On the Non-Equivalence of Tariffs and Tariffs: Welfare Ranking Ad Valorem and Specific Tariffs under Monopolistic Competition

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Actual trade and tariff policy prefers ad valorem tariffs to specific tariffs. Yet, this paper shows that, in a setting of monopolistic competition, realizing a given restriction on imports via a specific tariff would generate more consumer utility than obtaining the same restriction via an ad valorem tariff. (*JEL* F12)

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Krugman (1992) comments that even though new trade theory has been a major success in the economics profession, its impact on trade policy has been limited. Yet, modelling the impact of different trade policy instruments in settings of imperfect competition has generated important and often surprising insights, for an overview see Helpman and Krugman (1989). The present paper adds to this literature by examining two distinct forms of tariff regimes (i.e. ad valorem versus specific tariffs) and their respective impact on welfare, in a setting of monopolistic competition. In perfectly competitive industries and small country settings, specific and ad valorem tariffs can be shown to be identical policy tools. In an imperfectly competitive setting,

where a country faces a foreign monopoly or oligopoly, an ad valorem tariff is typically preferable to a specific tariff, because it is superior in terms of extracting rents from the foreign suppliers. For industries featuring monopolistic competition, the present paper finds that a specific tariff generates higher welfare than an ad valorem tariff. Hence, we find non-equivalence. In terms of actual trade policies, one observes that the great trading nations have focussed on ad valorem tariffs, ignoring the tool of specific tariffs. Also, GATT and later WTO traditionally promote the use of ad valorem tariffs. Finally, ad valorem tariffs may be preferable from an administrative point of view. Yet, the impact of an ad valorem tariff on industry and firm profits and hence industry structure, as compared to the impact from a specific tariff, makes for a non-trivial difference between the two policy tools.

An overview of trade policy equivalence or rather non-equivalence in models of imperfect competition, is provided by Helpman and Krugman (1989). More recently, for example, Kowalczyk and Skeath (1994) have shown that in a setting where a country faces one foreign monopolist, ad valorem tariffs are welfare superior to specific tariffs – opposite to our result. Their result is driven by the fact that the ad valorem tariff is superior in terms of revenue extraction. On the other hand, in line with our result, Das and Donnenfeld (1987) show that for a country facing a foreign monopolist that has a quality choice, the specific tariff generates the higher welfare. Yet, both the above contributions (as well as Helpman and Krugman (1989) when addressing non-equivalence of ad valorem to specific tariffs) deal with situations of monopoly or oligopoly but not – the object of the present paper – with symmetric

situations of monopolistic competition. The approach closest to the present model is that of Gros (1987). Gros builds a two-country single industry monopolistic competition model and studies a series of trade policies. His central results concern welfare effects of retaliation in tariff wars. However, Gros (1987) focusses on ad valorem tariffs, and does not deal with the welfare impact of the two forms of tariff tools.

The formal approach of the present paper builds on the seminal work of Krugman (1980). We model two symmetric countries, with two monopolistic competitive industries, of which one is internationally traded. The model is solved in general equilibrium and allows for two different forms of tariff policy (namely, bilateral specific and ad valorem tariffs) in order to obtain a certain import volume. All tariff revenues are completely redistributed to consumers. First, it is found that a specific tariff generates a larger number of variants in the traded sector than an ad valorem tariff. The reason is that industry profitability is higher under a specific tariff than under an ad valorem tariff. Or put differently, as a revenue extractor the ad valorem tariff is more efficient than the specific tariff (this is what drives the results of models featuring monopoly or oligopoly market power, see Helpman and Krugman (1989, ch.4)), but, due to this efficiency, industry profits are reduced, resulting in reduced entry and fewer firms. Second, explicit solutions for consumer welfare are derived. It is found that, driven by the number of firms, consumer utility under a specific tariff is higher than under the equivalent ad valorem tariff. Naturally, free trade dominates both forms of tariff policy in terms of consumer utility. Thus, applying ad valorem

tariffs instead of specific tariffs in order to limit imports in industries featuring monopolistic competition will have an opportunity cost in terms of lost consumer utility.

The paper is structured as follows. The next section introduces the model. Section 2 examines the impact of the two different tariff regimes on both the traded and the non-traded sector. In section 3 we present the welfare results. Section 4 concludes the paper.

I. The Model

The starting point of this model is the application of Chamberlinian monopolistic competition to international trade, developed by Krugman (1980 and 1981). In particular, it is assumed that the world consists of two symmetric countries, each with two industries. Market conditions are described by monopolistic competition, increasing returns to scale in production and differentiated goods. Each industry has a large number of potential variants which enter symmetrically into demand. For simplicity, we assume that the first industry is non-traded, while the other industry is a pure export industry, i.e. for this industry the home country exports its entire output to the foreign country and vice versa. This assumption may not be empirically reasonable; it is certainly not theoretically necessary. However, what is decisive for our results to occur is some degree of market segmentation, i.e. the assumption that

products within each industry are closer substitutes than products from home and abroad. Adopting the utility function of Krugman (1981), and applying the specific functional form introduced in Krugman (1980), one gets the following utility function, identical for all individuals:

$$U = \ln \sum_{i=1}^{N} c_i^{\theta} + \ln \sum_{j=1}^{\hat{N}} \hat{c}_j^{\theta} \qquad (1)$$

where $0<\theta<1$ and c_i is consumption of the *i*th variant of the import industry and $\hat{c}_j$ is consumption of the *j*th variant of the non-traded home industry. The number of variants actually produced (n and $\hat{n}$) is assumed to be large, although smaller than N and $\hat{N}$. Utility maximisation implies that consumers spent an equal share of income on each industry. Also, with a large number of variants being produced in each industry, the pricing decision of each producer in the industry will have a negligible effect on marginal utility of income. Hence, every firm faces a demand curve with an elasticity of $\frac{1}{1-\theta}$.

For the moment we examine the properties of the export industry alone, bearing in mind that under free-trade, the equilibrium of the export industry is identical to the equilibrium of the non-traded industry. On the supply side it is assumed that all variants will be produced with the same cost function given by:

$$l_i = \alpha + \beta x_i \qquad i = 1,\ldots n \tag{2}$$

where l_i is labour used in the production of the *i*th variant in the traded industry and x_i is output of that variant. This specification includes fixed costs α and constant marginal costs β. Hence, average costs decline at a diminishing rate, and thus each variant is produced by only one firm. By assumption one firm only produces one variant, hence the number of variants equals the number of firms. Furthermore, (2) implies that all variants will behave identically, hence, in the remainder of the paper the subscripts *i* and *j* can be omitted.

Assuming equality between the numbers of workers, *L*, and consumers, the market clearing condition demands:

$$x = Lc \tag{3}$$

where *c* is the consumption of a representative consumer. Evoking i) free entry and exit of firms, ii) the zero-profit condition $\pi = px - (\alpha + \beta x)w = 0$ (where *w* is the economy-wide wage rate and *p* the price) and iii) labour market clearing at full employment, the standard results concerning firm output, price and the number of variants are obtained:

$$x = \frac{\theta\alpha}{(1-\theta)\beta} \tag{4a}$$

$$p = \frac{\beta w}{\theta} \tag{4b}$$

$$n = \frac{L(1-\theta)}{2\alpha} \tag{4c}$$

Equations (4a-c) also characterise the conditions for the import industry (i.e. the foreign export industry) and in fact the non-traded industry under free trade.

The trade volume in the free trade case is given by $\chi = nx = \frac{L\theta}{2\beta}$; accordingly a restriction on imports can be defined as:

$$\bar{\chi} = \gamma\chi = \frac{\gamma L\theta}{2\beta} \qquad 0 \le \gamma < 1 \tag{5}$$

The parameter γ in (5) measures how strict the import restriction is. Throughout the paper it is assumed that the same restriction is imposed by both countries, thus we need not evoke the usual balanced trade condition. Neither the rational nor the emergence of the import restriction is dealt with by the present model; it only addresses the consequences of implementing such a restriction with two different tariff tools.

II. Analysis of the Two Tariff Regimes

It is now possible to examine equilibrium under bilateral tariff imposition, given the import restriction aim. We need to distinguish the impact on the traded sector and the non-traded sector. Throughout the paper it is assumed that all tariff revenue is completely redistributed to consumers.

A. *Impact on the Traded Sector*

An ad valorem tariff, *t*, affects firms like a tax. Only the fraction $(1 - t)$ of total sales revenue enters the exporting firms' profit function. Hence, the revenue part of the profit function changes, resulting in the new profit function:

$$\pi^t = (1 - t)\, p^t x^t - (\alpha + \beta x^t)\, w$$

Free entry and exit ensure that firms compete industry profits to zero. The equilibrium under an ad valorem tariff that generates the import volume $\bar{x}$ is characterised by:

$$x^t = \frac{\theta\alpha}{(1-\theta)\beta} \tag{6a}$$

$$p^t = \frac{\beta w}{(1-t)\theta} \tag{6b}$$

$$n^t = \frac{\gamma L(1-\theta)}{2\alpha} \tag{6c}$$

$$t = (1-\gamma)\frac{2}{2-\gamma} \tag{6d}$$

Thus, compared to free trade, an ad valorem tariff results in a reduced number of variants (firms), the same amount of output per firm and higher prices. In fact, foreign producers have handed the entire import tax over to the consumers. The tariff level (t) is derived from the condition – stemming from the maximisation of (1) – that total consumer expenditure on the import industry must equal consumer expenditure on any industry, i.e. $p^t\overline{\chi} = \frac{wL+R^t}{2}$, where $R^t = t\,p^t\overline{\chi}$ is the tariff revenue which is redistributed to consumers.

Notice that there are two effects at work when imposing a tariff. An increase in the tariff level decreases imports because of the higher prices, but at the same time, it increases imports because of the increased consumer spending due to the redistributed tariff revenue. The former effect, however, dominates the latter due to the spillover into the non-traded sector. Also, due to the import restriction, there is

less labour employed in the traded sector compared to the free trade equilibrium. This labour will enter into the unrestricted non-traded sector. The amount of reallocated labour is given by:

$$\Delta L^{I} = (1-\gamma)\frac{L}{2}$$

Next we examine the same import restriction (5) executed with a specific tariff. Let T denote the specific tariff, then the profit function of a firm becomes:

$$\pi^{\tau} = (p^{\tau} - \mathrm{T})x^{\tau} - (\alpha + \beta x^{\tau})w \,.$$

Defining the specific tariff in real terms by $\tau = \frac{\mathrm{T}}{w}$ the profit function can be rewritten as $\pi^{\tau} = p^{\tau}x^{\tau} - (\alpha + (\beta + \tau)x^{\tau})w$. Hence, when a specific tariff is imposed, it enters the exporting firms profit function like an increase in marginal cost. Again free entry and exit ensure that firms compete industry profits down to zero. The market equilibrium turns out to be:

$$x^{\tau} = \frac{\theta\alpha}{(1-\theta)(\beta+\tau)} \qquad (7a)$$

$$p^{\tau} = \frac{(\beta+\tau)w}{\theta} \qquad (7b)$$

$$n^{\tau} = \frac{\gamma L(1-\theta)}{2\alpha}\frac{(\beta+\tau)}{\beta} \tag{7c}$$

$$\tau = \frac{\beta(1-\gamma)}{\gamma}\frac{2}{2-\theta} \tag{7d}$$

Again, the tariff rate τ is calculated from the condition that total consumer expenditure on the import industry must equal consumer expenditure on any industry, i.e. $p^{\tau}\overline{\chi} = \frac{wL+R^{\tau}}{2}$, where $R^{\tau} = \tau w\overline{\chi}$ is the tariff revenue which is redistributed to consumers. Plugging in the value for τ we get:

$$x^{\tau} = \frac{\gamma(2-\theta)}{2-\theta\gamma}\frac{\theta\alpha}{(1-\theta)\beta} < x \tag{8a}$$

$$n^{\tau} = \frac{L(1-\theta)}{2\alpha}\frac{2-\theta\gamma}{2-\theta} > n \tag{8b}$$

Thus, output per firm is less than under free trade and under the ad valorem tariff. However, the number of firms in the traded sector has increased, even above the equilibrium number of firms under free trade. What motivates this increase? As can be seen from (7b) the tariff cost is shifted onto prices with the factor $\frac{1}{\theta}$. The intuition is that firms – since they act like monopolists – set their price as a mark-up over marginal costs. As shown above the specific tariff is in fact a marginal cost increase.

Thus, in a sense firms overcompensate the specific tariff, increasing profitability (their operating surplus) and accordingly creating entry into the industry. Also, since tariff revenues are redistributed, consumers' spending power is maintained, thus eventually pushing the number of firms beyond the number of firms under free trade. However, as will be shown in section III, this increase in the number of firms is *not* a free lunch.

The number of workers employed in the traded sector under a specific tariff, compared to the free trade case, is reduced. In particular, we have labour that enters into the unrestricted non-traded sector

$$\Delta L^{\tau} = \theta(1-\gamma)\frac{L}{2}\frac{1}{2-\theta}.$$

Under a specific tariff fewer workers will transfer into the non-traded industry compared to the ad valorem case. Thus, under a specific tariff there remains more labour in the traded sector. This higher employment (even though the total production volume of the sector is still fixed at $\bar{\chi}$) is caused by the increased expenditure on fixed costs α (due to more variants).

What drives the difference between the specific and the ad valorem tariff is the interaction of industry and firm profitability. As the ad valorem tariff is simply passed

along to consumers (via the price increase), the individual firms profitability (operating surplus) remains unchanged, hence their maximisation results in the same firm-level output volume as before. However, since prices have risen, industry profitability is hurt and there is less room for firm entry before industry profits turn zero. In the specific tariff case, firms' profitability is in fact increased, i.e. an increase in the operating surplus. Since a constant fixed cost αw has to be exactly offset for a firm to enter the industry, then with a larger operating surplus smaller output runs suffice to achieve breakeven. Hence, industry profitability is also larger than in the ad valorem case, allowing more firms to exist before industry profits turn zero. So as a revenue extractor, the ad valorem tariff is more efficient than the specific tariff.[2] But, due to this efficiency, industry profits and firms' operating surplus are lower than under a specific tariff, resulting in fewer firms. To verify this point consider industry profitability Π^s, which we represented by the profits that a single firm would achieve under the above derived prices, tariffs and quantity $\bar{\chi}$, and operating surplus σ^s, given by the difference between marginal revenue and marginal cost. In particular it turns out that $\Pi^t = \frac{(1-\theta)w\gamma L}{2} - \alpha w < \frac{2-\theta\gamma}{2\gamma-\theta\gamma}\frac{(1-\theta)w\gamma L}{2} - \alpha w = \Pi^\tau$ and $\sigma^t = \frac{(1-\theta)\beta w}{\theta} < \frac{(1-\theta)(\beta+\tau)w}{\theta} = \sigma^\tau$.

2. This is in line with findings that Lookwood and Wong (2000) and Kowalczyk and Skeath (1994) have made in very different settings.

B. *Impact on the Non-traded Sector*

Turning to the non-traded sector, we have to account for the spillovers from the labour market. Labour from the constrained export industry will move into the non-traded industry. Intuitively, when more workers are employed in the non-traded sector, the result will be a larger number of variants available. Also, due to the redistribution of tariff revenue, total spending power has increased. As we solve the model in general equilibrium, this increase in spending power ensures that the extra variants produced in the non-traded sector will actually be demanded.

Formally, the new labour supply for the non-traded industries, $\hat{L}^s$, can be written as:

$$\hat{L}^s = \frac{L}{2} + \left(\Delta L^s\right) \qquad s = \tau, t \tag{9}$$

The increase in available labour does not influence the equilibrium output and price of the individual firm in the non-traded industry and hence individual firm output and price is equal to $\hat{x}$ and $\hat{p}$ given implicitly in (4a) and (4b). Thus, the reallocation of labour is identical to an increase in market size, i.e. it influences the equilibrium number of variants, and hence also total industry output. The equilibrium number of variants, $\hat{n}^s$, is found by using (9), the labour market clearing condition ($\hat{L}^s = (\alpha + \beta\hat{x})\hat{n}^s;\ s = \tau, t$), and the values for ΔL^s from above:

$$\hat{n}^t = (2-\gamma)n \tag{10}$$

$$\hat{n}^\tau = \frac{2-\theta\gamma}{2-\theta}n \tag{11}$$

From (10) and (11) it immediately follows that $\hat{n}^t, \hat{n}^\tau > \hat{n} = n$ and $\hat{n}^\tau < \hat{n}^t$. The last inequality is caused by the fact that the amount of reallocated labour to the non-traded industry is lowest under a specific tariff.

III. Welfare Results

Given the two forms of tariff policy, it is straightforward to calculate the welfare of consumers. Since we assume full redistribution of tariff revenues, all spending power is with consumers; hence, all that is produced will actually be consumed. Thus, the relevant values for output and the number of firms can be plugged into the utility function. Inserting the set of equations (4a-c) into (1) gives utility *U* under free trade:

$$U = 2\ln\left(\tfrac{L}{2}(1-\theta)^{1-\theta}\alpha^{\theta-1}\theta^{\theta}\beta^{-\theta}\right) \tag{12}$$

Utility depends positively on the size of the economy and falls for an increase of the fixed cost α and variable cost β.

Using (1), (4a), (6a-c) and (10), utility under an ad valorem tariff on basis of the import restriction is given by:

$$U^{t} = \ln\left((2-\gamma)\Omega\right) + \ln\left(\gamma\Omega\right) \qquad (13)$$

where $\Omega = \frac{L}{2}(1-\theta)^{1-\theta}\alpha^{\theta-1}\theta^{\theta}\beta^{-\theta}$. Further, using (1), (4a), (8a-b) and (11) we get utility under a specific tariff, given the same import restriction, as:

$$U^{\tau} = \ln\left(\frac{2-\theta\gamma}{2-\theta}\Omega\right) + \ln\left(\gamma^{\theta}\left(\frac{2-\theta\gamma}{2-\theta}\right)^{1-\theta}\Omega\right) \qquad (14)$$

The first term of (13) and (14) states the utility stemming from the consumption of non-traded products; these terms are in fact larger than the respective terms stemming from consumption of non-traded products under free trade. The second term in (13) and (14) measures utility from the consumption of imports, here the import restriction reduces utility compared to the free trade situation. From (12), (13) and (14) it is possible to deduce the following welfare ranking:

Proposition. *Given a certain import restriction, consumers strictly prefer a specific tariff to an ad valorem tariff. Yet free trade is preferred to any level of the import restriction. In particular,*

$$U > U^{\tau} > U^{t} \qquad (15)$$

Proof. *See appendix.*

Total consumer utility is larger under a specific tariff than under an ad valorem tariff (given the same trade restriction), yet, both tariff regimes are dominated by free trade. Since we have diminishing marginal utility, dragging the utility contribution of the traded sector below the utility maximising level cannot be compensated for by increasing the utility contribution of the non-traded industry beyond the utility maximising level (given the available fixed resources). Further, the superiority of the specific tariff compared to the ad valorem tariff stems from the fact that under a specific tariff more profits remain in the traded sector, allowing more firms to exist. Since consumers love variety, this policy generates the higher welfare, even though the total import restriction is the same.

IV. Conclusion

This paper argues that, in a world of monopolistic competition, ad valorem versus specific tariffs feature a non-trivial difference in terms of welfare. What drives the results of this paper is the number of variants in the export/import industry, which in turn is determined by the profits remaining in the industry after the implementation of a tariff. The model of the paper builds on Krugman (1980). It is found that enforcing a restriction on total imports via a specific tariff results in higher prices,

less output per firm, and more firms than under free trade. On the other hand, an import equivalent ad valorem tariff results in fewer firms, more output per firm and higher prices than under a specific tariff.

In terms of the impact on consumer utility, it is established that – given the same level of import protection – utility under a specific tariff is higher than under an ad valorem tariff, though less than under free trade. The results of this paper have clear implications in terms of tariff policies. Instead of advocating ad valorem tariffs across the board, tariff tools should be designed more carefully taking account of industry characteristics, i.e. market structure. In particular, with respect to the recent tariffication wave promoted by GATT and later WTO (see Nguyen et al. (1993)), an undue reliance on ad valorem tariffs might have a potential opportunity cost in terms of a lost number of variants, resulting in lower global consumer utility.

Appendix: Proof of the Proposition

1. Proof that $U^t < U$.

From (12) and (13) it follows that $U^t = U + \ln(2-\gamma) + \ln\gamma$. Hence, one has to show that:

$$K^t = \ln(2-\gamma) + \ln\gamma < 0 \quad . \tag{A1}$$

From (A1) we have $\lim_{\gamma\to 0} K^t = -\infty$ and $\lim_{\gamma\to 1} K^t = 0$. Since $\frac{\partial K^t}{\partial\gamma} = \frac{2-2\gamma}{(2-\gamma)\gamma} > 0$, K^t is monotone increasing in γ for all $0<\gamma<1$, (A1) is fulfilled. ■

2. Proof that $U^\tau < U$.

From (12) and (14) it follows that $U^\tau = U + (2-\theta)\ln\left(\frac{2-\theta\gamma}{2-\theta}\right) + \theta\ln\gamma$. Hence, one has to show that:

$$K^\tau = (2-\theta)\ln\left(\frac{2-\theta\gamma}{2-\theta}\right) + \theta\ln\gamma < 0 \tag{A2}$$

From (A2) we have $\lim_{\gamma\to 0} K^\tau = -\infty$ and $\lim_{\gamma\to 1} K^\tau = 0$. Since $\frac{\partial K^\tau}{\partial\gamma} = \theta\left(\frac{2(1-\gamma)}{2-\theta\gamma}\right) > 0$, K^τ is monotone increasing in γ for all $0<\gamma<1$, (A2) is fulfilled. ■

3. Proof that $U^\tau > U^t$.

From (13) and (14) it follows that:

$$\begin{aligned} & U^\tau > U^t \\ & \Updownarrow \\ & (2-\theta)\ln\left(\frac{2-\theta\gamma}{2-\theta}\right) + \theta\ln\gamma > \ln(2-\gamma) + \ln\gamma \end{aligned} \tag{A3}$$

Define the function:

$$F(z) = (2-z)\ln\left(\frac{2-z\gamma}{2-z}\right) + z\ln\gamma \qquad \text{(A4)}$$

If $F(z)$ is monotone decreasing in z, then $b>a$ implies $F(a) > F(b)$, and hence (A3) is fulfilled as $1>\theta$.

From (A4) it follows that

$$\frac{\partial F}{\partial z} = \ln\left(\frac{\gamma(2-z)}{2-z\gamma}\right) + \frac{2(1-\gamma)}{2-z\gamma} \qquad \text{(A5)}$$

One has to show that for a given z (A5) is negative for all γ, $0<\gamma<1$. It follows from (A5) that

$$\lim_{\gamma\to 0}\frac{\partial F}{\partial z} = -\infty \quad and \quad \lim_{\gamma\to 1}\frac{\partial F}{\partial z} = 0$$

and since

$$\frac{\partial\left(\frac{\partial F}{\partial z}\right)}{\partial\gamma} = \frac{4(1-\gamma)}{\gamma(2-z\gamma)^2} > 0$$

(A5) is monotone increasing in γ for all z and thus negative in the relevant parameter interval. ■

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