scenario D** (DF, DFI) to be the Nash-equilibrium, we need

$$t_1 < \frac{(n+1)t^A + t^C}{n+2} \text{ (I)}, \; t_1 < t^B \text{ (II)}, \; t_2 < \frac{(n+1)t^A + t^B}{n+2} \text{ (III) and } t_2 < t^C \text{ (IV)}$$

CONCLUSIONS

In this thesis we used a simple partial equilibrium analysis to examine the effects of tariffs and quotas on mergers and direct foreign investment. In the first two chapters we directed our attention on the effects of the two policies on merger profitability. By extending Falvey (1998) which examines the effects of tariffs on mergers, we studied the case of quotas and mergers. When a merger produces no cost synergies, i.e. a case of market-concentrating merger, we found that quotas seem to protect the inefficient firms in both the restricting and the non-restricting countries from being merger targets while tariffs only protect the inefficient firm in the restricting country. Thus when trade barriers are reduced we expect to see the increase in merger activity (national and international) that involves the closure of inefficient firms in the restricting country in the tariff case, and the increase in most types of merger that involves the closure of inefficient firm in the quota case. The comparison of the two regimes also reveals that the merger profitability of national mergers (both in the restricting country and the non-restricting country) is higher under the equivalent quota regime.

In chapter 3 we showed that the tariff-quota equivalence under Cournot oligopoly can also break down if the foreign firms have the option of direct investment. We examined the home market entry decisions of the foreign firms when the direct investment is possible under the tariff and the quota (which are imposed by the home government). The main difference between the two policies is that a foreign firm will switch from the export option to the direct investment option when the tariff is sufficiently restrictive, while a foreign firm under the quota will find it is more profitable to choose both options when the quota rate is sufficiently restrictive. Comparisons between the two policies showed that although we can find price equivalent tariffs and quotas, the import equivalence cannot be found in some range of quotas. Moreover there is no uniform condition for the equivalence of the two regimes, the adjustment on the equivalent conditions needs to be made for different levels of each trade policies. We also found that the quota rate that starts inducing direct investment production is less restrictive than the tariff rate that starts inducing the more efficient foreign firm to switch to the direct investment option. But once the tariff policy induces direct investment, the size of DFI is generally larger under the tariff regime than the price-equivalent quota regime.

In chapter 4, we examined the interaction between the welfare-maximising home government and the foreign firm who has the direct investment option. By incorporating game theoretical technique we showed that the optimal tariff policy by the home government may be hindered by the availability of direct investment option to the foreign firm. In the case where the foreign firm moves first, it may pre-empt the home government by choosing the direct investment option in the first place if the expected optimal tariff is too high. In the case where the home government moves first and the direct investment offers no welfare benefit to the home country, the home government will set the tariff at the optimal level provided that the tariff does not induce the foreign firm to invest or it will set at the level just below the switch-over tariff.

The collection of essays in this thesis demonstrated the uses of a simple international Cournot model to examine the issues concerning trade policies, mergers and foreign direct investment. Although tariffs and quotas are believed to be equivalent under the Cournot oligopoly, the difference in nature of these two policies may lead to the different results when merger and direct investment activities are considered. In addition we also showed the different approach to examine the effects of a tariff policy on direct investment by endogenising the active role of the home government.

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