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Tariffs that may fail to protect: A model of trade and public goods

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Abstract

This paper develops a model of small open economy, with a differentiated goods sector and voluntary provisioning of public good. It is shown that trade policy can alter the quantity of public good provided in the equilibrium. Interestingly, tariffs may fail to protect, leading to a Metzler Paradox like situation. This is because the income effect generated due to the imposition of tariff can lead to an increase in the contribution to the public good. An expanding public sector crowds out the import competing sector. This result holds unambiguously in the neighbourhood of free trade.

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Keywords: trade, monopolistic competition, tariffs, public goods

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1. Introduction

A good or a service is considered to be public, if it is non-rival in consumption. Thus, these goods are potentially for collective consumptions. In general, markets fail to allocate public goods efficiently and thus the issue of providing and financing public goods through collective action has become an important issue in the literature. Oslon (1965) had argued that in a society with competing political groups, provision of public good becomes increasingly difficult through voluntary contribution, as the group size increases. Chamberlin (1974) and Mcguire (1974), show that in a competitive set-up, if the public good provided is a normal good, then contribution by each member increases and reaches a finite value with an increasing group size. Cornes and Sandler (1989) builds a model, with both a public good and private good. Both these goods are produced with labour. Increase in labour endowment of each individual increases his contribution to the public good. In the two factor model developed by Vicary (2004) the effect of group size become ambiguous and depends on the relative factor intensities of the public good and the private good.

Pecuniro (2009) builds a model, where labour is employed between a differentiated private goods sector and a public good sector. As labour increases, the variety sector expands which in turns implies a higher expenditure on the differentiated goods sector. This increases the marginal utility of income and thus the aggregate contribution made to the public good falls. In Mondal (2013), marginal utility of income is inversely related to the aggregate expenditure on the variety sector and thus increasing group size, in contrast to Pecuniro (2009) increases the aggregate contribution to the public good.

The present model, extends Mondal (2013) and incorporates trade in the differentiated goods sector. The economy is assumed to be small, in a sense that the prices of the foreign brands and the number of foreign varieties are exogenously given (See Sen et al. 1997). Imposition of tariff, by the home country in such a set up has interesting implications. An increase in tariff cetirus paribus (that is at the level of constant import demand), increases the income of the individuals through the tariff income rebated to the agents. This generates an "income effect" by which agents would contribute more to the public good and thus increase the aggregate expenditure on public goods. Market clearing implies that an expanding public goods sector draws labour out of the differentiated goods sector and thus this sector may contract. Tariffs then would fail to protect the import competing sector. Such a result is reminiscent of the famous Metzler Paradox result in classical trade

theory (See Metzler 1949).

Competitive trade theory has an extensive literature that deals with the effects of imposition of tariffs. In general, imposition of tariff has two effects, firstly, it enhances welfare by improving the terms of trade for the tariff imposing country, and secondly, it reduces welfare by causing the import competing sector to expand (and thus crowd out cheaper importables). Competitive trade theory identifies a situation known as the Metzler Paradox (see Metzler 1949), when the improvement in terms of trade, for the tariff imposing nation is so high that it actually lowers the domestic price of the output of the import competing sector and thus fail to protect it. Helpman and Krugman (1989) builds a model of trade with monopolistic competition and scale economies. They show that in such set up, the price lowering effect of the tariffs can become more pronounced since it requires much lesser restrictive conditions than Metzler (1949). A single factor of production, labour is allocated between a differentiated goods sector and a homogeneous goods sector. Differentiated goods sector is traded but is subject to transportation costs while trading of the homogeneous good is costless. Imposition of tariffs in a two country world leads to re-allocation of firms in the tariff imposing country. Since the relatively cheaper home varieties increases; the aggregate price index faced by the domestic consumers fall. Home market effects can thus lower the domestic price of the import competing sector.[3] The present model is also related to this class of literature. However, the possibility that tariffs may fail to protect the import competing sector comes through a completely different channel (not through home market effects) and in a different manner. Increase in the tariff, increases the revenue earned from the imports directly. As this tariff income is rebated back to the agents, it reduces the marginal utility of income and thus agents increase their contribution to the public good. On the other hand, increase in the tariff rate causes the import demand to fall, which may reverse the effect. The net effect thus is ambiguous. To focus on the intuition, we study the equilibrium in the neighbourhood of free trade. Near the free trade equilibrium, the first effect dominates the second and tariffs fail to protect the import competing sector unambiguously. The number of domestic (import competing) brands falls and the total volume of the import competing sector contracts.

The next section outlines the basic model, and section-3 develops the

[3]Davis (1998) builds another model that discusses the implications of home market effects and trade policy.

comparative statics. The last section concludes the model.

2. The Basic Model

Consider a hypothetical small open economy which produces n_h number of varieties domestically and imports n_f number of varieties from foreign. "Smallness" implies that the number and prices of the foreign varieties are exogenously given to this economy as in Sen (1997). Moreover, the agents also consume a public good, G which is financed by voluntary contribution of the agents. All the agents supply one unit of labour inelastically and total number of residents is assumed to be L. Government imposes a tariff on the import of the foreign varieties. The utility function of the agents is given by

$$U = \log\left(\sum_{i}^{n_h} C_h^{\rho} + \sum_{j}^{n_f} C_f^{\rho}\right)^{\frac{1}{\rho}} + f(G/w). \tag{1}$$

where $f' > 0$ and $f'' < 0$. C_h indicates the representative consumption of the home variety while C_f is the consumption of any foreign variety. σ $(= \frac{1}{1-\rho})$ is the elasticity of substitution and $\sigma > 1$ as $\rho \in (0, 1)$. G and w are the total expenditure on the public good and the wage rate in the economy respectively. For simplicity, it is assumed that one unit of labour is used for producing one unit of public good. Thus $\frac{G}{w}$ is the total labour employed for the production of public good. Suppose the voluntary contribution made by each individual is given by g. Then $G = gL$ as all agents are symmetric. Then the demand functions can be obtained by maximising (1) when the income of each consumer is

$$M = w + T/L. \tag{2}$$

M, w are the individual income and the wage rate earned by the individual by supplying the one unit of labour it possess inelastically respectively. T is the aggregate tariff revenue earned by the government which we assume to be rebated equally among the agents. Utility maximisation implies

$$\frac{C_h}{C_f} = \left(\frac{p_h}{p_f(1+t)}\right)^{-\sigma}. \tag{3}$$

p_h, p_f and t represents the prices of the home produced brand, imported brand and the tariff rate respectively. Each consumer would make a volun-

tary contribution [4]

$$g = w + T/L - \frac{w}{f'(G/w)}. \tag{4}$$

Total amount of public good thus produced in the economy would be given by

$$G = wL + T - \frac{wL}{f'(G/w)}. \tag{5}$$

Domestic production of each variety requires α units of labourers to start production and β units of labourers for each additional unit of output produced. Producers maximise profits by equating the marginal revenue with the marginal cost.

$$p_h(1 - \frac{1}{\sigma}) = \beta w. \tag{6}$$

which implies,

$$p_h = \frac{\beta w}{\rho}. \tag{7}$$

Free entry in the variety sector, means that in the equilibrium, firms would equate the surplus with the fixed costs of production,

$$\frac{p_h x_h}{\sigma} = \alpha w \Longrightarrow x_h = \frac{\alpha\rho}{\beta(1-\rho)}, \tag{8}$$

when x_h is the output of the domestic firm. Total value of exports made by this small open economy is $n_h p_h(x_h - LC_h)$ and the aggregate value of imports is given by $n_f p_f LC_f$. Balance of payments would require that value of imports should be equal to the value of exports.

$$n_h p_h(x_h - LC_h) = n_f p_f LC_f. \tag{9}$$

The tariff revenue earned by the government is given by

$$T = tn_f p_f C_f L. \tag{10}$$

Labour is required for production of the public good and the variety sector. Labour is assumed to be the numeraire and thus $w = 1$. Thus the labour market clearing condition is

$$n_h(\alpha + \beta x) + G = L. \tag{11}$$

Equations (1) to (11) completes the description of the model.

[4] See Mondal (2013) for derivation of this demand function.

3. Comparitive statics

To understand the effect of tariffs in this model, we totally differentiate equation (9) to get

$$\hat{n_h} - s\hat{C_h} = \hat{C_f}, \tag{12}$$

where $s = \frac{LC_h}{x_h - LC_h}$, and $s > 0$ the ratio of aggregate domestic consumption of each brand to its imports. Utility maximisation implies that $\hat{C_h} = \hat{C_f} + \sigma\frac{dt}{1+t}$ (See equation(3)). Substituting this into equation (12), we obtain an equation involving $\hat{n_h}$ and $\hat{C_f}$.

$$\hat{n_h} - (1+s)\hat{C_f} = \frac{\sigma s dt}{1+t}. \tag{13}$$

From equation (5),

$$dG = tn_f p_f C_f(\hat{C_f} + \hat{t}) + Lf'^{-2}f''dG.$$

which would in turn imply

$$\hat{G} = \frac{tn_f p_f C_f(\hat{t} + \hat{C_f})}{G[1 - L\frac{f''}{f'^2}]}. \tag{14}$$

Using the labour market clearing condition (11) equation (14) can be written as

$$-[1 - L\frac{f''}{f'^2}](\alpha + \beta x)n_h\hat{n_h} - tn_f p_f C_f\hat{C_f} = n_f p_f C_f dt. \tag{15}$$

Solving equations (13) and (15) the change in total number of home produced varieties and the import demand due to a change in tariffs can be expressed as:

$$\hat{n_h} = \frac{-(1+s)n_f p_f C_f + \frac{tn_f p_f C_f \sigma s}{1+t}}{D}dt. \tag{16}$$

$$\hat{C_f} = -\frac{[1 - L\frac{f''}{f'^2}](\alpha + \beta x)n_h\sigma s/(1+t) + n_f p_f C_f}{D}dt. \tag{17}$$

where $D = n_h(1+s)(1 - \frac{Lf''}{f'^2})(\alpha + \beta x) + tn_f p_f C_f > 0$.

Equations (16) and (17) can be used to derive the following propositions.

Proposition 1. *Tariffs may fail to protect the import competing sector. Moreover, around the free trade equilibrium an increase in tariffs cause an unambiguous contraction of the import competing sector.*

Proof. Consider equation(16). The number of brands produced by the import competing sector will decline if the parametrisation $\frac{\sigma t}{1+t} - \frac{1+s}{s} < 0$ holds. It is straightforward to check that around the free trade equilibrium,$(t = 0)$, imposition of tariffs reduce the total number of varieties produced by the home economy. This implies that tariffs fail to protect the import competing sector in the presence of public good. This is because as the per firm output produced by the import competing sector is constant, the volume of import competing sector's output $(n_h x_h)$ contracts unambiguously. ■

Imposition of tariff increases the total income accruing to the consumers, which thus reduces the opportunity cost of contributing to the public good. Thus the voluntary contribution to the public good increases, which draws labour out of the production of the home produced varieties. As the per firm output is constant, the total number of home produced varieties gets reduced, which in turn implies that the total volume of the import competing sector $(n_h x_h)$ contracts. This can be summarized as the following proposition.

Proposition 2. *In the neighbourhood of the free trade equilibrium, imposition of tariffs increases the tariff revenue.*

Proof. Differentiating equation (5) we get

$$\frac{dT}{dt} = t n_f p_f \frac{dC_f}{dt} + n_f p f C_f \tag{18}$$

Assuming free trade (that is, $t = 0$), $\frac{dT}{dt} > 0$. ■

Equation (17) shows the usual effect of tariffs on the import demand. The volume of import falls, because imposition of tariffs makes it dearer to the consumers. From the labour market clearing condition (11), near the free trade equilibrium a fall in the number of varieties implies higher output of the public good.

4. Conclusion

Metzler (1949) had shown that tariffs may fail to protect the import competing sector. This can happen when the improvement in terms is very large. Helpman and Krugman (1989) builds a model of monopolistic competition and love for variety and shows that home market effects can lead to

Metzler Paradox type result. The present model generates a similar result, though through a completely different channel. Presence of a public good implies, that around the free trade equilibrium the differentiated goods sector (which is the import competing sector) would contract. Thus, tariffs may fail to protect, though in general, the effect of tariffs on public good and the total volume of the import competing sector remains ambiguous. This is interesting because tariffs are often invoked to protect the domestic import competing industry.

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