

## Protection of a Domestic Finishing Industry\*

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It is well known that the quality content of imports will be distorted by a quota in a Barzel-type substitution, towards untaxed attributes of some good (quality) and away from taxed attributes (units). This paper demonstrates that a tariff will have a similar distorting effect when the location of quality finishing is variable. A tariff which causes foreign exporters to seek to limit the taxable value of their exports may lead to high cost finishers in the importing country adding finishing value to the imports.

### I. Introduction

The long list of studies exploring the lack of equivalence between tariffs and quotas has been extended by Rodriguez (1979). He found that import quality would tend to rise, beyond some optimal level, when imports are quantitatively restricted. On the other hand, an ad valorem tariff on imports would not distort the level of quality inherent in goods.<sup>1</sup> These findings are consistent with Barzel's demonstration (1976) that taxation will induce substitution within commodities from taxed attributes to untaxed attributes in that an ad valorem tariff taxes all imported value-increasing attributes while quantitative restriction allows substitution toward more quality. However, Rodriguez concludes that a quota is welfare superior to an equally restrictive tariff, for inspite of distorting unit production costs above their minimum level, a quota allows for the importation of more consumed services.

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<sup>1</sup> In a similar study, Falvey (1979) has shown that quotas will shift the composition of imports toward more expensive items in a product category, where expense serves as a proxy for quality. Santoni and VanCott (1980) discuss tariffs, quotas, and quality under different industrial organizations.

There is an additional Barzel-type substitution that needs to be examined. Firms, in an attempt to reduce the value of a product taxed by an ad valorem tariff, may choose to have value adding services provided untaxed in the importing country. Goods which are imported before some final assembly or preparation stage is completed may offer examples of this type of tariff avoidance.<sup>2</sup>

To show the effects of such a substitution in production location, this paper examines a model of a domestic, services-adding industry which is protected not so much for welfare considerations but for rent creation. It is assumed that trade restrictions cannot be set on the services content of an import, but only on its physical units or value.

Initially, Rodriguez's model of quality is discussed. The second section introduces a domestic service industry which can compete in adding services to improve quality. This domestic service industry will be assumed more costly than the foreign industry, and thus in need of protection in order to be viable. The third section compares the competitive, minimum-average-cost levels of domestic and foreign services as a variable rate, ad valorem tariff is increased.

The effects of a tariff of this type and of quantitative restriction over the number of imported goods will be examined. It will be shown that although a quota will still tend to distort the optimal amount of quality services added per unit, it will not change the point of application. A tariff, though, may not only suggest a non-optimal amount of services per unit, but also may suggest a change in the point of service application. In general, beyond some level, tariffs will be shown to reduce the level of quality services imported, replacing them with domestically added services.

## II. The Rodriguez Quality Model

The quality model adopted by Rodriguez and extended in this paper makes several simplifying specifications. Quality is of one dimension and can be increased by adding services to the quantitatively measured units of a good, for instance, aging bottles of wine. Further, demand is for quality services per unit of time, measured as quality per unit times units. This

<sup>2</sup> This trade pattern frequently arises when the tariff rates on finished goods exceed those on unfinished goods as discussed in the effective protection literature. The point of this discussion is that even when tariff rates on finished and unfinished goods are the same, firms will add as much value as they can in the untaxed location, tempered, of course, by the additional cost incurred.

implies that consumers can substitute between many low quality units and few high quality units.<sup>3</sup> Finally, through cost minimization, it is assumed that all goods are produced with the same level of quality applied per unit.<sup>4</sup>

Appropriate examples of quality services can be envisioned as upgrading, stying, packaging, finishing or quality control testing. Some good, light bulbs for instance, might be produced with a certain failure rate. Consumers, however, desire working bulbs and some degree of quality control testing may be in order to reduce the failure rate and provide more of the lighting services demanded. Thus, a certain amount of testing is applied to each batch of bulbs to improve quality by rejecting bad bulbs.

Rodriguez's results stem from a perfectly elastic supply curve of services which becomes upward sloping, rather than perfectly inelastic, in the presence of a quota. Figure 1 shows a demand for quality-service units,  $P(S)$ , where  $P$  is the price per unit of quality services,  $S$ . In perfect competition, firms will add to physical units of some good, produced at constant cost, a cost-minimizing amount of services per unit,  $\bar{x}$ . The total cost of adding these services is  $f(\bar{x})$ . A U-shaped average cost is assumed, and for  $\bar{x}$ ,  $f'(\bar{x}) = f(\bar{x})/\bar{x}$  which is the free-trade supply curve of services.

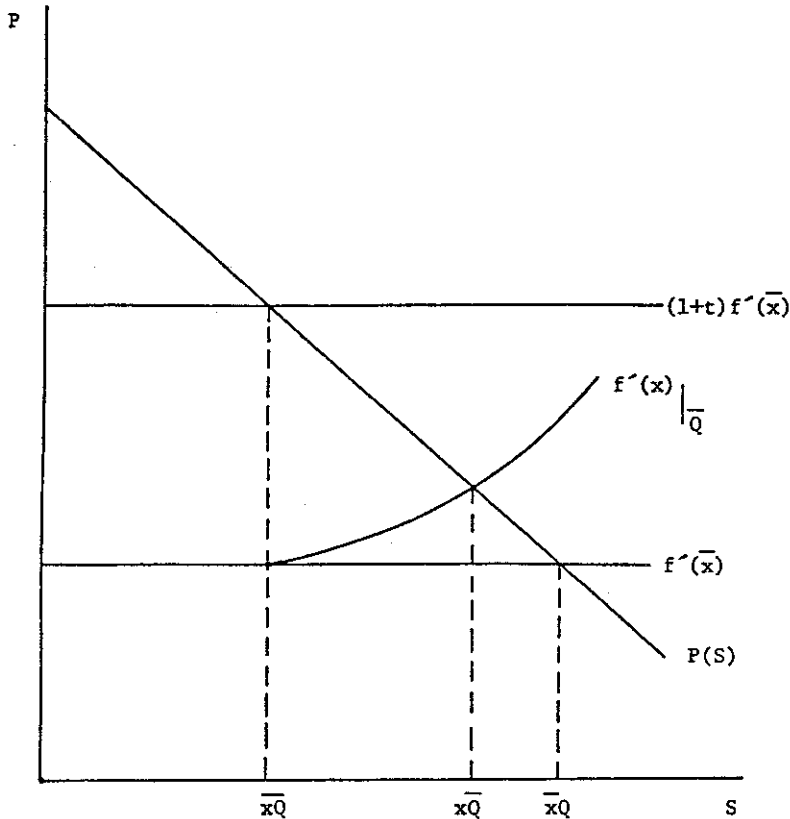
An ad valorem tariff rate of  $t$  will push this import services supply curve as shown, to  $(1+t)f'(\bar{x})$ . Given domestic demand for services,  $\bar{Q} = S/\bar{x}$  physical units of the basic good will be imported. However, a quota over units of the basic good of  $\bar{Q}$  will not result in the same solution. Rather each unit of  $\bar{Q}$  will be produced with extra amounts of services per unit as indicated by  $f'(x)|_{\bar{Q}}$ , the quota restricted supply curve where  $x$  will rise above the cost minimizing  $\bar{x}$ , while  $\bar{Q}$  is fixed.

The Barzel-type substitution toward supra-optimal quality per unit will allow more total service imports under a quota than under a tariff. Rodriguez demonstrates that the welfare loss associated with the quota is less than that associated with the tariff. His proof shows that the consumer gain afforded by the lower price per unit of service under the quota outweighs the loss from higher production costs under the quota. However, both instruments are dominated by the welfare advantages of free trade, so some explanation must be given as to why they would be

<sup>3</sup> Kaempfer and Brastow (1985) explore the significance of allowing quality/quantity substitution with respect to the Alchian-Allen or "shipping the good apples out" proposition.

<sup>4</sup> Leffler (1982) generalizes from this type of production simplification and examines multiple efficient solutions for quantity/quality trade-offs.

Figure 1



considered at all. The presumption of this paper is that a commercial policy has been chosen simply to establish a domestic finishing industry, perhaps to create rents for some group of interest.

### III. The Domestic Services-Added Industry

Consider a group of domestic firms, unable to produce the actual physical units of some good, but able to apply the desired quality services to imported units. Assume, however, that the domestic services-added industry can only add their services at a greater cost than foreign firms. Thus, in order to be viable, these domestic firms will need to be protected from imports. If this protection has been decided upon, the appropriate

question under the conditions of Rodriguez's model becomes: which "protective" device is likely to have the greatest protective effect.

In general, final goods sold domestically will embody certain imported services and contain other services added domestically. In order to simplify, however, ignore imported services initially. This allows consideration of domestic producers who import  $Q$  units of some unfinished good and add  $x$  services to each of these units.

Domestic total costs are

$$(1) \quad C_b = h(x) Q$$

for  $S = xQ$  service units, where  $h(x)$  is the domestic total cost of services added for each of the  $Q$  units, including the cost of each unfinished imported unit, and  $h'(x) > 0$ . Competition among domestic firms insures the average cost per unit of service,

$$(2) \quad \frac{C_b}{S} = \frac{h(x) \cdot Q}{x \cdot Q}$$

will be minimized. The domestic services supply curve will be perfectly elastic at this minimum, defined as  $\bar{x}$  where  $h'(\bar{x}) = \frac{h(\bar{x})}{\bar{x}}$ . Compare this domestic supply to Rodriguez's world free trade supply and note that  $\bar{x}$  does not necessarily equal  $\bar{x}$ ,

$$(3) \quad h'(\bar{x}) = \frac{h(\bar{x})}{\bar{x}} > \frac{f(\bar{x})}{\bar{x}} \geq \frac{f(\bar{x})}{\bar{x}} = f'(\bar{x}).$$

#### IV. Protection of the Domestic Services Industry

Equation (3) implies that in the presence of free trade, services would not be produced domestically since imported services would always under-price domestic services. Similarly, quantitative restriction over physical units would be an ineffective attempt at protection. A quota would restrict  $Q$  regardless of the number of services added. Thus domestic producers of services-added would still be at a cost disadvantage in adding their expensive services to the restricted imports. An ad valorem tariff, however, could protect domestic production. Due to the assumption of perfectly elastic supply curves, though, the tariff will either have no protective effect, or be prohibitive. The rest of this section will derive this

prohibitive tariff rate.

Figure 2 shows the supply curve for importing services in the presence of an ad valorem tariff of  $t$  percent. The domestic total cost of producing services and average cost per unit of service will also change with protection to

$$(4) \quad C_p = h(x) Q + t f(0) Q,$$

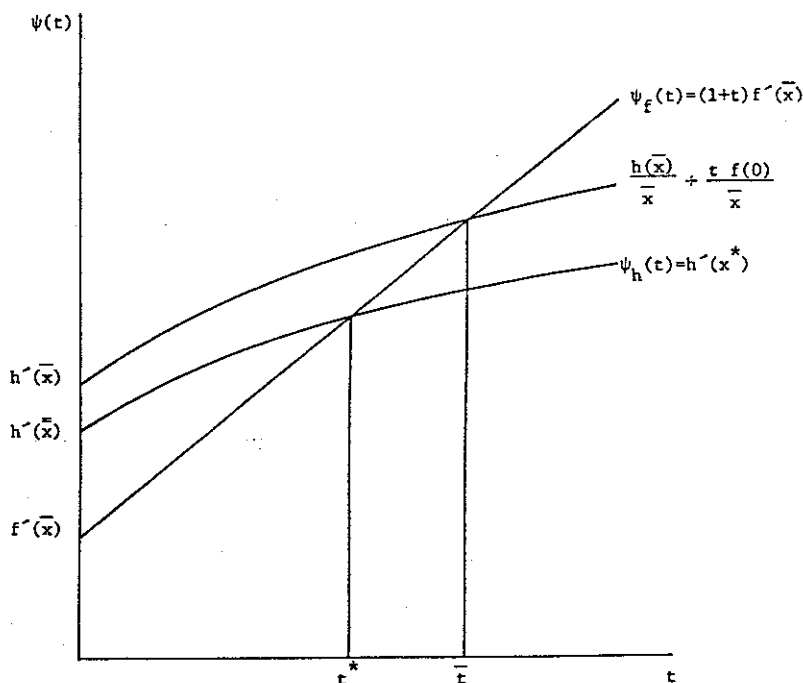
and

$$(5) \quad \frac{C_p}{S} = \frac{C_p/Q}{x} = \frac{h(x)}{x} + \frac{t f(0)}{x}$$

where  $f(0)$  is the average cost of importing a unit of  $Q$  with no services added. The value of the raw imported physical units of  $Q$  are taxed at the rate  $t$ , while domestic services added are not.

Ignoring, for the moment, that foreign services could be imported, consider this process by which goods are imported and services are added

Figure 2



to them domestically. Taxing the imported good will tend to shift the way in which total services are provided to consumers as in a Barzel-type substitution. Fewer taxed units of the good will be imported, but more untaxed services will be added to each unit. The rate at which this occurs, as the tariff rises, can be distilled from the average and marginal costs of adding services per unit. Differentiating (4) with respect to  $x$  gives the marginal cost of adding services per unit of  $Q$ ,  $h'(x)$ , which is invariant to the tariff. Increasing the tariff rate will tend to "push up" average costs per unit of service, nevertheless, the marginal cost per unit of services remains  $h'(x)$ .

Competition will always cause domestic services-added firms to produce at the minimum average cost of a unit of service. For any tariff rate, this minimum is described by the intersection of  $C_p/S$ , the average cost per unit of service, and  $h'(x)$ . This intersection is the domestic supply of services

$$(6) \quad \Psi_b(t) = \frac{h(x^*)}{x^*} + \frac{t f(0)}{x^*} = h'(x^*)$$

where  $x^*$ , the minimum-cost, services added per physical unit is an implicit function of  $t$ .<sup>5</sup> Given a tariff, domestic supply will be perfectly elastic, but as the tariff rises, the domestic supply curve will shift up.

Substituting the implicit function,  $x^* = x^*(t)$ , and differentiating (6) yields

$$(7) \quad \frac{d\Psi_b(t)}{dt} = h''(x^*) \frac{dx^*}{dt} = \frac{f(0)}{x^*}$$

as  $\frac{dx^*}{dt} = \frac{f(0)}{x^* h''(x^*)}$ . Since (7) must be positive, minimum average cost or the domestic supply of services must increase as the tariff rate increases. However, the fact that

$$(8) \quad \frac{d^2\Psi_b(t)}{dt^2} = - \frac{f(0) \frac{dx^*}{dt}}{(x^*)^2} < 0$$

<sup>5</sup> Minimizing average cost as  $t$  varies describes a new function of  $x^*$  and  $t$ ,  $J(x^*, t) = x^* h'(x^*) - h(x^*) - t f(0) = 0$ . Assuming  $h''(x^*) > 0$  for  $x^* > \bar{x}$ ,  $\partial J / \partial x^* = x^* h''(x^*) > 0$  for  $t \geq 0$ . This suggests the existence of an implicit function  $x^* = x^*(t)$ . Further, by the implicit function theorem,  $\frac{dx^*}{dt} = - \frac{\partial J / \partial t}{\partial J / \partial x^*} = \frac{f(0)}{x^* h''(x^*)} > 0$ .

implies that it increase at a falling rate.

A changing import tariff will also change the minimum average cost of importing services from abroad. Rodriguez identifies  $\bar{x}$  as the invariant average cost minimizing level of services added per unit of  $Q$  when those services are imported. Using this constant services per unit solution we get minimum average foreign cost of a unit of service as a function of the tariff rate:

$$(9) \quad \Psi_f(t) = (1+t) \frac{f(\bar{x})}{\bar{x}} = (1+t) f'(\bar{x})$$

Evaluating (6) and (9) when  $t=0$  gives the domestic and world minimum average costs of services and thus supply curves when there is no tax. As already shown, the domestic supply curve must exceed the world supply curve at this zero tax rate. Evaluating (5) at  $\bar{x}$  and setting it equal to (9) gives

$$(10) \quad \frac{h(\bar{x})}{\bar{x}} + \frac{t f(0)}{\bar{x}} = \frac{f(\bar{x})}{\bar{x}} + \frac{t f(\bar{x})}{\bar{x}}$$

Solving this for  $t = \bar{t}$  yields

$$(11) \quad \bar{t} = \frac{h(\bar{x}) - f(\bar{x})}{f(\bar{x}) - f(0)}$$

the tax rate which equates the domestic cost of adding  $\bar{x}$  amount of services to each unit of  $Q$  with the cost of importing these services. By assumption  $h(\bar{x}) > f(\bar{x})$  and since  $f'(x) > 0$ ,  $f(\bar{x}) > f(0)$ , thus  $\bar{t} > 0$ . However, the average cost of adding services domestically when  $t = \bar{t}$  would be minimized at  $x^*$ , not necessarily equal to  $\bar{x}$ . That is, at  $\bar{t}$ , services would not be imported since they could be provided more cheaply at  $x^* = x^*(\bar{t})$  per unit of  $Q$ , domestically.

Thus there must exist some level of import taxation,  $t^*$  which equates (9) and (6):

$$(12) \quad (1+t^*) f'(x) = h'(x^*(t^*)).$$

This  $t^*$ , which is positive, though less than  $\bar{t}$ , is the minimum import tariff which must be levied to make domestic services cheaper than foreign



services. Under the cost assumptions of this model, any domestic import tariff on  $S$  of less than  $t^*$  will not only leave the optimal level of services added per unit of  $Q$  unchanged at  $\bar{x}$ , but it will also maintain foreign production of the services. On the other hand, a tariff of greater than  $t^*$  will be prohibitive in that all services will be added domestically to the imported  $Q$ . Figure 2 shows  $\Psi_f(t)$  and  $\Psi_b(t)$  as well as solutions for  $\bar{t}$  and  $t^*$ . Also shown is  $(h(\bar{x}) + t f(0))/\bar{x}$ , the left-hand side of (10).

## V. Conclusions

Rodriguez gears his protection to a desired level of imports of either physical goods or total services. If instead the desire is to protect a domestic finishing industry, we reach quite different results. As has been demonstrated, a quota will never protect a more costly domestic industry while a tariff may. The effect of a tariff depends upon the cost structure of the domestic industry and the rate of nominal protection.<sup>6</sup> Up to a certain tariff level, domestic services remain more expensive than the same imported services for all amounts of services desired. Beyond this tariff level, however, the domestic industry replaces the foreign industry as the cheapest source of services to domestic consumers. Thus the protection offered to the domestic industry is of an all or nothing variety. In general terms, the lack of equivalence between tariffs and quotas with respect to their effectiveness in protecting a domestic finishing industry does not have to be measured in relative welfare costs, but rather in the fact that one instrument, an ad valorem tariff can protect at certain rates, while the other, a quantitative restriction as defined, will never be a protective device. Further, as Falvey (1979) shows, specific tariffs will have the same effect as quotas and a restriction on the total value of goods entering will have the same effect as an ad valorem tariff.

This should not, however, be construed as a justification of protection on non-welfare-maximizing grounds. Rather it is a reemphasis of Rodriguez's basic result: given the specifications of this model, a quota is welfare superior to an equally restrictive tariff. Quotas are superior not so much for the fact that they engender a Barzel-type substitution toward supra-optimal quality per unit that allows additional imports of the consumer desired services, but because this quality is added by the low cost foreign firms. Under a sufficiently high tariff, high cost domestic firms

<sup>6</sup> Note that since the nominal rates on the input, units of the good, and the final product, the total services, are the same, the effective rate equals the nominal rate for the services added industry.

will add quality services. This substitution in the site of production also increases the level of services available to consumers, but at an even greater welfare cost.

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