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IMPORT PROTECTION AS EXPORT PROMOTION

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Abstract: In this paper we re-visit Krugman's (1984) thesis that import protection leads to export promotion. Krugman (1984) argues that in the absence of dynamic scale economies, the formalization of this idea appears to require the 'heterodox' assumption that marginal costs are decreasing. We seek to extend Krugman (1984) by providing an alternative foundation of the idea based on free entry and linear marginal costs. Interestingly the welfare implications are sensitive to whether there is free entry in only one of the countries, or both, as well as to whether import protection is of the tariff, or the non-tariff kind.

Key words: Import Protection, Export Promotion, Free Entry.
JEL Classification Number: L130, F120.

1. INTRODUCTION

One of the most important intuition to come out of the recent literature on international trade is that of import protection as export promotion. Krugman (1984) demonstrates that in the presence of scale economies, a model with oligopolistic and segmented markets can be used to formalize the intuitive notion. He considers several different scenarios with static and dynamic economies of scale and shows that the argument goes through for all these scenarios.

The basic argument is quite intuitive. Suppose that there is import protection. The effect is to make the home market more profitable. Thus production in the home market would expand. If there are scale economies (either static or dynamic) then marginal

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costs would decline, so that firms in country 1 become more competitive in the foreign market. Hence exports would increase.

With static economies of scale the formalization however appears to require, as Krugman (1984) himself points out, an heterodox assumption in the form of deceasing marginal costs. Moreover, Krugman (1984) does not provide any welfare analysis. The objective of the present paper is thus two fold. First, we want to extend the analysis by suggesting an alternative foundation for the import protection argument that does not require marginal costs to be decreasing. In fact, we use a model with constant marginal cost of production. Secondly, we use our framework to derive some interesting welfare implications.

We consider a model with two countries, country 1 and country 2. The markets are segregated and trade takes the form of reciprocal dumping. For simplicity we assume that the demand functions in the two countries are identical and that the demand and the cost functions are linear in the level of output. Depending on whether there is free entry by the home country firms in the home industry or not, we consider three versions of the model. First when potential entrant firms from country 1 can freely enter the industry in country 1, but potential entrants from country 2 are not free to enter the country 2 industry. Second when there is free entry in country 2 alone and third when there is free entry by the home firms in both the countries.

We show that in all three cases import protection leads to export promotion. This demonstrates that even in the absence of dynamic scale economies, the assumption that marginal costs are decreasing is not required to formalize the idea that import protection leads to export promotion.

The intuitions are somewhat different in the three cases. The effect of import protection by, say, country 1 is to make production in country 1 more profitable. With free entry in country 1 alone, this attracts a larger number of firms into the country 1 market, making country 1 as a whole more competitive. While this leads to a fall in export by individual firms, aggregate exports increase as the increase in the number of firms is more than enough to make up the fall in individual exports. With free entry in both the countries there is the additional effect that the number of firms in country 2 declines. In this case the relative increase in the number of firms in country 1 is even larger, so that the result goes through.

Notice that in the above two versions of our model it is country 1 as a whole that is becoming more competitive, leading to increased exports. The export levels of individual firms are, in fact, adversely affected. This is in countrast to the result in Krugman (1984) where it was the individual firm that was becoming more competitive.

If there is free entry in country 2 alone then with an increase in import protection the number of firms in country 2 decreases. In this case the export level of every firm in country 1 increases, and hence so does aggregate export.

Finally turning to the welfare analysis we find that the results are model specific. They also depend on whether we consider non-tariff, or tariff protection.

First consider the case of non-tariff barriers. If there is free entry in country 1 alone, then import protection by country 1 reduces the welfare level in country 1, whereas if there is free entry in both the countries then import protection turns out to be welfare improving. Given the free entry assumption, in both these cases it is sufficient to focus on consumers' surplus. There are two effects in operation here. Import protection leads to a decline in imports from country 2. This would tend to reduce consumption in country 1. On the other hand, production in country 1 would increase. This would tend to increase consumption, and hence welfare. With free entry in country 1 alone the first effect dominates, while with free entry in both the countries the second effect dominates. In case there is free entry in country 2 alone, there is the additional effect that with an increase in import protection, aggregate profits in country 1 would go up. Hence welfare may either increase or decrease. If, however, the tariff levels in both the countries are small enough to begin with and the firms are efficient, then an increase in tariff protection leads to a decrease in the welfare level in country 1.

Next consider the case of tariff protection. In this case the results are somewhat more complex. If there is free entry in country 1 alone, then import protection by country 1 reduces the welfare level in country 1, if, to begin with, either the level of tariffs in both the countries are small enough (and the demand function satisfies some technical condition), or if the level of tariffs in country 1 is high enough. Whereas if there is free entry in both the countries and the level of tariffs in country 1 is low enough to begin with, then import protection turns out to be welfare improving. In case there is free entry in country 2 alone, the tariff levels in both the countries are small enough to begin with and the firms are efficient, then we provide sulfficient conditions for the welfare level in country 1 to be decreasing (as well as increasing) in the tariff level.

We then briefly relate our paper to the existing literature. The basic model adopted in this paper is very similar to those developed by Brander (1981), Brander and Krugman (1983), Brander and Spencer (1983), Dixit (1983) and Venables (1985), all of which consider trade models with Cournot competition in identical commodities. While Brander (1981), Brander and Spencer (1983) and Dixit (1983) all consider models where the number of firms is exogenously given, Dixit and Norman (1980) and Brander and Krugman (1983) consider models where the number of firsms is endogensously determined.

Our model is closest to Venables (1985) who considers a model of Cournot competition with free entry in both the countries. In contrast we consider three different cases, with free entry in country 1 alone, with free entry in country 2 alone and with free entry in both the countries. Moreover, Venables (1985) does not address the central concern of this paper, i.e. whether import protection leads to export promotion. The focus in Venables (1985) is on the welfare effect of various parameter changes like technical progress, export subsidy etc. Of course he also studies the welfare implications of an increase in import protection. One important contribution of our paper is to extend the analysis in Venables (1985) by examining the sensitivity of the welfare results to the nature of product market competition.

The rest of the paper is organized as follows. In the next section we write down the basic model. The analysis for the case of non-tariff barriers is taken up in section 3, while that for the case of tariff barriers is taken up in section 4. Finally, section 5 concludes.

2. THE BASIC MODEL

There are two countries, country 1 and country 2 with n (≥ 1) and n^* (≥ 1) firms respectively, all producing a single homogeneous product that they sell in both the countries.

The inverse demand functions in the two countries are identical and linear. Let y_i and x_i denote the domestic sale and export of the i-th firm in country 1, and let y_i and x_j denote the comestic sale and export of the j-th firm in country 2. The demand function in country 1 is given by

$$p_1 = a - b\left(\sum_{i=1}^{n} y_i + \sum_{j=1}^{n^*} x_j\right). \tag{1}$$

Similarly, the demand function in country 2 is given by

$$p_2 = a - b\left(\sum_{j=1}^{n^*} y_j + \sum_{i=1}^{n} x_i\right). \tag{2}$$

The cost function of all firms have two components, production costs and *transport* costs in case of exports.[1] We assume that the production costs of all firms are identical and linear in the level of output, i.e. marginal costs are constant. Furthermore, there is a fixed cost as well, so that the production cost displays increasing returns to scale. Thus the production cost of the i-th firms in country 1 is given by

$$C_i(q_i) = \begin{cases} F + cq_i\,, & \text{if } q_i > 0\,, \\ 0\,, & \text{otherwise}\,. \end{cases} \tag{3}$$

where $q_i = y_i + x_i$. We assume that for every unit of export, firms in country 1 bear a transport cost of t per unit. Thus the total cost of the i-th firm producing q_i and exporting x_i is given by $C_i(y_i + x_i) + tx_i$. Similarly, the production cost of the j-th firm in counry 2 is given by

$$C_j(q_j) = \begin{cases} F + cq_j\,, & \text{if } q_j > 0\,, \\ 0\,, & \text{otherwise}\,, \end{cases} \tag{4}$$

where $q_j = x_j + y_i$. Moreover, for every unit of export, a firm in country 2 bears a transport cost of t^* per unit. Thus the total cost of the j-th firm in country 2 producing q_j and exporting x_j is given by $C_j(x_j + y_j) + t^*x_j$.

We solve for the Cournot equilibrium of this model. Let π_i and π_j denote, respectively, the profit function of the i-th firm in country 1 and the j-th firm in country 2. Then

[1] In section 3 these transport costs will be interpreted as the monetised value of non-tariff barriers, while in section 4 these will be interpreted as the level of tariffs.

$$\pi_i = \left(a - b\left(\sum_{i=1}^{n} y_i + \sum_{j=1}^{n^*} x_j\right)\right) y_i + \left(a - b\left(\sum_{j=1}^{n^*} y_j + \sum_{i=1}^{n} x_i\right)\right) x_i - F - cy_i - cx_i - tx_i \,. \tag{5}$$

Similarly,

$$\pi_j = \left(a - b\left(\sum_{j=1}^{n^*} y_j + \sum_{i=1}^{n} x_i\right)\right) y_j + \left(a - b\left(\sum_{i=1}^{n} y_i + \sum_{i=1}^{n^*} x_j\right)\right) x_j - F - cy_j - cx_j - t^* x_j \,. \tag{6}$$

Thus the first order conditions of the i-th firm in country 1 are:

$$\frac{\partial \pi_i}{\partial y_i} = a - b\left(\sum_{i=1}^{n} y_i + \sum_{j=1}^{n^*} x_j\right) - by_i - c = 0\,, \tag{7}$$

and

$$\frac{\partial \pi_i}{\partial x_i} = a - b\left(\sum_{j=1}^{n^*} y_j + \sum_{i=1}^{n} x_i\right) - bx_i - c - t = 0\,. \tag{8}$$

Similarly the first order conditions for the j-th firm in country 2 are given by:

$$\frac{\partial \pi_j}{\partial y_j} = a - b\left(\sum_{j=1}^{n^*} y_j + \sum_{i=1}^{n} x_i\right) - by_j - c = 0\,, \tag{9}$$

and

$$\frac{\partial \pi_j}{\partial x_j} = a - b\left(\sum_{i=1}^{n} y_i + \sum_{j=1}^{n^*} x_j\right) - bx_j - c - t^* = 0\,. \tag{10}$$

We then simultaneously solve equations (7) to (10) for the variables y_i, x_i, x_j and y_j. Restricting attention to symmetric solutions we can write $y_i = y_1$ and $x_i = x_1$ for all i, and $y_j = y_2$ and $x_j = x_2$ for all j.[2,3] Using the symmetry assumption, equations (7) to (10) can be re-written as follows:

$$y_1 = \frac{a - c - n^* b x_2}{b(n+1)}\,, \tag{11}$$

$$x_1 = \frac{a - c - t - n^* b y_2}{b(n+1)}\,, \tag{12}$$

[2] Note that the 1 in the subsecript of y_1 and x_1 refer to country and not to the first firm. Similarly, the 2 in the subscript of y_2 and x_2 refer to country 2 and not to the second firm. This should not create any confusion.

[3] It is simple to use equations (7) to (10) to argue that the solution is, in fact, symmetric and unique.

$$y_2 = \frac{a - c - nbx_1}{b(n^* + 1)}, \tag{13}$$

and

$$x_2 = \frac{a - c - t^* - nby_1}{b(n^* + 1)}. \tag{14}$$

Notice that equations (11) and (14) form a sub-system of two equations in the two variables y_1 and x_2. Solving equations (11) and (14) simultaneosuly we find

$$y_1 = \frac{a - c + n^*t^*}{b(n + n^* + 1)}, \tag{15}$$

and

$$x_2 = \frac{a - c - t^*(1 + n)}{b(n + n^* + 1)}. \tag{16}$$

Similarly, solving equations (12) and (13) simultaneously we obtain

$$x_1 = \frac{a - c - t(n^* + 1)}{b(n + n^* + 1)}, \tag{17}$$

and

$$y_2 = \frac{a - c + nt}{b(n + n^* + 1)}. \tag{18}$$

Thus equations (15) to (18) solve for the production levels of the firms as functions of n and n^*. Letting X_1 denote the level of aggregate export by country 1 we have

$$X_1 = nx_1 = \frac{n[a - c - t(n^* + 1)]}{b(n + n^* + 1)}. \tag{19}$$

Clearly

$$\frac{\partial X_1}{\partial n} = \frac{(1 + n^*)[1 - c - t(n^* + 1)]}{b(n + n^* + 1)^2} = \frac{(1 + n^*)x_1}{n^* + n + 1}, \tag{20}$$

and

$$\frac{\partial X_1}{\partial n^*} = -\frac{n[a - c - nt]}{b(n + n^* + 1)^2} = -\frac{ny_2}{n^* + n + 1}. \tag{21}$$

Thus X_1 is increasing in n and decreasing in n^*.

We then describe the free entry conditions in country 1 and country 2. Under the symmetry assumption, the free entry condition in country 1 can be captured by the zero profit condition for country 1 firms[4]

$$(a - b(ny_1 + n^*x_2))y_1 + (a - b(nx_1 + n^*y_2))x_1 - F - cy_1 - cx_1 - tx_1 = 0, \tag{22}$$

i.e.

$$b(y_1)^2 + b(x_1)^2 - F = 0. \tag{23}$$

[4] As usual we ignore the integer problem.

Using equations (15) and (17) to substitute the values of y_1 and x_1 respectively in the above equation we obtain

$$\begin{aligned}&2(a-c)^2+2(a-c)n^*(t^*-t)-2(a-c)t+n^{*2}(t^{*2}+t^2)\\&\quad+t^2+2t^2n^*=Fb(n+n^*+1)^2\,.\end{aligned}\tag{24}$$

We then consider the free entry condition in county 2. Under the symmetry assumption this can be written as:

$$\begin{aligned}&(a-b(nx_1+n^*y_2))y_2+(a-b(ny_1+n^*x_2))x_2\\&\quad-F-cy_2-cx_2-t^*x_2=0\,.\end{aligned}\tag{25}$$

Using equations (15) to (18) we can simplify the above equation

$$\begin{aligned}2(a-c)^2+2(a-c)n(t-t^*)-2(a-c)t^*+n^2(t^2+t^{*2})+2nt^{*2}+t^{*2}\\=Fb(n+n^*+1)^2\,.\end{aligned}\tag{26}$$

We are now in a position to begin our analysis.

3. THE ANALYSIS: NON-TARIFF BARRIERS

In this section we analyze the impact of an increase in import protection on export and welfare, where these protective measures are intepreted as non-tariff barriers.

Depending on whether there is free entry in one or both the countries, we shall consider three different versions of the model. Whether there is free entry for domestic firms in a country or not, depends on several factors. One is the domestic industrial policy of the country. In many countries (especially in less developed ones) entry into many industries require acquiring a license from the government. Often acquiring these licenses are so costly (in terms of money, effort and time spent) that, for all practical purposes, entry into these industries is not feasible for potential entrants.[5] Another reason is the differential access to technology and other scarce resources (e.g. skilled management) in the two countries. If, for example, new technologies are acquired on a centralized basis by some government agency and distributed among certain firms, then entry is virtually restricted for the other firms who do not obtain this technology.[6] Even otherwise if acquiring the technology, or skilled management is relatively costly for potential entrants in one of the countires, we can say that entry is relatively difficult in that country. For analytical tractability, however, we focus on the extreme case where entry is either free, or completely prohibited.

[5] With the recent trend towards liberalization many less developed countries (e.g. India) are trying to foster free entry into their domestic industries. However, while many restrictions to free entry have been removed, many still remain. Thus in most less developed countries government regulations still represent significant barriers to free entry.

[6] In Japan, for example, the MITI played exactly this role. This enable Japanese firms to acquire new technologies relatively cheaply from foreign firms compared to the case if they had bargained independently for these technologies.

3.1. Free Entry in Country 1 Alone

We first examine the case where there is free entry in country 1 alone, the number of firms in country 2 begin exogenously given. The equilibrium conditions in this case are given by equations (15), (16), (17), (18), (22) and the condition that

$$n^* = \bar{n}^* . \tag{27}$$

For our purpose it is more convenient to consider the reduced form representation consisting of equations (24) and (27)

Suppose that there is an increase in non-tariff import protection by country 1, formalized as an increase in t^*. To begin with we examine the effects of such an increase in t^* on aggregate exports X_1. Totally differentiating equation (24) with respect to n and t^*, and collecting terms, we can write

$$\left.\frac{dn}{dt^*}\right|_{n^*=\bar{n}^*} = \frac{\bar{n}^*[a - c - \bar{n}^* t^*]}{Fb(n + \bar{n}^* + 1)} = \frac{\bar{n}^* y_1}{F} > 0 . \tag{28}$$

Notice that the above equation togeher with the result that X_1 is increasing in n (equation (24)), implies that X_1 is increasing in t^*.

With an increase in t^* exporting becomes more costly for firms in country 2, making the firms in country 1 more profitable. This attracts entry into the country 1 market, so that in equilibrium the number of firms in country 1 increases. While this leads to a fall in the export level of individual firms in country 1, aggregate exports increase as the increase in the number of firms more than makes up for the fall in individual exports.

Summarizing the above discussion we obtain our first propositon.

PROPOSITION 1. *Suppose that there is free entry in country* 1 *alone. An increase in t^* leads to an increase in aggregate exports from country* 1.

We then examine the effect of an increase in t^* on the welfare level in country 1. Notice that because of the free entry condition, producers' surplus in country 1 is zero. It is thus sufficient to examine the changes in consumers' surplus i.e. in the total quantity sold in country 1. From equations (15) and (16) we find that total consumption in country 1 is given by

$$S_1 = ny_1 + \bar{n}^* x_2 = \frac{(a - c)(n + \bar{n}^*) - t^* \bar{n}^*}{b(n + \bar{n}^* + 1)} . \tag{29}$$

Differentiating S_1 with respect to t^* and then using equation (28) we can write

$$\begin{aligned} \frac{dS_1}{dt^*} &= \frac{(a - c)(n + \bar{n}^* + 1) - (a - c)(n + \bar{n}^*) + \bar{n}^* t^*}{b(n + \bar{n}^* + 1)^2} \frac{dn}{dt^*} - \frac{\bar{n}^*}{b(n + \bar{n}^* + 1)} \\ &= \frac{\bar{n}^*[b(y_1)^2 - F]}{Fb(n + \bar{n}^* + 1)} . \end{aligned} \tag{30}$$

We then use equation (23) to conclude that $b(y_1)^2 - F = -b(x_1)^2 < 0$. Hence $\frac{dS_1}{dt^*} < 0$.

The intuition is as follows. With an increase in t^* there is a decline in imports of country 1, i.e. $\bar{n}^* x_2$. This tends to reduce the consumption level in country 1. On the other hand, production in country 1 itself, i.e. ny_1 increases. This tends to increase consumption in country 1, and hence welfare. With free entry in country 1 alone the first effect dominates. Hence the result.

The welfare impact on country 2 is, however, ambiguous. Note that the producers' surplus in country 2 is given by

$$\begin{aligned}\Pi_2 = \bar{n}^*[(a - b(nx_1 + \bar{n}^* y_2))y_2 \\ + (a - b(ny_1 + \bar{n}^* x_2))x_2 - F - cx_2 - cy_2 - t^* x_2].\end{aligned} \tag{31}$$

Differentiating with respect to t^* and using the envelope theorem we obtain

$$\begin{aligned}\frac{d\Pi_2}{dt^*} &= \frac{\partial \Pi_2}{\partial n}\frac{dn}{dt^*} + \frac{\partial \Pi_2}{\partial t^*} \\ &= -\frac{by_1\bar{n}^{*2}[x_1y_2 + y_1x_2]}{F} - x_2\bar{n}^* < 0.\end{aligned} \tag{32}$$

Thus with an increase in t^* producers' surplus in country 2 declines.

As the number of firms in country 1 increases, however, this has a beneficial effect on the consumers' surplus in country 2.[7] This is because with an increase in $n + \bar{n}^*$ there is greater competition in the market in country 2 so that the total quantity sold in country 2 increases.

These two effects, however, operate in the opposite directions, making the final effect ambiguous.

PROPOSITION 2. *Suppose that there is free entry in country* 1 *alone. An increase in* t^* *leads to a decline in the welfare level in country* 1. *The welfare effect on country* 2 *is, however,, ambiguous.*

3.2. *Free Entry in Country 2 Alone*

We now examine the case where there is free entry in country 2, but the number of firms in countury 1 is exogensously given. The equilibrium conditions are given by equations (15), (16), (17), (18), (25) and the condition that

$$n = \bar{n}. \tag{33}$$

Again it is more convenient to consider the reduced form representation consisting of equations (26) and (33).

We begin by examining the effect of a change in the level of import protection, i.e. t^*, on the level of exports. Totally differentiating equation (26) with respect to n^* and t^* we obtain that

[7] Note that consumers' surplus in country 2 is given by

$$S_2 = \frac{(a - c)(n + \bar{n}^*) - nt}{b(n + \bar{n}^* + 1)}.$$

Differentiating the above equation with respect to t^* and using equation (28) we obtain

$$\frac{dS_2}{dt^*} = \frac{\bar{n}^* y_1 x_1}{F(n + \bar{n}^* + 1)} > 0.$$

$$\left.\frac{dn^*}{dt^*}\right|_{n=\bar{n}} = -\frac{(1+\bar{n})[a-c-t^*(1+\bar{n})]}{Fb(n^*+\bar{n}+1)} = -\frac{(1+\bar{n})x_2}{F} < 0 . \tag{34}$$

Putting equations (21) and (34) together we obtain our next proposition.

PROPOSITION 3. *Suppose that there is free entry in country 2 alone. An increase in t^* leads to an increase in aggregate exports by country 1.*

In this case with an increase in t^* the profit level of firms in country 2 gets squeezed. Thus in equilibrium the number of firms in country 2 declines, making country 1 more competitive vis-a-vis country 2. Hence the export level of every firm in country 1 increases and hence aggregate export increases as well.

We then examine the impact of a change in t^* on the welfare level in country 1. First consider the impact on consumers' surplus, i.e. on aggregate consumption in country 1. Differentiating S_1 with respect to t^* we obtain

$$\frac{dS_1}{dt^*} = bx_2\frac{dn^*}{dt^*} - \frac{n^*}{b(\bar{n}+n^*+1)} . \tag{35}$$

Given equation (34), $\frac{dS_1}{dt^*} < 0$. Thus an increase in t^* leads to a decline in consumers' surplus.

The impact on Π_1, the producers' surplus in country 1 is, however, positive. Note that

$$\begin{aligned}\Pi_1 &= \bar{n}[(a-b(\bar{n}y_1+n^*x_2))y_1 \\ &\quad + (a-b(\bar{n}x_1+n^*y_2))x_1 - F - cx_1 - cy_1 - tx_1] .\end{aligned} \tag{36}$$

Differentiating Π_1 with respect to t^*, using the envelope theorem, and simplifying we obtain

$$\frac{d\Pi_1}{dt^*} = \frac{\partial \Pi_1}{\partial n^*}\frac{dn^*}{dt^*} = \frac{b(1+\bar{n})\bar{n}x_2[y_1x_2+x_1y_2]}{F} > 0 . \tag{37}$$

This is because of two reasons, first the number of firms in country 2 becomes less and second, these firms become less efficient in the export market. Hence all firms in country 1 becomes more profitabable.

Thus there are two opposing effects on the welfare level in country 1 and the net effect is ambiguous.

Finally, consider the impact of a change in t^* on the welfare level in country 2. Clearly producers' surplus in country 2 is zero. With an increase in t^* the total number of firms in country 2, $\bar{n}+n^*$, declines (equation (34)).Thus the aggregate output in country 2 declines. Hence the welfare level in country 2 is decreasing in t^*.[8]

PROPOSITION 4. *Suppose that there is free entry in country 2 alone. The effect of an increase in t^* on the welfare level in country 1 is ambiguous. The welfare level in country 2 is, however, decreasing in t^*.*

We then consider the case where t and t^* are both very small.

Let W denote the welfare level in country 1, when W is the sum of consumers' surplus (C) and producers' surplus. Thus

$$W = \frac{1}{2}(\bar{n}y_1 + n^* x_2)^2 + \Pi_1 , \tag{38}$$

where Π_1 satisfies equation (36).

We then note that

$$\frac{dC}{dt^*} = (\bar{n}y_1 + n^* x_2)\frac{dS_1}{dt^*} . \tag{39}$$

Next using equations (15), (16), (34) and (35) we have that

$$\begin{aligned}\left.\frac{dC}{dt^*}\right|_{t=t^*=0} &= -\frac{(\bar{n}+n^*)(a-c)}{b(\bar{n}+n^*+1)}\left[-\frac{(1-\bar{n})(a-c)^2}{Fb(\bar{n}+n^*+1)^2} - \frac{n^*}{b(\bar{n}+n^*+1)}\right] \\ &= -\frac{(\bar{n}+n^*)(a-c)}{b(\bar{n}+n^*+1)}\left[-\frac{(1+\bar{n})}{2} - \frac{n^*}{b(\bar{n}+n^*+1)}\right],\end{aligned} \tag{40}$$

where the last line follows from equation (26). We then use equation (37) to show that

$$\begin{aligned}\left.\frac{d\Pi_1}{dt^*}\right|_{t=t^*=0} &= \frac{2\bar{n}(1+\bar{n}(a-c)^3}{Fb^2(\bar{n}+n^*+1)^3} \\ &= \frac{\bar{n}(1+\bar{n})(a-c)}{b(\bar{n}+n^*+1)},\end{aligned} \tag{41}$$

where the last line follows from equation (26). Combining the equations (40) and (41) we find that

$$\left.\frac{dW}{dt^*}\right|_{t=t^*=0} = \frac{(a-c)}{b(\bar{n}+n^*+1)}\left[\frac{(\bar{n}-n^*)(1+\bar{n})}{2} - \frac{n^*(\bar{n}+n^*)}{b(\bar{n}+n^*+1)}\right]. \tag{42}$$

We require the following observation before we can proceed further.

OBSERVATION 1. $\lim_{F\to 0} n^* = \infty$.

[8] Note that consumers' surplus in country 2

$$S_2 = \bar{n}x_1 + n^* y_2 = \frac{(a-c)(n^*+\bar{n}) - \bar{n}t}{b(\bar{n}+n^*+1)} .$$

Differentiating the above equation with respect to t^* and using equation (34) we obtain

$$\frac{dS_2}{dt^*} = -\frac{x_2 y_2 (1+\bar{n})}{F(\bar{n}+n^*+1)} < 0 .$$

Proof. The gross profit of a firm from country 2 is given by

$$\frac{(a-c+\bar{n}t)^2}{b(\bar{n}+n^*+1)^2}+\frac{(a-c-t^*(1+\bar{n}(a-c+n^*t^*)}{b(\bar{n}+n^*+1)^2}.$$

Note that the above expression is decreasing n^*. Moreover, it converges to zero as n^* becomes very large. Let $n^*(F)$ solve equaitons (26) and (33). Clearly, $n^*(F)$ is increasing in F. Moreover, given that the gross profit is strictly positive for all n^*, $n^*(F)$ goes to infinity for F small.[9] ■

From Observation 1 it now follows that for F small, $\bar{n}-n^* < 0$. Hence from equation (42) we have that $\frac{dW}{dt^*}|_{t-t^*=0} < 0$.

Summarizing the above discussion we obtain our next proposition.

PROPOSITION 5. *There exist F' and $\bar{t}$ (>0) such that whenever $t, t^* < \bar{t}$ and $F < F'$ the welfare level in country 1 is decreasing in t^*.*

Note that in this case while consumers' surplus is decreasing in n^*, the aggregate profits in country 1 is increasing in n^*. For F small enough (i.e. n^* large enough), the first effect dominates, hence the result.[10]

3.3. *Free Entry in Both the Countries*

Finally we examine the case where there is free entry in both the countries.

Note that the equilibrium conditions in this case are given by equations (15), (16), (17), (18), (22) and (25). The reduced form representation is given by equations (24) and (26).

Consider the effect of a change in t^* on the level of export in country 1. We proceed diagrammatically. Let us plot equations (24) and (26) in the $n-n^*$ space (see figure 1). We say that an equilibrium $(\bar{n}, \bar{n}^*)$ is *regular* if at this equilibrium the slope of equation (24) is steeper than that of equation (26) i.e.

$$\left.\frac{dn^*}{dn}\right|_{24,\bar{n},\bar{n}^*} < \left.\frac{dn^*}{dn}\right|_{26,\bar{n},\bar{n}^*}. \tag{43}$$

Now suppose that t^* increases. Then, from equation (28), equation (24) shifts to the right and from equation (34), equation (26) shifts to the left. Clearly if the equilibrium is unique and regular then in equilibrium n increases and n^* decreases (see figure 1). Hence, from equations (20) and (21), aggregate export is increasing in t^*.

We then provide a set of sufficient conditions for the existence of a regular and unique equilibrium. Note that

$$\left.\frac{dn^*}{dn}\right|_{(24)} = -\frac{Fb(1+n+n^*)}{Fb(1+n+n^*)-(a-c)(t^*-t)-t^2-n^*(t^2+t^{*2})}, \tag{44}$$

[9] Suppose to the contrary $n^*(F)$ is bounded above by $\hat{n}$. Now, for F small enough the net profit of firms would be strictly positive for $n^* = \hat{n}+1$. Thus in equilibrium the number of foreign firms must be at least $\hat{n}+1$, a contradiction.

[10] We are very grateful to an anonymous referee for motivating us to work on Proposition 5.

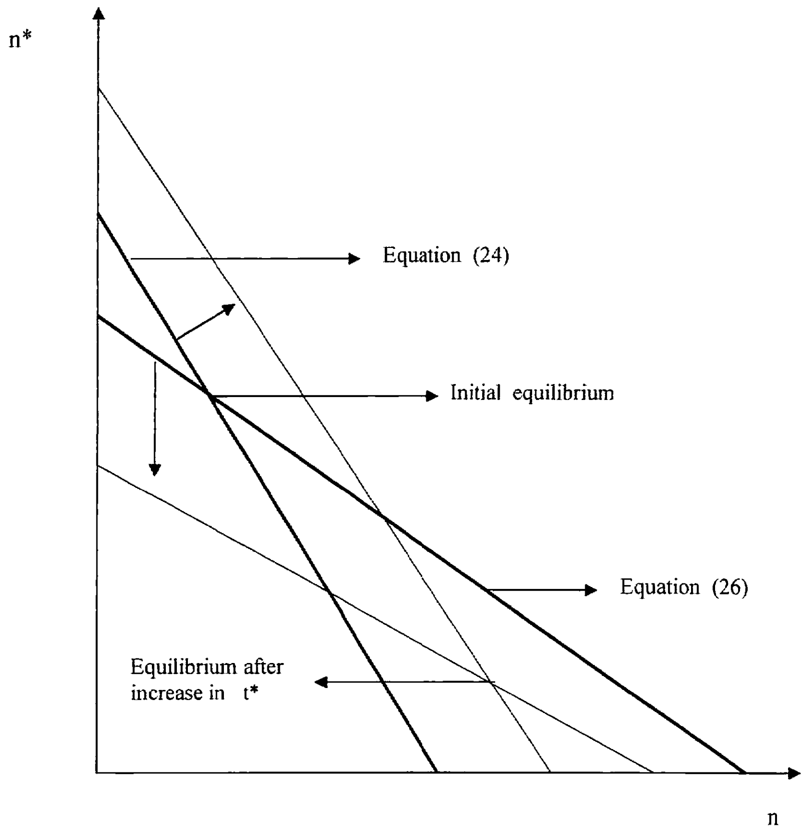

Figure 1.

$$\left.\frac{dn^*}{dn}\right|_{(26)} = -\frac{Fb(1+n+n^*) - (a-c)(t-t^*) - t^{*2} - n(t^2+t^{*2})}{Fb(1+n+n^*)}. \tag{45}$$

Note that if t and t^* are both small enough then equations (24) and (26) are both negatively sloped. Moreover, the slope of equation (24) is strictly less than -1 and that of equation (26) is strictly greater than -1.[11] This implies that equations (24) and (26) have a unique and regular intersection. In fact if t and t^* are both small enough then existence is also ensured.[12]

Summarizing the above discussion we obtain Proposition 6.

PROPOSITION 6. *Suppose that there is free entry in both the countries.*

[11] The existence of the fixed cost F implies that the equilibrium n and n^* are bounded above even if t and t^* are small. Hence if t and t^* becomes very small, then in equations (44) and (45) all the terms associated with t and t^* go to zero.

[12] This follows from the fact that if $t = t^* = 0$, then compaared to equation (26), equation (24) has a strictly greater intercept on the n^* axis and a strictly smaller intercept on the n axis (see figure 1).

(i) *If the equilibrium is unique and regular then an increase in* t^* *leads to an increase in aggregate exports.*

(ii) *There exists some* $\varepsilon > 0$ *such that whenever* $t, t^* < \varepsilon$, *there is a unique and regular equilibrium.*

We then examine the impact of a change in t^* on the welfare levels of the two countries. Note that for the case where there is free entry in both the countries our model is a simplified version of that in Venables (1985). In particular the demand function is weakly convex. Moreoveer, there is a home market bias in the sense that $y_1 > x_2$ and $y_2 > x_1$ (see equations (15) to (18)).[13] Thus Proposition 7 in Venables (1985) applies. Hence we obtain our next proposition.

PROPOSITION 7. *Suppose that there is free entry in both the countries. Then the welfare level in country* 1 *is increasing and that in country* 2 *is decreasing in* t^*.

Propositions 2, 4, 5 and 7 together demonstrate that the welfare implications of an increase in t^* depends on the nature of product market competition, i.e. whether there is free entry in only one of the countries or both of them. Thus Propositions 2, 4, 5 and 7 together provide an extension of Proposition 7 in Venables (1985).

4. THE ANALYSIS: TARIFF BARRIERS

In this section we re-interpret the import restrictions as tariff barriers.[14] Clearly this re-inerpretation does not affect the positive part of the analysis that import protection leads to export promotion. An increase in the level of tariff essentially increases t^* i.e. it makes the firms in country 2 less competitive in the country 1 market. Since it is this feature that derives Propositions 1, 3 and 6, all three propositions go through in case of tariff restrictions as well.

Note, however, that in this case there would be an additional component of welfare in country 1, arising out of the tariff revenue accruing to the government. Thus the welfare analysis in country 1 may be sensitive to this alternative interpretation. Clearly, however, the welfare level in country 2 will not be affected by this alternative interpretation.

We then consider the welfare implications of an increase in tariffs in country 1 for all three versions of the model.

4.1. Free Entry in Country 1 Alone

In this subsection we examine the effects of a change in t^* on the welfare level in country 1 when there is free entry in country 1 alone. As in subsection 3.1. earlier, the equilibrium conditions are again given by equations (15), (16), (17), (18), (22) and (27). Again it is convenient to conduct the analysis in terms of the reduced form equations (24) and (27).

Let T denote the total tariff revenue accruing to the government in country 1. For simplicity we interpret the whole of the transport costs as tariffs. Thus

[13] See Venables (1985), section 5. pp. 9.

[14] We are deeply indebted to an anonymous referee for motivating us to work on this section.

$$T = t^*\bar{n}^*x_2 . \tag{46}$$

Totallty differentiating the above equation with respect to t^* we obtain

$$\frac{dT}{dt^*} = \bar{n}^*x_2 + \bar{n}^*t^*\frac{dx_2}{dt^*} = \frac{\bar{n}^*[a - c - 2t^*(1+n)]}{b(n + \bar{n}^* + 1)} , \tag{47}$$

where the last equality follows from equation (16) earlier.

Observation 2 below is useful for our subsequent analysis.

OBSERVATION 2. (i) $\left.\frac{dT}{dt^*}\right|_{t^*=0} = \frac{\bar{n}^*(a-c)}{b(n+\bar{n}^*+1)} > 0.$

(ii) *Thee exists* $t^*(t)$ *such that* $\frac{dT}{dt^*} < 0$, *whenever* $t^* > t^*(t)$.

Proof. (i) Follows from equation (47).

(ii) From equation (28) earlier we know that n is increasing in t^*. Thus there exists $t^*(t)$ such that whenecveer $t^* > t^*(t)$, we have that $t^*(1+n) > \frac{a-c}{2}$. ■

Let $\tilde{W}$ denote the welfare level in country 1. Given that there is free entry in country 1, all firms in country 1 have a profit of zero. Thus

$$\tilde{W} = \frac{1}{2}(ny_1 + \bar{n}^*x_2)^2 + t^*\bar{n}^*x_2 , \tag{48}$$

where the first term denotes the consumers' surplus C and the second term denotes the tariff revenue T. Next using equations (15), (16) and (30) and simplifying we obtain

$$\frac{dC}{dt^*} = -\frac{\bar{n}^*[(a-c)(n * \bar{n}^*) - \bar{n}^*t^*]}{Fb(n + \bar{n}^* + 1)^2}(x_1)^2 . \tag{49}$$

For analytical tractability we consider two cases, first where t and t^* are both small and second, where t^* is large.

We first examine the case where both t and t^* are small. From Observation 2(i) we know that the tariff revenue is increasing in t^* for this case, whereas from Proposition 2 we know that the consumers' surplus is decreasing in t^*. We, howeveer, demonstrate that for t, t^* small enough, the increase in tariff revenue will be dominated by the fall in consumers' surplus, so that there is a decrease in welfare.

To begin with observe that

$$\begin{aligned} \left.\frac{dC}{dt^*}\right|_{t=t^*=0} &= -\frac{\bar{n}^*(a-c)^3(n+\bar{n}^*)}{Fb^3(n+\bar{n}^*+1)^4} \\ &= -\frac{\bar{n}^*(a-c)(n+\bar{n}^*)}{2b^2(n+\bar{n}^*+1)^2} , \end{aligned} \tag{50}$$

where the last line follows from equation (24). Thus from Observation 2(i) and equation (50)

$$\left.\frac{d\tilde{W}}{dt^*}\right|_{t=t^*=0} = \frac{\bar{n}^*(a-c)}{b(n+\bar{n}^*+1)}\left[1 - \frac{n+\bar{n}^*}{2b(n+\bar{n}^*+1)}\right]. \tag{51}$$

Next note that since $\bar{n}^* \geq 1$, $\frac{n+\bar{n}^*}{2(n+\bar{n}^*+1)} > \frac{1}{4}$. Thus for all $b < \frac{1}{4}$, $\left.\frac{d\tilde{W}}{dt^*}\right|_{t=t^*=0} < 0$. Similarly, note that $\frac{n+\bar{n}^*}{2(n+\bar{n}^*+1)} < \frac{1}{2}$. Thus for all $b > \frac{1}{2}$, $\left.\frac{d\tilde{W}}{dt^*}\right|_{t=t^*=0} > 0$. Thus for t, t^*

small enough, depending on the value of b, the welfare level in country 1 may be either decreasing, or increasing in t^*.

We then consider the case where $t^* > t^*(t)$. From Observation 2(ii) we know that the tariff revenue is decreasing in t^*. From Proposition 2 earlier we know that the consumers' surplus is also decreasing in t^*. Hence, for $t^* > t^*(t)$, the welfare level in country 1 is decreasing in t^*.

PROPOSITION 8. *Suppose that there is free entry in country* 1 *alone.*

(i) *There exists* $\hat{t}$ *such that whenever* $t, t^* < \hat{t}$ *and* $b < \frac{1}{4}$, *the welfare level in country* 1 *is decreasing in* t^*, *whereas if* $t, t^* < \hat{t}$ *and* $b > \frac{1}{2}$, *then the welfare level in country* 1 *is increasing in* t^*.

(ii) *There exists* $t^*(t)$ *such that the welfare level in country* 1 *is decreasing in* t^* *whenever* $t^* > t^*(t)$.

Thus in the presence of free entry in country 1 alone there is a large range of parameter values for which an incease in tariff protection leads to a decrease in welfare in country 1.

4.2. Free Entry in Country 2 Alone

In this subsection we examine the effects of a change in t^* on the welfare level in country when there is free engtry in country 2 alone. As in subsection 3.2 earlier, the equilibrium conditions are given by equations (15), (16), (17), (18), (25) and (33). Again it is more convenient to consider the reduced form representation consisting of equations (26) and (33).

Note that the welfare in country 1, $\tilde{W}$ consists of three components, consumers' surplus, the aggregate profits of firms and tariff revenues. Thus

$$\tilde{W} = \frac{1}{2}(\bar{n}y_1 + n^*x_2)^2 + \Pi_1 + t^*n^*x_2\,, \tag{52}$$

where Π_1 is given by equation (36).

For analytical tractability we consider the case where t, t^* are both small. The next observation is useful later on.

OBSERVATION 3. $\frac{dT}{dt^*}\Big|_{t^*=0} = \frac{n^*(a-c)}{b(\bar{n}+n^*+1)} > 0.$

Proof. Note that $T = t^*n^*x_2$. Thus

$$\frac{dT}{dt^*} = n^*x_2 + t^*n^*\frac{dx_2}{dt^*} + t^*x_2\frac{dn^*}{dt^*}\,.$$

Hence

$$\frac{dT}{dt^*}\bigg|_{t^*=0} = \frac{n^*(a-c)}{b(\bar{n}+n^*+1)} > 0\,.$$

∎

Next from Observation 3 and eqaution (42) earlier we have that

$$\begin{aligned} \left.\frac{d\tilde{W}}{dt^*}\right|_{t=t^*=0} &= \frac{(a-c)}{b(\bar{n}+n^*+1)}\left[\frac{(\bar{n}-n^*)(1+\bar{n})}{2} - \frac{n^*(\bar{n}+n^*)}{b(\bar{n}+n^*+1)}\right] \\ &\quad + \frac{n^*(a-c)}{b(\bar{n}+n^*+1)} \\ &= \frac{(a-c)}{b(\bar{n}+n^*+1)}\left[\frac{\bar{n}(1+\bar{n})}{2}\right. \\ &\quad \left. + n^*\left\{1 - \frac{1+\bar{n}}{2} - \frac{(\bar{n}+n^*)}{b(\bar{n}+n^*+1)}\right\}\right]. \end{aligned} \tag{53}$$

Given Observation 1 earlier it is clear that as F approaches zero, $\frac{(\bar{n}+n^*)}{(\bar{n}+n^*+1)}$ goes to 1 and $1 - \frac{1+\bar{n}}{2} - \frac{(\bar{n}+n^*)}{b(\bar{n}+n^*+1)} = 1 - \frac{1+\bar{n}}{2} - \frac{1}{b}$. Thus, from equation (53) above, we have that for t, t^* and F small enough, if $1 - \frac{1+\bar{n}}{2} - \frac{1}{b} < 0$, then the welfare level in country 1 is decreasing in t^*, whereas if $1 - \frac{1+\bar{n}}{2} - \frac{1}{b} > 0$, then the welfare level in country 1 is increasing in t^*.

We are now in a position to write down our next propositon.

PROPOSITION 9. *Suppose that there is free entry in country 2 alone. There exist* $\underline{F}$ *and* $\bar{t}$ *such that whenever* $t, t^* < \bar{t}$ *and* $F < \underline{F}$, *the welfare level in country 1 is decreasing in* t^* *if* $1 - \frac{1+\bar{n}}{2} - \frac{1}{b} < 0$, *and the welfare level in country 1 is inceasing in* t^* *if* $1 - \frac{1+\bar{n}}{2} - \frac{1}{b} > 0$.

Thus Proposition 9 establishes that for t, t^* small enough, an increase in tariff protection may lead to a decrease in the welfare level in country 1 if the firms are efficient in the sense that F is small.

4.3. Free Entry in Both the Countries

We finally examine the effects of a change in t^* on the welfare level in country 1 when there is free entry in both the countries. As before it is convenient to work with the two reduced form equations (24) and (26).

Let $\tilde{W}$ denote the welfare level in country 1. Given that there is free entry in both countries, all firms in country 1 have a profit of zero. Thus

$$\tilde{W} = \frac{1}{2}(ny_1 + n^*x_2)^2 + t^*n^*x_2\,, \tag{54}$$

where the first term denotes the consumers' surplus and the second term denotes the tariff revenue.

For simplicity we consider the case where t^* is small. Recall that for t^* small, the tariff revenue is increasing in t^* (Observation 3). Also recall that Proposition 7 establishes that the consumers' surplus is increasing in t^*. Thus for t^* small enough, the welfare level in country 1 is increasing in t^*.

PROPOSITION 10. *Suppose that there is free entry in both the countries. Then there exists* $\bar{t}^*$ *such that whenever* $t^* < \bar{t}^*$, *the welfare level in country 1 is increasing in* t^*.

4.4. *Discussion*

Finally, in this sub-section we discuss some robustness issues.

The assumption that the demand functions and production costs are identical across the countries is esentially simplifying in nature. All the results should go through even if we allow these functions to vary across the two countries. The assumption that the demand function is linear is also mainly technical in nature.[15]

The assumption that production costs are linear is, however, much more basic. Recall that with static enonomies of scale, the result in Krugman (1984) is driven by the assumption that marginal costs are decreasing. Suppose instead that marginal costs are strictly increasing. Then with an incease in t^* exports would decline if the number of firms is exogeneously given. If one now allows for free engtry then there would be two opposing effects. The free-entry effect would tend to increase exports, while the marginal cost effect would tend to decrease it. In general the result would be ambiguous.

5. CONCLUSION

In this paper we re-visit Krugman's (1984) thesis that import protection leads to export promotion. Krugman (1984) argues that in the absence of dynamic scale economies, the formalization of this idea appears to require the 'heterodox' assumption that marginal costs are deceasing. We seek to extend Krugman (1984) by providing an alternative foundation of the idea based on free entry and linear marginal costs. We also derive some interesting welfare conclusions.

The welfare results suggest that the fact that exports may be increasing in the level of import protection, is not enough to justify a policy of import protection. While such a policy is necessarily welfare improving when there is free entry in both the countries and import protection is of the non-tariff kind, we identity many scenarios under which import protection may be welfare-reducing. Thus care is required before appealing to this idea to justify a policy of import protection.

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[15] For a general demand function we shall have to impose conditions that ensure uniqueness and stability, for example, the Hahn (1962) condition. Venables (1985) demonstrates that for the case where there is free entry in both the countries the comparative statics analysis also requires that the demand function be convex.

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