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An Example of Welfare Reducing Tariff Under Monopolistic Competition

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WELFARE REDUCING TARIFF UNDER MONOPOLISTIC COMPETITION

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ABSRACT

We look at the effect of a tariff on the import of the brands of a differentiated good produced abroad by a small open economy. We show that in the presence of intra-industry trade if the elasticity of substitution between brands of the differentiated goods is higher than that between the differentiated good and the homogeneous good the imposition of a tariff lowers welfare. This happens because a tariff shifts demand towards the homogeneous good which can only be met by increased production at home. There is an exit out of the differentiated goods industry which reduces welfare.

1. Introduction

It is well-known that tariffs reduce the welfare of a small open economy in competitive models of international trade. Over the last fifteen years, since Krugman's seminal paper (see Krugman (1979)), trade theorists have spent considerable energy in analyzing cases of welfare-improving commercial policy in models with imperfect competition.

Within the framework of a monopolistic competitive framework various authors have derived conditions under which tariffs will improve the welfare of a small open economy (see e.g., Krugman (1979), Venables (1982),Venables (1987), Gros (1987), Markusen (1990)). This literature is admirably surveyed in Helpman and Krugman (1989, chapter 7) and in Helpman (1990).

Three channels have been identified through which a tariff affects the welfare of an economy. First, there is the terms of trade effect. Second, it changes output per firm. And finally it changes variety choice.

A channel which has been identified in the literature as the one which leads to a reduction in welfare of a small open economy is the relative magnitudes of the elasticity of substitution between various brands of the differentiated good and the elasticity of substitution between the homogeneous good and the differentiated good (as a group). Helpman (1990) points out that if the latter is greater then a tariff leads to reduction in the output per firm and thus a loss in welfare. The number of brands produced also falls (in a model where output per firm is given) if that condition is satisfied. This is shown by Markusen (1990) in a model with differentiated inputs in the tradition of Ethier (1982).

In this paper we show that even if this condition is not met it is possible for a small open economy to become worse off after the imposition of

a tariff if the country exports its brands of the differentiated good. This is because the tariff causes an excess demand for the homogeneous good and resources must move to increase its supply. As a consequence exit takes place in the differentiated goods sector.

In section 2 we set out the model. Section 3 analyzes the effect of a tariff and section 4 summarizes the conclusions.

2. The Model

The consumers maximize a CES utility function with the homogeneous good y and an aggregate X of the differentiated good as arguments

$$U = [y^a + X^a]^{a^{-1}} \qquad (1)$$

$$\text{where } a \equiv 1 - 1/\varepsilon \qquad \varepsilon \geq 0$$

subject to the following budget constraint (before the imposition of a tariff which is done is section 3 below)

$$y + PX = z \qquad (2)$$

where P is the price index corresponding to X, the price of the numeraire good y is unity, and z is the gross domestic product.

This maximization exercise yields the following demand functions

$$y = z/(1+P^{1-\varepsilon}) \qquad (3)$$

$$X = z\, P^{-\varepsilon}/(1+P^{1-\varepsilon}) \qquad (4)$$

Now given PX from (4), the consumer allocates this over the differentiated goods i.e., to maximize

$$\left[\sum_i x_i^b + \sum_j x_j^{*b}\right]^{b^{-1}} \qquad i=1,\ldots n. \quad j=1,\ldots n^* \qquad (5)$$

$$\text{where } b \equiv 1 - 1/\sigma \qquad \sigma > 1$$

subject to

$$\sum_i p_i x_i + \sum_j p_j^* x_j^* = PX \qquad i=1,\ldots n. \quad j=1,\ldots n^* \qquad (6)$$

where

$$P^{1-\sigma} \equiv [\sum_{i} p_i^{1-\sigma} + \sum_{j} p_j^{*(1-\sigma)}] \qquad i=1,\ldots n. \quad j=1,\ldots n^* \qquad (7)$$

where $x_i(x_j^*)$ is the amount of the i^{th} (j^{th}) brand consumed whose price is $p_i(p_j^*)$. There are $n(n^*)$ of domestic (foreign) brands.

This gives rise to the following demand functions

$$x_i = PX(p_i^{-\sigma}/P^{1-\sigma}) \qquad (8a)$$

$$i = 1,\ldots,n$$

$$x_j^* = PX(p_j^{*-\sigma}/P^{1-\sigma}) \qquad (8b)$$

$$j = 1,\ldots,n^*$$

Since we shall be concerned with a symmetric equilibrium where all p_i's and x_i's are the same and so are all the p_j^*'s and x_j^*'s we shall drop the subscripts.

The economy is a small one which takes as given the price and the number of brands of the differentiated good produced abroad. This is a natural assumption to make for a small open economy (see Venables (1982)).

In the analysis that follows we shall assume $\sigma \geq \epsilon$ that is the differentiated goods are "more substitutable" for one another that they are as a group for the homogeneous good .[1]

The domestic firms produce the homogeneous good, using a constant returns to scale technology, and the differentiated good, the production of which exhibits increasing returns to scale due to the presence of fixed costs.

The economy has a labour endowment of $\bar{L}$. Each brand of the differentiated good uses L_x units of labour as variable input and F units of labour as fixed input. Therefore, the total labour employed in the differentiated goods sector is $n(L_x+F)$. The output of the homogeneous good is therefore

$$Y = \bar{L} - n(L_x + F) \qquad (9)$$

where we have assumed that each unit of labour produces one unit of Y (which implies the wage rate in terms of the homogeneous good is unity). The (constant) marginal cost of production in the differentiated good is given by

$$c = L_x/V \tag{10}$$

where V is the output per brand.

The differentiated goods industry is monopolistically competitive so we have the mark-up pricing rule

$$p = (c/b) \text{ where } b \equiv 1 - 1/\sigma \tag{11}$$

Entry drives profits down to zero in the large group case. So average cost equals price

$$p = c + (F/V) \tag{12}$$

Note that (10), (11) and (12) imply that p, V and L_x can be solved for independently of the rest of the system. Thus the only variable which affect the size of the differentiated goods industry is the number of varieties produced locally.

The gross domestic product is the sum of the production in the two industries i.e.,

$$z = \bar{L} - n(L_x + F) + npV = \bar{L} \tag{13}$$

i.e., all production income accrues to the only factor of production-labour.

In this paper we shall assume that the homogeneous good is not traded. Strictly speaking, all we require is that the amount of this good exported be fixed and at the margin any change in imports be met by an equivalent change in differentiated goods export. The non-traded nature of the homogeneous good could be motivated by thinking of these as labour services

The market clearing condition for the non-traded good is given in equation (14)

$$\bar{L} - n(L_x + F) = (1 + P^{1-\varepsilon})^{-1} \bar{L} \tag{14}$$

Note that this equations implies that (by Walras' Law) trade would be balanced.

3. The Tariff

Now suppose starting from a situation of free trade the home government imposes a small tariff on the imported brands of the differentiated goods and rebates the proceeds back to the public. This changes the price of the imported brands from p^* to $p^*(1+t)$ and income of the representative household to $\bar{L} + T$ where $T \equiv n^* p^* x^* t$ is the tariff revenue.

Before turning to the analysis of the effects of a tariff note that the indirect utility function for the consumer's problem in the presence of tariffs (using (1), (3), (4) and (13) is

$$v \equiv \max U \equiv (1+P^{1-\varepsilon})^{[1/(\varepsilon-1)]} \{\bar{L}+T\} \qquad (15)$$

This depends on P ($\frac{\partial v}{\partial P} < 0$) and T. P in turn from equation (7) depends on n ($\partial P/\partial n < 0$) and t ($\partial P/\partial t > 0$),[2] since the price per brand p is fixed by (11) and n^* is taken to be exogenous. The tariff then affects welfare through P and T. But we know that the tariff revenue just compensates the consumers for the increased price of the imported brands , so the only effect on welfare is through n i.e.

$$\hat{v} = \alpha.\beta.(\sigma-1)^{-1}.\hat{n} ,$$

where a $\hat{(\ )}$ denotes a percentage change, α is the share of the differentiated goods in expenditure and β is the share ofthe domestic brands in PX.

When the homogeneous good becomes non-traded (or at least the amount traded is fixed) and its market-clearing equation is given by (14), we can obtain the effect on variety choice following the imposition of a tariff in equation (16).

$$\frac{dn}{dt} = -\varepsilon.n^{*}p^{*}x^{*}(1-\alpha)(1-\sigma) \;/[pV(1-\sigma)-px(1-\varepsilon)(1-\alpha)] \qquad (16)$$

The denominator is positive because $V-x > 0$ being the export of each brand, α the share the differentiated good is less than unity and $\sigma \geq \varepsilon$. Note that $\sigma \geq \varepsilon$ is a sufficient condition for the result to hold. In particular even if $\sigma = \varepsilon$, the expression in (16) is negative.

A rise in the price of the foreign brands, ceteris paribus raises P and thus the demand for the homogeneous good. This is reinforced by the rebated tariff revenues. This excess demand can only be met by increased production at home. Labour has to shift to increase its supply. This is achieved through a fall in n which further raises P.

The balanced trade equation ("the trade triangle") makes the process at work clearer. This is given in (17)

$$np(V-x) = n^{*}p^{*}x^{*} \qquad (17)$$

The right hand side of (17) falls due to the tariff (own price effect) and the left hand side must fall as well. V and p are fixed and thus this fall is achieved through a rise in x (the domestic brands are cheaper) and/or a fall in n — both of these actually happen.[3]

Welfare falls as n falls because the tariff revenue just compensates the representative consumer for the increase in the price of the imported brands.

Venables (1987) had shown that for a large country tariffs are welfare improving for the tariff-imposing country because they cause exit abroad and entry at home. Here the small open economy in a bid to redirect demand towards its differentiated goods sector ends up directing it towards its homogeneous goods production also. Free trade is preferable than a tariff here.

It is true that in this set-up there is an underproduction, from a social point of view, of the differentiated goods because of pricing above marginal cost in that industry. Unfortunately, the imposition of a tariff cannot be used to correct this.

4. Conclusion

In this paper we looked at the effect of a tariff on the import of the brands of a differentiated good produced abroad by a small open economy. We showed that in the presence of intra-industry trade if the elasticity of substitution between brands of the differentiated goods is higher than that between the differentiated good and the homogeneous, good the imposition of a tariff lowers welfare. This happens because a tariff shifts demand towards the homogeneous good which can only be met by increased production at home. There is an exit out of the differentiated goods industry which reduces welfare.

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FOOTNOTES

1. This is a sufficient condition for most of the results below. See the discussion following equation (16) below.

2. $\partial v/\partial P = -\alpha P/v < 0$, $\partial P/\partial n = (1-\sigma)^{-1}\beta n P^{-1} < 0$.

$\partial P/\partial t = (1-\beta).P > 0$

3. $x = p^{-\sigma}P^{\sigma-\varepsilon}.(1+P^{1-\varepsilon})(\bar{L} + T) = p^{-\sigma}P^{\sigma-\varepsilon}y$

x must rise because P rises, $\sigma \geq \varepsilon$ and y rises.

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