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THE PROTECTIVE EFFECT OF AN AD VALOREM VERSUS SPECIFIC TARIFF UNDER UNCERTAINTY

By

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ABSTRACT

This paper shows that in a small country where arrangements to enable risk-sharing do not exist, a specific tariff is more protective under uncertainty than a mean-equivalent ad valorem tariff. This result does not necessarily hold for a large country case.

I. INTRODUCTION

The purpose of this paper is to compare the rate of protection derived from a specific tariff to the one derived from a mean-equivalent ad valorem tariff. It is well known that, in a deterministic and competitive framework, specific and a mean-equivalent ad valorem tariffs give rise to the same rate of protection. In the case of a small country operating in uncertain environment, where its supply shocks do not influence the world price of that commodity, specific and ad valorem tariffs increase the firm's expected profits by the same amount but the variance of the profits is smaller in the case of a specific tariff. Since it is assumed that the firm dislikes higher variances for the same expected profits, the protected sector output in the case of specific tariffs is higher than it would have been in the case of a mean-equivalent ad valorem tariff.

Most of the literature about restricting trade in uncertain environment has compared ad valorem tariffs and quotas (e.g. Fishelson and Flatters (1975), Dasgupta and Stiglitz (1977), Pelcovits (1976), Young (1980)). Young and Anderson (1980) have compared the welfare effects of ad valorem and specific tariff and quotas under uncertainty. Here I am concerned only with the positive question of the relative protective effects of ad valorem and specific tariffs under uncertainty.

2. THE MODEL

Consider a small country comprising of two sectors, each of which consists of firms which have identical production functions, utility functions, and probability assessments. Sector i produces output of commodity i, denoted by X_i, by means of labor and capital; the output of each firm in this sector depends on its employment of capital and labor as well as on the state of the world. In particular, in every state of the world α, $\alpha = 1,2,\ldots,s$, the output of firm j is:

$$X_{ij}(\alpha) = \theta_i(\alpha) f_i(L_{ij}, K_{ij}) \qquad i = 1,2 \qquad (1)$$

where θ_i is a positive-valued random variable, $f_i(\cdot)$ a standard neoclassical linear homogeneous production function of commodity i, L_{ij} the labor input of firm j, K_{ij} the capital input of firm j and X_{ij} is the output of firm j, which is random.

Assume that there are no financial markets to enable risk-sharing. Firms choose their input level before the resolution of uncertainty so as to maximize their expected utility, U_j, from profits, $\Pi_{ij}(\alpha), i = 1,2$; i.e

$$\max_{L_{ij}, K_{ij} \geq 0} E\{U_j[\Pi_{ij}(\alpha)]\} \qquad (2)$$

where E is the expectation operator and the firms' profit function under free trade is:

$$\Pi_{ij}(\alpha) = P_i(\alpha)X_{ij}(\alpha) - wL_{ij} - rK_{ij} \qquad (3)$$

where w and r stand for the labor and capital returns respectively, and P_i denotes the price of good i, $i = 1,2$. The firms' utility functions are assumed to be bounded from above and twice differentiable with derivative signs $U_j' > 0$ and $U_j'' < 0$. We assume that this utility function is a mean-variance one; namely, the firms like higher expected profits and dislike higher variances, for the same expected profit.

Inserting the constraints into the objective functions, differentiating, and rearranging we obtain the following form of the first order conditions:

$$w = \frac{E\{U_j'[\Pi_{ij}(\alpha)][P_i(\alpha)\theta_i(\alpha)]\}}{E\{U_j'[\Pi_{ij}(\alpha)]\}} \cdot \frac{\partial f_i(\cdot)}{\partial L_{ij}} \qquad i = 1,2$$

$$r = \frac{E\{U_j'[\Pi_{ij}(\alpha)][P_i(\alpha)\theta_i(\alpha)]\}}{E\{U_j'[\Pi_{ij}(\alpha)]\}} \cdot \frac{\partial f_i(\cdot)}{\partial K_{ij}} \qquad i = 1,2 \qquad (4)$$

Equation (4) is the equivalent of the conditions, under certainty, that factor prices are set equal to the value marginal product. Here, however, the valuation formula includes the risk premium associated with the particular industry. Note that equation (4) implies that even when firms operate in an uncertain environment, they set the marginal rate of substitution between factors equal to the factor price ratio.

In a long run equilibrium, the risk-averse entrepeneur's expected profits are positive, whereby the value of the expected profits equals the risk premium (see Sandmo [1971, p.71] and Baron [1970, p.476]). Usually the value of expected profits would differ across industries according to the risk involved in their returns.

The long run equilibrium conditions are of three types. The conditions of the first type are the conditions which ensure optimization by each firm, namely conditions (4). The conditions of the second type are the ordinary factor markets clearing conditions. The conditions of the third type are the conditions which stem from the absence of barriers to enter or exit for a competitive industry, taking into account the entrepreneur's alternative of zero production. As was shown in Mayer [1976, p.800] the latter condition can be written as:

$$E\{U_j[\Pi_{ij}(\alpha)]\} = m \qquad \text{for} \quad i = 1,2 \qquad (5)$$

where m is an arbitrarily chosen real number that the representative entrepreneur assigns to a situation of zero profit; i.e. $U_j(0) = m$.

3. THE PROTECTIVE EFFECTS OF AN AD VALOREM VERSUS SPECIFIC TARIFF UNDER UNCERTAINTY

Let us assume that in order to protect the import sector (i.e. the domestic second industry), two measures are considered: an ad-valorem tariff denoted by t, and a specific tariff denoted by s. In comparing the two instruments I assume that both give rise to the same increase in the mean value of the second commodity price in the small country; i.e.

$$E[(1 + t)P_2(\alpha)] = E[P_2(\alpha) + s] \qquad (6)$$

or

$$t\, E[P_2(\alpha)] = s.$$

We can simplify the discussion even further by choosing units such that equation (7) holds.

$$E[P_2(\alpha)] = 1 \qquad (7)$$

The purpose of this section is to show that the two measures give rise to different rates of protection. The firm's profit functions under the alternative protective measures are:

$$\Pi^t_{2j}(\alpha) = (1+t)P_2(\alpha)\theta_2(\alpha)f_2(L_{2j}, K_{2j}) - wL_{2j}-rK_{2j}$$

$$(8)$$

$$\Pi^s_{2j}(\alpha) = (P_2(\alpha) + s)\theta_2(\alpha)f_2(L_{2j}, K_{2j}) - wL_{2j}-rK_{2j}$$

where $\Pi^t_{2j}(\alpha)$ and $\Pi^s_{2j}(\alpha)$ stand for the random profits of firm j in the second industry under the ad valorem and specific tariff cases respectively. We adopt the following interpretation of the small country assumption:

$$E[P_2(\alpha)\theta_2(\alpha)] = E[P_2(\alpha)]E[\theta_2(\alpha)]$$

$$E\{[P_2(\alpha)]^2[\theta_2(\alpha)]^2\} = E[P_2(\alpha)]^2E[\theta_2(\alpha)]^2 \tag{9}$$

which means that the real shocks at home (i.e. the random parameter $\theta_2(\alpha)$) are country specific, and have no influence on the world price. Under the above assumptions it is shown (equation (10)) that the expectations of the random profits in the two cases are the same, while the variance of the profits is bigger in the case of ad valorem tariff (equation (11)).[1]

$$E[\Pi^A_{ij}] = \{E[P_2(\alpha)]E[\theta_2(\alpha)] + t\ E[P_2(\alpha)]E[\theta_2(\alpha)]\}f_{2j}(\cdot) - wL_{2j} - rK_{2j}$$

$$= E[P_2(\alpha) + s]E\theta_2(\alpha)f_{2j}(\cdot) - wK_{2j} - rK_{2j} = E[\Pi^S_{2j}] \tag{10}$$

$$\mathrm{Var}[\Pi^A_{2j}] = f^2_{2j}(\cdot)\ \mathrm{Var}\ [P_2(\alpha)\ \theta_2(\alpha) + t\ P_2(\alpha)\theta_2(\alpha)] = \tag{11}$$

$$= f^2_{2j}(\cdot)\{\mathrm{Var}[P_2(\alpha)\theta_2(\alpha)] + 2t\ \mathrm{Var}\ [P_2(\alpha)\theta_2(\alpha)] + t^2\ \mathrm{Var}[P_2(\alpha)\theta_2(\alpha)]\}$$

$$> f^2_{2j}(\cdot)\{\mathrm{Var}[P_2(\alpha)\theta_2(\alpha)] + 2s\ \mathrm{Var}[\theta_2(\alpha)] + s^2\ \mathrm{Var}[\theta_2(\alpha)]\}$$

$$= f^2_{2j}(\cdot)\ \mathrm{Var}[P_2(\alpha)\theta_2(\alpha) + s\theta_2(\alpha)] = \mathrm{Var}[\Pi^S_{2j}]$$

Since variance lowers the expected utility of the representative firm, the risk averse entrepeneur would demand higher expected profits (risk premium) in the case of an ad valorem tariff than in the case of a specific tariff. In a long-run equilibrium, total product will be exhausted by ordinary factor payment plus risk premium, i.e.: expected price = average cost plus average risk premium = marginal cost plus marginal risk premium. Hence higher factor payment would be afforded in the case of a specific tariff which would increase the employment of both factors in that sector. Expected output is accordingly higher under a specific tariff than under a mean-price equivalent ad valorem tariff.

This result does not necessarily hold in the large country case. In that case, the real shocks do affect the world's price of that commodity and a negative correlation between $P_2(\alpha)$ and $\theta_2(\alpha)$ is likely to exist. Hence the variance of the profits in the case of ad valorem tariff might be smaller than the one resulting from a specific tariff.

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FOOTNOTES

1 Note, it is assumed that $P_2(\alpha)$ is not a degenerative function, so

$Var[P_2(\alpha)] = E[P_2(\alpha)]^2 - [EP_2(\alpha)]^2 > 0$. Hence,

$$Var[P_2(\alpha)\theta_2(\alpha)] = E\{[P_2(\alpha)]^2[\theta_2(\alpha)]^2\} - [EP_2(\alpha)]^2[E\theta_2(\alpha)]^2$$

$$= E[P_2(\alpha)]^2 E[\theta_2(\alpha)]^2 - [E\theta_2(\alpha)]^2 >$$

$$> [EP_2(\alpha)]^2 E[\theta_2(\alpha)]^2 - [E\theta_2(\alpha)]^2 = Var[\theta_2(\alpha)].$$