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# INFANT-INDUSTRY PROTECTION RECONSIDERED: THE CASE OF INFORMATIONAL BARRIERS TO ENTRY

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# Infant-Industry Protection Reconsidered: The Case of Informational Barriers to Entry

ABSTRACT

In industries with imperfect consumer information, the lack of a reputation puts latecomers at a competitive disadvantage vis-a-vis established firms. We consider whether the existence of such informational barriers to entry provides a valid reason for temporarily protecting infant producers of experience goods and services. Our model incorporates both moral hazard in an individual firm's choice of quality and adverse selection among potential entrants into the industry. We find that infant-industry protection often exacerbates the welfare loss associated with these market imperfections.

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# I. INTRODUCTION

The skepticism and occasional critiques of certain international economists notwithstanding, the infant-industry argument remains a well-respected legitimization of temporary protection for emerging sectors in developing countries, and even elsewhere. The argument presumes the existence of barriers to entry, which inhibit or prevent the growth of a new local industry in circumstances where the home country would seem to enjoy long-run comparative cost advantage in performing a particular activity. If the failure of the industry to come into existence or to expand to a degree consistent with underlying cost conditions can be traced to an external effect among producers, and if the prior emergence of a competing foreign sector contributes to the inability of the local industry to establish itself, then it would seem that temporary, entry-promoting protection is justified on social welfare grounds.

Traditionally, proponents of the infant-industry argument have pointed to dynamic scale economies stemming from learning-curve effects and from the need for development of a base of applicable skills among the sectoral labor force as the relevant barriers to entry into industrial activities.[1] More recently, industrial organization theorists have noted (making reference, however, to the seminal work of Bain (1956)) that imperfect information can serve as a barrier to entry when consumers cannot readily observe all of the attributes of a good prior to purchase, and when they must, therefore, rely on reputation as an indication of product quality. Schmalensee (1982), Farrell (1986), and Bagwell (1985) have developed models in which early entrants enjoy a competitive advantage relative to latecomers merely as a consequence of their having entered sooner. In these models, the industry mavericks already have developed their reputations among

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[1] See, for example, Clemhout and Wan (1970) and the critical discussion in Corden (1974, chapter 9).

consumers when later potential competitors contemplate entry. "Me-too" brands offering similar quality products at similar or even lower costs to those of established brands often are not able to penetrate the market, in cases where the initial entrants, facing no corresponding competition, were able to do so.

The argument that informational barriers might preclude efficient entry would seem to have relevance for certain progressive industries in the modern, manufacturing sector. Many innovative products are technically sophisticated, so that some consumers may be ill-equipped to assess their attributes. Some less developed countries may have comparative advantage in producing various of these goods based on relative factor-cost comparisons. But the LDC producers may find it difficult to enter the (local or international) market in competition with the initial, foreign developers of the products, whose names and reputations are likely to be well-known to consumers by the time that domestic entry is technologically feasible.

The argument may have even more force when applied to international trade in services. Recently, there has been much discussion of appropriate trade policy for services, and many commentators have noted the seeming reluctance of the less developed countries to enter into negotiations aimed at liberalizing trade in this sector.[2] An infant-industry argument based on learning-by-doing and decreasing costs over time may not apply to many of the service industries (see Hindlay and Smith (1984)). But consider a characteristic shared by most services, namely that production is customized to the requirements of each particular consumer. Once a service has been produced for a specific customer, the provider is unlikely to be able to remarket that same service to an alternative buyer in the event that the initial one is dissatisfied. This means

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[2]For a discussion of the LDC position on liberalization of services trade, see Bhagwati (1986).

that the consumer and the supplier must enter into a purchase contract before the service actually has been performed, and therefore at a time when the buyer will not be in a position to inspect the quality of the final output. It follows that reputations will be especially important in the markets for services. Absent protection, potential local entrants into service industries may find it difficult or impossible to compete with well-established international concerns.

The above discussion raises the important question of whether the existence of informational barriers to entry provides a valid reason for temporarily protecting infant producers of experience goods and services in countries that are followers rather than leaders in innovative industries.[3] In what follows we argue, perhaps surprisingly in light of the evident market failure described by Schmalensee, Farrell, and Bagwell, that the answer is "no". We base our argument on a fully specified model of endogenous entry, quality choice, and information transmission. Our model combines elements of those of Farrell (1986) and Bagwell (1985), incorporating both moral hazard in a firm's choice of quality and adverse selection among potential entrants into the industry. We pay special attention to the process of expectations formation, in keeping with the recent literature on the role of reputations in markets with incomplete consumer information.

Our conclusions contrast sharply with those from a similarly focused study by Mayer (1984). Mayer argued that export subsidization is warranted when actual consumption experiences are required for (foreign) consumers to learn about (domestic) products' qualities. The difference in findings can be attributed to the fact that Mayer posited an ad hoc "product familiarization" process whereby demand for home goods varies positively with cumulative past consumption; whereas we incorporate expectations formation and consumer learning about the brands that

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[3]Nelson (1970) introduced the term "experience goods" to denote products whose qualities can be fully judged only after they have been consumed.

they have experienced explicitly into our analysis. Our message is reminiscent of that of Baldwin (1969), who took a closer look at the microfoundations of dynamic scale economies and found that infant-industry protection often could not correct the market distortions that the proponents of such policy described.

The paper is organized as follows. In Section II we specify a two-period model of an infant domestic industry facing competition from an established foreign sector. In this section, all potential domestic firms face a similar capacity constraint, and it is not profitable for the more efficient among them to signal (via price) their higher quality. We study the efficacy of both temporary (first-period) and permanent protection under alternative assumptions about consumers' expectations. In Section III, we allow for the possibility of signalling via first-period output choice. We reconsider the welfare effects of a temporary or permanent import tariff in the context of a separating equilibrium. Our findings are summarized in a brief, concluding section.

## II. INFANT-INDUSTRY PROTECTION WHEN SIGNALLING VIA OUTPUTS IS NOT POSSIBLE

### A. A Model[4]

Initially, a well-established foreign sector supplies the domestic market for an experience good or service. The attributes of the products sold by the various foreign companies are known to domestic consumers from their past consumption experience. The representative individual among a continuum of domestic consumers demands exactly one unit of the good or service in each period, with total demand equal to N. Perfect competition among the foreign firms drives the surplus offered by each to a common level, $U^{*}-t_j$, where $t_j$ is the specific tariff applicable to imports in period j.

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[4]Our model draws on the work of Farrell (1986), who considers competition between a single (strategic) incumbent and a single potential entrant.

At the outset of period 1, a set of potential domestic producers indexed by $\theta$ has acquired the technology needed to enter the industry. At this time, if a firm of type $\theta$ decides to enter, it chooses once-and-for-all its level of quality, $q(\theta)$, which, however, is not immediately observable by domestic consumers. Firms are limited to qualities equal to or exceeding some $q_0$; consumers are assumed to be able to distinguish products of less than this minimum, threshold level. A consumer who purchases the product of any domestic firm in period 1 will learn that firm's quality before the start of the second and final period. Thus, period 1 represents the infancy of the home industry, when foreign products are known but local products are not, whereas period 2 is the phase of mature competition, with domestic firms already having established reputations among their clientele.

We assume that each domestic firm can produce at most one unit of output in each period.[5] A firm of type $\theta$ choosing quality $q$ has a per-period variable production cost of $\theta c(q)$. The cumulative distribution of $\theta$'s among the set of potential entrants is denoted by $F(\theta)$, with marginal density function $f(\theta)$ and $f(\cdot) > 0$ on support $[\theta_{min}, \theta_{max}]$. With this specification, each firm faces moral hazard in its choice of quality, while the heterogeneity across firms in the cost of providing quality introduces adverse selection into the industry equilibrium.

Consumers value quality at rate $\gamma$. A consumer having purchased domestic brand $\theta$ in period 1 and thereby learned its quality can enjoy second-period surplus $\gamma q(\theta) - z(\theta)$ if he buys from the same firm again, where $z(\theta)$ is that

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[5]This assumption is made mostly for expositional convenience. We shall comment below on its significance, contrasting our results with those that would obtain if each firm had upward sloping marginal costs, but outputs were not observable by consumers. If outputs could vary and were observable by consumers, then firms might use quantity as a signal of quality, as we discuss in Section III.

firm's second-period price. Thus, a firm of type $\theta$ can maintain its customer base in the second period by setting $z(\theta) = \gamma q(\theta) - U^* + t_2$. We assume for simplicity that any firm that chooses to produce minimum quality cannot profitably remain active once product qualities are known.[6] We will refer to such firms as "fly-by-night," while firms that produce above minimum quality are termed "reputable."

In the first period, no domestic firm will find it profitable to signal its intention to produce high-quality merchandise. All active firms will have a common output level, namely one unit. So the only variable potentially available as a signal is price. But higher prices cannot signal quality, since all firms would then raise their prices; and there can be no benefit to a reputable firm from choosing a low price to signal quality, since the only time that such an investment could possibly be recouped is in the second period, and then information is in any event complete. It follows that all domestic firms will charge the same price, p, in the first-period equilibrium, and consumers will be willing to buy local goods only if expected surplus equals or exceeds $U^* - t_1$.

Consider now the decision problem facing a firm of type $\theta$. This firm must decide whether to enter the industry, and if so, what quality to produce and what price to charge in the first period. Let us take the first-period price as given for the moment. Then first-period profits from entering at quality q are $\pi^1(\theta) = p - \theta c(q)$. In the second period, if the firm has been reputable, it earns $\pi^2(\theta) = \max \{0, \gamma q - U^* + t_2 - \theta c(q)\}$; otherwise, it earns zero. We assume that the firm weights second-period profits by $\delta$ when comparing these to first-period profits. Note that $\delta$ can exceed one, even with positive discounting, if the

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[6] None of our results depends in any way on the exit of producers of minimum-quality products from the market.

"second" period actually represents a series of identical periods that occur after reputations have been formed.

A reputable firm must earn positive profits in the second period, or else it would have no incentive to choose $q > q_0$. The optimal quality for a firm of type $\theta$, if it chooses to be reputable, is found by maximizing $\pi(\theta) = \pi^1(\theta) + \delta\pi^2(\theta)$. The first-order condition implies

$$\delta\gamma = (1 + \delta)\theta c'(q) \quad , \tag{1}$$

yielding discounted profits

$$\pi^R(\theta) = p + \delta(\gamma\hat{q}(\theta) - U^* + t_2) - (1 + \delta)\theta c(\hat{q}(\theta)) \quad , \tag{2}$$

where $\hat{q}(\theta)$ solves equation (1). Alternatively, the firm can choose a fly-by-night strategy, in which case it earns profits $\pi^F(\theta) = p - \theta c(q_0)$.

We plot $\pi^R$ and $\pi^F$ in Figure 1. Note that both are monotonically decreasing functions of $\theta$ and that $d[(\pi^R(\theta)-\pi^F(\theta)]/d\theta = c(q_0) - (1+\delta)c(\hat{q}(\theta)) < 0$. That is, the incentive to establish a reputation declines with $\theta$. This reflects the fact that the marginal cost of supplying greater quality is lowest when $\theta$ is small. For a range of the most efficient potential entrants, the optimal strategy generally involves choosing $q = \hat{q}(\theta) > q_0$. For some $\theta$, the profits from being reputable are equal to those from being fly-by-night. If, at this value of $\theta$, $\pi^R(\theta) > 0$ (as drawn), then the type of the marginal reputable firm, $\theta^R$, is given implicitly by $\pi^R(\theta^R) = \pi^F(\theta^R)$, or

$$\delta(\gamma q^R - U^* + t_2) = \theta^R[(1 + \delta)c(q^R) - c(q_0)] \quad , \tag{3a}$$

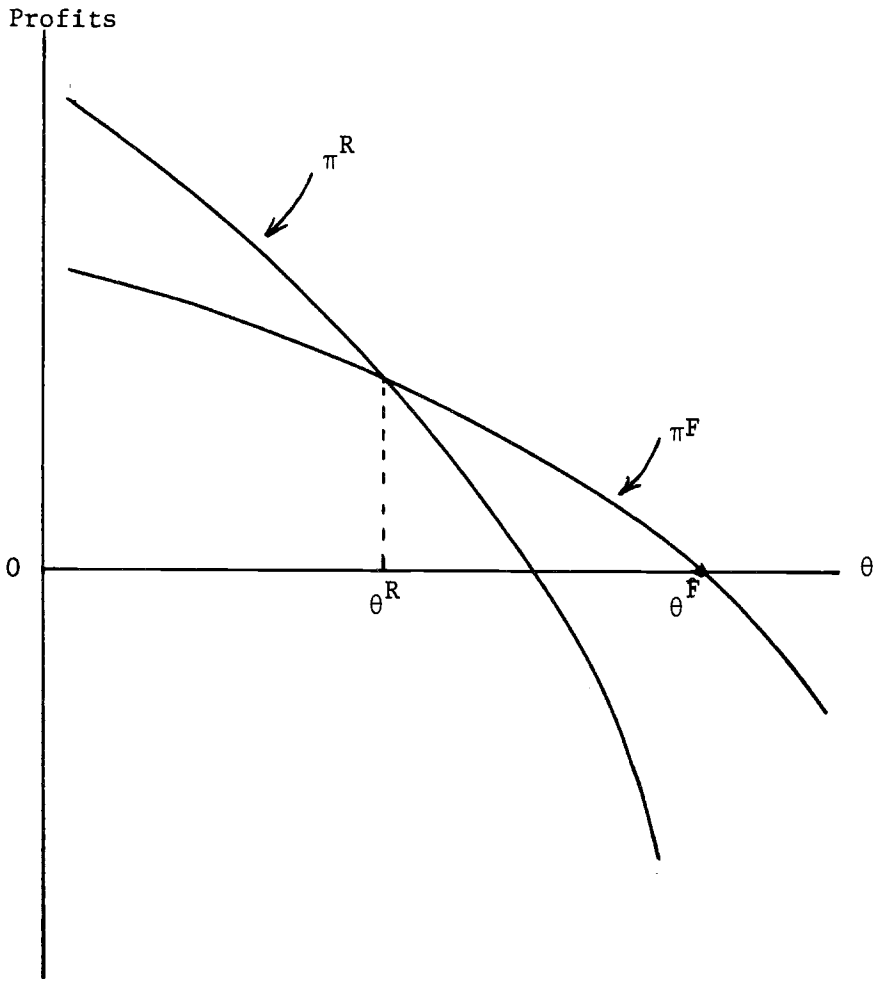


Figure 1

where $q^R \equiv \hat{q}(\theta^R)$. In this case, potential entrants with intermediate values of $\theta$ in the range $(\theta^R, \theta^F]$ also will enter the market as fly-by-nights. The marginal firm in the market earns zero profits, so $\theta^F = p/c(q_0)$.

Alternatively, if profits are negative at the point where the two curves cross, then the marginal firm is a reputable one. In this case $\theta^R$ is given by the zero-profit condition,

$$p + \delta(\gamma q^R - U^* + t_2) = (1 + \delta)\theta^R c(q^R) \quad , \tag{3b}$$

and there are no fly-by-night firms active in the market (i.e., $\theta^F = \theta^R$).

Finally, equilibrium first-period prices must be determined. These will depend on how consumers form their beliefs about the quality of domestic output. We entertain two alternative assumptions about expectations. First, we specify that (equilibrium) expectations are rational, as in Farrell (1986), and that out-of-equilibrium beliefs satisfy a "reasonableness" constraint. We also investigate the implications for infant-industry protection of exogenous expectations on the part of domestic consumers, as in Schmalansee (1982).[7]

With rational expectations, consumers calculate the average quality of domestic products available on the market, and expect to receive this quality on average when they buy from a local firm. Let $q^e$ be the expected average quality of a domestic product and $\bar{q}$ be the actual average quality. Then rational expectations imply $q^e = \bar{q}$ and

$$\bar{q} = \frac{1}{F(\theta^F)} \left[ \int_{\theta_{min}}^{\theta^R} \hat{q}(\theta) dF(\theta) + q_0[F(\theta^F) - F(\theta^R)] \right] \tag{4}$$

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[7] In the earlier literature on equilibrium in markets with imperfect consumer information, Shapiro (1983) assumed that consumers suspected the worst about new entrants, while Allen (1984) allowed the consumers sufficient information to

Consumers willingly purchase domestic products in the first period whenever $p \leq \gamma\bar{q} - U^{*} + t_1$. Indeed, if this weak inequality holds as a strict inequality, then all consumers will prefer domestic goods. Such a situation could be consistent with a rational expectations equilibrium, if consumers were to hold sufficiently pessimistic beliefs about what would be the quality offered by a firm charging more than the going price. Then, no domestic firm would be able to raise its price in response to excess demand. However, we would argue that many of these beliefs about out-of-equilibrium behavior are not "reasonable." A consumer seeing a deviant price, $p^d$, might reasonably be agnostic about which of the firms that could make a profit at $p^d$ has actually produced the good in question. But consumers should rule out the possibility that the product offered at price $p^d$ originates from a firm that would make losses charging that price and choosing its optimal quality. If consumers calculate expected quality out of equilibrium using a formula similar to (4), but with $\theta^F$ there replaced by the index of the marginal entrant at price $p^d$, then any firm experiencing excess demand at a candidate equilibrium price can always deviate by raising its price slightly and still make sales. The unique sequential equilibrium satisfying our restriction on out-of-equilibrium beliefs has

$$p = \gamma\bar{q} - U^{*} + t_1 \quad . \tag{5a}$$

Consumers may lack the information on the cost function, $c(\cdot)$, and on the distribution of $\theta$'s in the population of potential entrants necessary to calculate the average quality consistent with equilibrium. In such an event, a rule

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calculate the incentives for the provision of quality consistent with the equilibrium.

of thumb might be used instead. We are interested in the extent to which our conclusions about infant-industry protection rest on the strong informational requirements of a rational expectations equilibrium. So we will investigate as well a simple alternative: consumers initially hold some arbitrary (and perhaps skeptical) belief about the average quality of a local good or service, $q^e = \tilde{q}$. With these beliefs and firms pricing to maximize profits, the equilibrium first-period price clears the market[8], i.e.,

$$p = \gamma\tilde{q} - U^* + t_1 \quad . \tag{5b}$$

This completes the description of the equilibrium. We turn now to the welfare analysis of temporary protection.

B. Temporary Protection

The infant industry argument typically endorses temporary protection until such a time as the domestic industry achieves equal footing with its foreign rivals. In our model, this corresponds to a policy with $t_1 > 0$ and $t_2 = 0$.

We take domestic welfare, W, to be the sum of consumer surplus, CS, producer surplus, PS, and government revenue, GR. These are given by

$$CS = F(\theta^F)(\gamma\bar{q} - p) + [N - F(\theta^F)](U^* - t_1) + \delta N(U^* - t_2)$$

$$PS = \int_{\theta_{min}}^{\theta^R} [p + \delta z(\theta) - (1+\delta)\theta c(\hat{q}(\theta))]dF(\theta) + \int_{\theta^R}^{\theta^F} [p - \theta c(q_0)]dF(\theta)$$

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[8] If expectations are "too pessimistic," entry by even the most efficient firm at the price dictated by equation (5b) would be precluded. Such would always be the case under our assumptions, for example, if $\tilde{q} = q_0$.

$GR = t_1[N - F(\theta^F)] + \delta t_2[N - F(\theta^R)]$ . Evaluating $dW/dt_1$ at $t_2 = 0$, we have

$$\frac{dW}{dt_1} = f(\theta^F)[\gamma(\bar{q} - q^e) - t_1] \frac{d\theta^F}{dt_1} + F(\theta^F)\gamma \frac{d\bar{q}}{dt_1} \qquad (6)$$

Next we substitute into (6) for $d\bar{q}/dt_1$ calculated from (4), which yields

$$\frac{dW}{dt_1} = -f(\theta^F)[\gamma(q^e - q_0) + t_1] \frac{d\theta^F}{dt_1} + f(\theta^R)(q^R - q_0) \frac{d\theta^R}{dt_1} \qquad (7)$$

Consider first the case of rational expectations. If the marginal firm is a fly-by-night, $d\theta^R/dt_1 = 0$ (from 3a)) and $d\theta^F/dt_1 > 0$. Thus, the right-hand side of (7) is negative for any positive $t_1$. If, instead, the marginal firm is reputable, so that $\theta^F = \theta^R$, then the right-hand side of (7) reduces to $-f(\theta^R)[t_1 + (\bar{q} - q^R)]d\theta^R/dt_1$, which again is negative for $t_1 > 0$. In either event, temporary infant-industry protection reduces welfare in a rational expectations equilibrium.

Although protection promotes further entry, it does not correct the distortions associated with the imperfect consumer information. The rise in the first-period price caused by the tariff benefits the various domestic firms equally, and to an extent that is independent of the qualities that they choose. In particular, the relative incentive that firms have to behave reputably remains the same.[9] This can be seen, for example, from equation (3a), where we find that

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[9] If firms had general cost functions with rising marginal costs, then the benefit each would enjoy from the tariff would be proportional to its output level. Since the marginal cost of high-quality goods exceeds that of

a change in the first-period price has no effect on the margin between reputable and fly-by-night firms.

Entry in itself adds no producer surplus beyond the implicit subsidy in the tariff, because the marginal firm earns zero profits. This leaves only the effect of protection on consumer surplus (net of tariff revenue) to be considered. Consumers with rational expectations pay a price that leaves them indifferent between importing and buying the <u>average</u> domestic product. Since the marginal entrant always provides lower quality than does the average domestic firm, the entrant's product provides negative social surplus. In other words, while temporary protection does not alleviate the moral hazard problem, it actually exacerbates the distortion stemming from adverse selection.[10]

Next, we consider the case of exogenous expectations, with $q^e = \tilde{q}$. Surprisingly, the analysis is quite similar. If the marginal firm is a fly-by-night, then again $d\theta^R/dt_1 = 0$, and since we must have $\tilde{q} > q_0$ for entry to occur, any positive first-period tariff rate yields lower welfare than does free trade.

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minimum-quality goods at any level of output, it is likely that the firm with index $\theta^R$ would produce more as a fly-by-night than it would as a reputable firm. Against this is the fact that the effective price it receives (over the two periods) for above minimum-quality output, $[p + \delta z(\theta^R)]/(1 + \delta)$, might exceed the price it receives for minimum-quality output, $p$. If indeed the optimal output for $\theta^R$ as a fly-by-night were greater than its optimal output as a reputable firm, a tariff would actually lower the incentive for reputable behavior. Then $\theta^R$ would fall, which then is an additional channel through which protection would reduce domestic welfare.

[10] If outputs could vary, as they would if cost functions were instead $\theta c(q,x)$, then there would be a further effect of protection on welfare, in addition to that already noted in footnote 9. That is, firms with above average quality might expand their outputs by more or less than those with below average quality. In this regard, there are offsetting considerations present in our model. First, the firms producing the highest quality products are also the ones that are most efficient, so their marginal costs might be expected to rise less steeply than for the others. But the fly-by-nights might also expand output relatively greatly, since their quality level is significantly lower. This would be the case if $c_{xxq}$ were positive. An argument for protection based on output expansion by existing firms would require that the former effect dominates the latter; but we see no reason to believe that this would generally be the case.

The only circumstance under which temporary protection can be beneficial arises if expectations are very pessimistic, so that entry is quite difficult, and firms that would otherwise choose to be reputable are excluded from the market. With the marginal firm being a reputable one, a small first-period tariff raises welfare if and only if $q^R > \tilde{q}$ . Temporary protection is warranted only when the quality of the worst domestic product available on the market exceeds the quality expected by consumers to be the average among domestic goods. Evidently, our conclusions about the harmful effects of temporary protection in markets plagued by moral hazard and adverse selection problems are not very sensitive to the specification of the way in which consumers form their expectations about product quality.

C. Permanent Protection

Proponents of the infant-industry argument do not often advocate permanent protection of the new sectors. It is believed that protection from imports will no longer be "needed" once the industry reaches its maturity. In our model, permanent protection suffers the additional disadvantage of being time inconsistent. Once the second period arrives, the government will have no incentive to continue any protection that it provided in the first period. However, we will now argue that if the government can somehow commit itself to a policy of permanent protection of the infant industry, such a policy might actually enhance domestic welfare in situations where temporary protection would do just the opposite.

The point can be seen most easily by considering the effect of protection provided only in the second period. Such protection benefits only those firms that remain active then, namely the firms that choose to be reputable. By offering a reward that can only be collected by reputable firms, the government

alters the incentives for producing above-minimum quality and thereby partially alleviates the moral hazard problem.

Formally, we calculate for the case of rational expectations

$$\frac{dW}{dt_2} = -t_2 f(\theta^R) \frac{d\theta^R}{dt_2} + F(\theta^F)\gamma \frac{d\bar{q}}{dt_2}$$

$$= f(\theta^R)[\gamma(q^R - q_0) - t_2] \frac{d\theta^R}{dt_2} + f(\theta^F)\gamma(q_0 - \bar{q}) \frac{d\theta^F}{dt_2} \qquad (8)$$

If the marginal firm is a fly-by-night, then $d\theta^F/dt_2 = 0$. But the first term in (8) is positive for small $t_2$, since $d\theta^R/dt_2 > 0$ and $q^R > q_0$. A second-period tariff does not affect the total number of firms that initially enters the market, but more of those that do enter opt to establish reputations for high quality. Consequently, average quality rises in the first period, yielding higher social welfare.

The result is different if the marginal firm in the market, absent protection, is a reputable one. Then $d\bar{q}/dt_2 = (q^R - \bar{q})d\theta^R/dt_2 < 0$. Second-period protection causes more firms to enter, and the new entrants behave reputably. But these new firms offer lower quality than any of the original participants in the market, so average quality falls. It follows that second-period protection is detrimental to domestic welfare in this case.

What then of permanent protection at a constant rate t? Clearly such protection must be harmful when the marginal firm under free trade has $q > q_0$. But in the case where the marginal firm is a fly-by-night, the beneficial effect of second-period protection in correcting the moral hazard problem can outweigh the deleterious effect of the first-period tariff, which induces more fly-by-

night entry. The condition for a small permanent tariff to increase domestic welfare is

$$\frac{f(\theta^R)(q^R - q_0)}{(1+\delta)c(q^R) - c(q_0)} - \frac{f(\theta^F)(\bar{q} - q_0)}{c(q_0)} > 0 \quad .$$

This condition is most likely to be satisfied when there are more firms at the margin of being reputable than there are at the zero-profit margin, and when the marginal reputable firm provides above-average quality.

## III. INFANT-INDUSTRY PROTECTION IN A SIGNALLING EQUILIBRIUM

### A. Separating Equilibrium in a Model with Signalling

In the model of the previous section, the more efficient firms were not able to signal their greater quality incentives to the uninformed consumers. In this section, we modify the model to allow for potential signalling. When signalling is successful, consumers can infer qualities from their observation of some other variables chosen by the firms. In the resulting separating equilibrium, first-period prices reflect the qualities actually provided. As we shall see, the effects of tariffs in such circumstances are rather different from those that obtain when signalling is not possible.

We alter the model in two ways, one substantive and the other merely for simplification. First, we suppose that firms can select their capacity levels, $x(\theta)$, by investing in capital equipment. Capital is assumed to be durable and can be used to produce output of any quality. Thus, x might reflect the size of a manufacturing firm's factory or the number of professionals a service provider maintains on its (quasi-fixed) payroll. A firm of type $\theta$ with installed capacity x can produce up to x units of a good or service of quality q at constant

variable cost $\theta c(q)$. All firms face the same cost of capital, $k(x)$, with $k' > 0$ and $k'' > 0$.

Second, we limit the set of possible quality choices to two: $q^H$ and $q^L$, with $q^H > q^L$. As before, we assume that a product with characteristics $q^L$ cannot profitably be sold by even the most efficient firm to consumers who know or suspect its quality. This means that, in a fully separating equilibrium, fly-by-night firms do not make any sales.

With these new assumptions, capacity (or output) can serve as a signal of quality. A firm that plans to be reputable has greater incentive to install durable capacity, which it can use for two periods, than does a fly-by-night firm, which must amortize its equipment in a single period. By sinking a large fixed investment, a potential entrant partially commits itself to remaining active in the market. Consumers may come to associate high quality with firms that have made large capital investments, while those with little commitment to the market will be suspected of being fly-by-nights.

Suppose that consumers' expectations are formed as follows:

$$q^e = \begin{cases} q^H & \text{if} \quad x \geq \bar{x} \\ q^L & \text{if} \quad x < \bar{x} \end{cases}$$

Consumers buy only from firms that they believe will offer high-quality products. They are willing to pay a first-period price of $p = \gamma q^H - U^* + t_1$ and a second-period price (as before) of $z = \gamma q^H - U^* + t_2$. Thus, a firm of type $\theta$ that chooses $q = q^H$ and $x \geq \bar{x}$ can enjoy profits $\pi^R(\theta) = (1+\delta)[\gamma q^H - U^* - \theta c(q^H)]x + (t_1 + \delta t_2)x - k(x)$. Alternatively, such a firm could choose $q^L$ but (falsely) signal high quality and thereby earn $\pi^F(\theta) = [\gamma q^H - U^* + t_1 - \theta c(q^L)]x - k(x)$, for $x \geq \bar{x}$.

The most efficient firms might not be constrained by the need to install capacity at least equal to $\bar{x}$ to signal their reputable intentions. Their profits are maximized at $\hat{x}(\theta) > \bar{x}$, given by the first-order condition

$$(1+\delta)[\gamma q^H - U^* - \theta c(q^H)] + t_1 + \delta t_2 = k'(\hat{x}) \quad . \tag{9}$$

We let $\theta^S$ denote the index of the marginal firm for whom the signalling constraint is just binding, i.e., $\hat{x}(\theta^S) = \bar{x}$.

Firms with intermediate efficiency parameters in the range $\theta \in (\theta^S, \theta^R]$ enter the market by installing capacities $x(\theta) = \bar{x}$, which exceed the levels that they would choose under full information.[11] The associated loss of profits is the cost to them of having to signal their intention to produce quality $q^H$. The marginal firm earns zero profits, so

$$(1+\delta)[\gamma q^H - U^* - \theta^R c(q^H)]\bar{x} + (t_1 + \delta t_2)\bar{x} - k(\bar{x}) = 0 \quad . \tag{10}$$

Finally, it must be the case that all those firms that enter the market actually prefer to provide high quality rather than low quality, and that those

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[11] It is interesting to compare this property of our signalling equilibrium with that which would obtain under an alternative cost and information structure. Suppose there was no durable capacity to serve as a commitment to the market (i.e., no sunk costs), but that production in each period required a fixed cost and a rising marginal cost, with the marginal cost of goods of quality $q^H$ exceeding that of goods of quality $q^L$ at any given level of output. Suppose further that word-of-mouth information flows were sufficient to allow reputable firms to expand their sales to the extent they would wish to do so, once their reputations had been established. Then absent signalling considerations, fly-by-night firms would generally choose output levels greater than those selected by reputable firms, and the latter could signal quality by remaining smaller in the first period than would otherwise be optimal. It seems consistent with casual empirical observation that large firms are believed to be reputable in industries with large sunk costs (e.g., soft drinks, laundry detergents), since these firms have much to lose from running down their reputations.

that do not enter could not make positive profits at either quality level. We note that $d[\pi^R(\theta)-\pi^F(\theta)]/d\theta < 0$, so that if the marginal firm has $\pi^R(\theta^R) \geq \pi^F(\theta^R)$, so too will those that are more efficient. Also, $d\pi^R(\theta)/d\theta < 0$ and $d\pi^F(\theta)/d\theta < 0$, so that those potential entrants that are less efficient than the firm of type $\theta^R$ cannot earn positive profits.

We obtain our final equilibrium condition by placing a restriction on out-of-equilibrium beliefs. If, in a candidate equilibrium, $\pi^R(\theta^R)$ were strictly greater than $\pi^F(\theta^R)$, then any firm with $\theta \in [\theta^S,\theta^R]$ could reduce its capacity investment slightly by $\varepsilon$, and claim that only a reputable firm would have an incentive to install capacity $\bar{x} - \varepsilon$. The deviant firm would be correct in its claim, and, if believed, the deviation would be profitable. We choose to restrict the class of signalling equilibria to those in which no reputable firm can credibly separate itself from the fly-by-nights at some alternative and more profitable level of output.[12] With this further restriction, the equilibrium must have $\pi^R(\theta^R) = \pi^F(\theta^R)$. After some rearrangement, this condition reduces to

$$\delta(\gamma q^H - U^* + t_2) = \theta^R[(1+\delta)c(q^H) - c(q^L)] \ . \qquad (11)$$

Equations (9), (10) and (11) determine a function $\hat{x}(\theta)$, and values for $\theta^R$ and $\bar{x}$ that satisfy all the conditions for a separating equilibrium. If the solution to these equations has $\hat{x}(\theta_{min}) > \bar{x}$, then these values comprise the unique equilibrium satisfying our constraint on out-of-equilibrium beliefs. In particular, no pooling equilibrium can exist under these circumstances. If,

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"Smallness" often is associated with high quality where sunk costs are not important, such as in many service activities.

[12] In effect, we are arguing that the most plausible among all the separating, rational expectations equilibria is that which has the smallest signalling requirement, $\bar{x}$.

alternatively, $\hat{x}(\theta_{min}) < \bar{x}$, then there might also exist a pooling equilibrium, with some fly-by-night firms entering the market, all active firms producing the same output, and consumers rationally expecting a level of quality equal to the average among domestic firms. Since the pooling equilibrium that might arise in this case is qualitatively the same as that analyzed in Section II, we will concentrate here on the separating equilibrium that obtains when (10), (11), and possibly (9) apply.

B. Temporary and Permanent Tariffs

As before, we take social welfare to be the sum of consumer surplus, producer surplus, and government revenue. These now are given by

$$CS = N(U^* - t_1) + \delta N(U^* - t_2) ,$$

$$PS = \int_{\theta_{min}}^{\theta^S} \{(1+\delta)[\gamma q^H - U^* - \theta c(q^H)]\hat{x}(\theta) + (t_1+\delta t_2)\hat{x}(\theta) - k(\hat{x}(\theta))\}dF(\theta)$$

$$+ \int_{\theta^S}^{\theta^R} \{(1+\delta)[\gamma q^H - U^* - \theta c(q^H)]\bar{x} + (t_1+\delta t_2)\bar{x} - k(\bar{x})\}dF(\theta)$$

$$GR = (t_1+\delta t_2)\{N - \int_{\theta_{min}}^{\theta^S} \hat{x}(\theta)dF(\theta) - [F(\theta^R) - F(\theta^S)]\bar{x}\}$$

Letting $d\alpha$ denote any change in policy, it is easy to calculate

$$\frac{dW}{d\alpha} = -(t_1+\delta t_2)\left\{\int_{\theta_{min}}^{\theta^S} \frac{d\hat{x}(\theta)}{d\alpha}\, dF(\theta) + f(\theta^R)\bar{x}\frac{d\theta^R}{d\alpha}\right\}$$

$$+ \frac{dx}{d\alpha}\left[\int_{\theta^S}^{\theta^R} \{(1+\delta)[\gamma q^H - U^* - \theta c(q^H)] - k'(\bar{x})\}\, dF(\theta)\right] \qquad (12)$$

Consider first temporary protection, with $d\alpha = dt_1$ and $t_2 = 0$. From (11) we see that $d\theta^R/dt_1 = 0$. Then (10) implies $d\bar{x}/dt_1 = \bar{x}^2/[\bar{x}k'(\bar{x}) - k(\bar{x})] > 0$. With infant-industry protection, firms must install more capacity to signal their intention to choose $q^H$. The extra cost of doing so dissipates the subsidy implicit in the tariff. In the new equilibrium, the same number of firms enter, but all firms operate at greater scale.

What then are the welfare implications of first-period protection? The first term in (12) is zero at free trade, but negative for any positive $t_1$. This term represents the distortion associated with any excess output by the most efficient firms. The second term reflects the welfare cost of any output expansion by the firms that must inflate their capital investments to signal quality. The term in the second integral is negative for any $t_1 \geq 0$, since for these firms $\bar{x} > \hat{x}(\theta)$ implies $(1+\delta)[\gamma q^H - U^* - \theta c(q^H)] - k'(\bar{x}) < -(t_1 + \delta t_2)$. But we have noted already that $d\bar{x}/dt_1 > 0$. Protection raises the cost of signalling, thereby exacerbating the social loss from the imperfect consumer information. It follows that <u>temporary protection necessarily reduces welfare in a separating equilibrium</u>.[13]

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[13]Referring to our discussion in footnote 11, protection would also lower welfare in situations where low levels of output were used to signal quality. Then an increase in $t_1$ would require reputable firms to further cut their outputs below the first-best level in order to signal their reputable intentions. We

We model permanent protection by setting $t_1 = t_2 = t$ and $d\alpha = dt$. Differentiating (11), we find immediately that $d\theta^R/dt = \delta/[(1+\delta)c(q^H)-c(q^L)] > 0$. Permanent protection improves the profit opportunities in the market, thereby causing more firms to enter. Next we differentiate (10), and substitute for $d\theta^R/dt$, which gives

$$\frac{d\bar{x}}{dt} = \left\{ \frac{(1+\delta)[c(q^H) - c(q^L)]}{(1+\delta)c(q^H) - c(q^L)} \right\} \left\{ \frac{\bar{x}^2}{\bar{x}k'(\bar{x}) - k(\bar{x})} \right\} > 0 \quad .$$

Evidently, an increase in the rate of permanent protection increases the critical level of capacity that signals reputable intentions.

The welfare effects of an increase in permanent protection are derived using (12). Away from free trade, both the expansion in the output of the most efficient firms and the entry into the market of additional (reputable) firms imply a loss of social welfare. Both sorts of extra output require resources whose opportunity cost exceeds their marginal social product in the infant industry. And, like first-period protection, a permanent tariff augments the social cost of signalling. We conclude therefore, in contrast with our findings for the no-signalling case, that <u>permanent protection always reduces welfare in a separating equilibrium</u>.

In a signalling equilibrium, the less efficient, low-quality producers impose an externality on those that seek to distinguish themselves as having the incentive to offer high quality. This externality arises from the mere potential presence of the former group in the market. The externality implies an excess burden for those that signal, since a signal can only be effective if it is

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conclude that irrespective of the direction that the signalling requirement pushes reputable firms, because a tariff makes entry by fly-by-nights easier <u>ceterus paribus</u>, it raises the social cost of the signals.

costly. Protection of any kind (and indeed any output subsidy) increases the profitability of the less efficient producers and makes them more of a threat to enter the market. It thereby raises the cost to the efficient producers of separating themselves out. Thus, entry-promoting protection is bound to be harmful in a signalling equilibrium.

## IV. CONCLUSION

We have investigated the case for infant-industry tariff protection in situations where information serves as a barrier to entry. Our starting point has been a model in which a well-established foreign sector competes in the domestic market for an experience good or service with a cost-efficient but initially unknown set of potential domestic entrants. In the infancy of the domestic industry, consumers must form expectations about the attributes of domestic products, recognizing both the moral hazard in an individual seller's choice of quality and the adverse selection that arises when various potential entrants have access to different technologies of production. Thus, domestic firms suffer a temporary competitive disadvantage owing to their lack of reputations.

We found that temporary tariff protection to promote entry generally lowers domestic welfare. When domestic firms are unable to signal their qualities, a temporary tariff does not alter the incentive each firm has to provide high-quality products, but the marginal entry induced by such a tariff generally reduces consumer surplus (and must do so if consumers have rational expectations). In other words, infant-industry protection does not alleviate the moral hazard problem in such cases, and actually exacerbates that caused by adverse selection. When domestic firms are in fact able to signal their reputable

intentions via their choice of a high level of capital investment, a temporary tariff increases the social cost of signalling.

Our results concerning permanent protection were mixed. We noted first that a policy of permanent protection generally is time inconsistent; that is, once the mature phase of industry competition arrives, the government has an incentive to terminate any protection from the infancy phase. However, if the government can somehow commit itself to continue protection, then there might be benefit from a permanent tariff, depending upon industry circumstances. For example, when firms cannot signal quality and when the marginal entrant produces minimum quality, a permanent tariff might raise domestic welfare, because the second-period tariff rewards only those firms that behave reputably in the first period. We found, however, that if quality signalling is possible, a permanent tariff like a temporary tariff is harmful, because it increases the level of excess capacity investment needed to signal high quality.

Our negative findings about the efficacy of protection do not imply that the market works well in the situations that we have described, or that other forms of government intervention would not be desirable. Rather, we have shown that trade policy (or output subsidies more generally) do not correct the distortions that arise when consumers are imperfectly informed. A temporary output subsidy rewards reputable firms and fly-by-nights equally, and does not alter the incentives that firms face in choosing among these strategies. Furthermore, even when information is a barrier to entry, the marginal firms that enter in response to an output subsidy may well lower the average quality of domestic products available on the market. These considerations suggest that appropriate policy should seek to reward firms that invest in their reputations, without encouraging entry or expansion by others. We leave to future research the task of identifying such policies.

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