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CLOSING THE TECHNOLOGY GAP: DOES TRADE LIBERALIZATION REALLY HELP?

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ABSTRACT

A common theme in discusssions of trade reform is the possibility of improved technical efficiency following trade liberalization. This paper presents a conceptual analysis of the likely linkages between trade regimes and technical efficiency. Three sets of arguments, having to do with X-inefficiency, macroeconomic instability, and increasing returns to scale, are reviewed and found misleading or incomplete. A simple model of technological catch-up by a domestic firm shows the opposite of the usual argument: the larger market share provided by protection to the firm increases its incentives to invest in technological effort. When modified to include oligopolistic considerations at home, the model suggests that the incentives could go either way, depending on the mode of strategic conduct. The presence of economies of scale provides perhaps the strongest reason for productivity improvements, but here the argument relies on frictionless entry into and exit from industries. The paper concludes that the relationship between trade policy and technical efficiency is fundamentally ambiguous.

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I. Introduction

The import-substitution strategy's fall into disrepute among academics, and increasingly among policy-makers, has been greatly assisted by the discovery that infant industries spawned by the strategy have failed to mature. It has become increasingly clear that indiscriminate protection of nascent industries yields few productivity gains, and that the benefits of the strategy are unlikely to offset its costs in terms of resource misallocation. For this and other reasons, "outward orientation" has now become the new orthodoxy. The new strategy's Siren song has many refrains, but one which is particularly appealing is the promise of improved technical efficiency once protective trade barriers are lifted. With trade liberalization set into motion, policy-makers are told, protected firms will have no choice but to modernize their techniques and cut their costs in order to compete with foreign producers. What is at stake is no longer some Harberger triangles, but hefty rectangles of unexploited technological opportunities.

The relationship between trade policy and technical efficiency is an old theme in economics, but one that has been overshadowed by the emphasis on the Ricardian doctrine of comparative costs. The traditional case for comparative advantage and free trade is one that stresses allocative efficiency (i.e. the allocation of domestic resources into sectors where they are most productive); it is mostly silent on technical efficiency. Interestingly, the original case for the gains from trade--as articulated by Adam Smith--relied on overall gains in productivity deriving from an expanded division of labor within a

larger market.[1] This rationale for trade--based on scale economies--was hidden from the view of academic economists by the intellectual appeal of the Ricardian outlook, and has only recently been resuscitated in the works of the "new" trade theorists.[2] But unlike the Ricardian perspective, the new one lacks a clean model: except for the limiting case where they are "external" to firms, scale economies must go hand in hand with imperfect competition. The range of possible outcomes of trade policy then becomes limited only by the analyst's imagination.

The hopes for trade liberalization are by no means based only on the exploitation of scale economies. Protection typically leads to the monopolization of the domestic market by a few producers. A common presumption is that the resulting market structures will not be conducive to improvements in productivity and technical efficiency. Liberalization, it is argued, would reverse the incentives. Here we bump against one of the oldest concerns of the literature on industrial organization: the relationship between market structure and innovation. The ease with which pro-liberalizers make their case is belied by the continuing debates in this literature about the nature of the relationship.[3] The Schumpeterian perspective would disagree strongly with the view that competition is conducive to either innovation or

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1. "By means of [foreign trade], the narrowness of the home market does not hinder the division of labour in any particular branch of art or manufacture from being carried to the highest perfection. By opening a more extensive market for whatever part of the produce of their labour may exceed the home consumption, it encourages them to improve its productive powers ...." Smith (1937 [1776]), Book IV, chap. I, p. 415.

2. See Helpman and Krugman (1985) for an integrated treatment of trade theory with increasing returns to scale.

3. For an excellent analytical survey, see Kamien and Schwartz (1982).

cost reducing investments.

My objective in this paper is to clarify some of the conceptual issues in the debate over the relationship between trade policy and technical efficiency. After a brief review of the arguments and the evidence in the next section, I will devote most of my analysis to a set of highly stylized models that shed light on different aspects of the debate. I will argue that much current discussion has served only to muddy the waters by inadequately distinguishing between trade policy proper and other (mostly macro) policies deployed in support of outward orientation. Once attention is focused on trade policy, it becomes extremely difficult to sustain the case that liberalization, as a general rule, must have a positive impact on technical efficiency. The models considered here demonstrate the fundamentally ambiguous nature of the relationship.

II. The Arguments and the Evidence

The available evidence suggests that increases in productivity have played an important role in the economic growth of the developing countries. But the contribution of productivity change relative to the growth of factor inputs has been typically not as high as in developed countries. On average, the increase in total factor productivity (TFP) accounts for about half of the growth in value added in developed economies; the comparable figure for developing countries is around a third (see Table 1).

Is there any reason to believe that choices with respect to trade strategy will have systematic effects on the level of technical efficiency and

its change over time? The straightforward answer is no. The theory of trade policy is generally silent on the effects of liberalization on the rate of growth of output or productivity. The conventional benefits of liberalization are once-and-for-all gains, and although such gains can accumulate over time, they do not necessarily put the economy on a superior path of technological development.[4]

To be sure, there is no shortage of arguments regarding how trade policy can affect domestic productivity. The above comments refer to the lack of any general theoretical presumptions; particular stories do abound. Among such stories, three deserve special mention as the ones that come closest to satisfying minimum standards of logical coherence, and it is on these that I will focus in this section.

X-efficiency. The first set of arguments revolve around X-inefficiency. While the particular rendition differs, the general theme here is that protection makes it more likely that domestic entrepreneurs will succomb to the "quiet life" of the monopolist. Why work hard to improve productivity and cut costs if foreign competition presents little threat? In its simplest form, this argument relies on satisficing, rather than optimizing, behavior on the part of entrepreneurs, and requires further that domestic competition be not severe enough of a threat to keep them on their toes. With optimizing behavior, it cannot be shown in general that protection weakens the pursuit of higher productivity. In fact, as I will argue in the following section, the

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4. The language in the World Bank's World Development Report, 1987 (focusing on trade and industrialization) reflects an all-too obvious tension between the desire to make a positive case for liberalization on productivity grounds and the need to acknowledge that the theoretical and empirical support for such a case is weak. See pp. 90-92.

normal case would be quite the opposite: for an individual firm, the larger market share provided by trade restrictions increases at the margin the benefits of cost improvements, and is likely to spur, not retard, technological effort. If entrepreneurs satisfice instead, the presumed negative effect can indeed occur. But the working hypothesis of satisficing behavior would require liberalizers to sacrifice too many other beliefs held even more firmly: for example, how many of them would be likely to reject the notion that devaluation spurs exports, as they must if entrepreneurs are indeed prone to satisficing?

A more satisfactory theoretical explanation for this hypothesis is provided by the possibility that liberalization may influence the labor-leisure choice of entrepreneurs. Suppose that reducing X-inefficiency requires constant effort and diligence, which cuts into leisure. Protection increases the rents to entrepreneurs, who take some of their increased income in the form of leisure. As overall effort declines, technical efficiency settles on a lower path. Liberalization would then reverse the process. The definitive analysis of this question can be found in Corden (1974, pp. 224-231)[5], who carefully disects the argument and shows its fragility. Notice that this line of reasoning is valid only when income effects outweigh substitution effects, i.e. when the labor supply curve of entrepreneurs is backward-bending; as indicated in the preceding paragraph, the substitution effect is likely to go in the other direction. In addition, this argument has some disconcerting implications when viewed in general-equilibrium terms:

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5. I am grateful to Howard Pack for pointing me in Corden's direction.

liberalization increases the incomes of exporters, who, by the same reasoning, would be prone to relax on their technological efforts. I suspect that this contradicts a widely held belief to the contrary.[6]

Macroeconomic instability. The second major line of reasoning relies on the evidence that inward-oriented regimes are prone to foreign exchange bottlenecks and stop-go macroeconomic cycles. The instability in the macroeconomic environment and the consequent tendency for output to periodically fall below the full-capacity level are certainly inimical to growth in measured productivity. In addition, the overvaluation of the domestic currency and shortages of imported inputs discourage domestic firms from attempting to reap the benefits of scale via foreign markets. While these arguments have an important kernel of truth, they say practically nothing about the role of trade policy per se. Conceptually, any level of trade protection is compatible with macroeconomic stability, realistic exchange rates, and the like. The view that protection leads to chronic current account deficits mixes up macroeconomics with microeconomics. Indonesia, for example, has had a very restrictive trade regime in combination with exchange-rate and macro policies that are quite unobjectionable.[7] Similarly, Korea and Taiwan achieved macroeconomic stability in the 1960s

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6. Corden points out, rightly, that the welfare consequences of liberalization are not necessarily magnified by these X-efficiency effects even when entrepreneurial labor supply is backward-bending. The reason is that the additional leisure taken by entrepreneurs is part of social welfare as well. Rescuing the argument then requires some additional hypotheses regarding externalities and the like. See also Selten (1986) for a model of imperfect competition in which "slack" is assumed to increase with profits.

7. For a fascinating recent account see Woo and Nasution (1988).

without any sizable trade liberalization.[8]

Current terminology ("outward orientation", "export promotion strategy") has the glaring shortcoming that it lumps together macroeconomic policies with trade policies. Worse still, the combination is sometimes referred to as the "trade regime", with devaluation-cum-stabilization episodes referred to as "trade liberalization".[9] While this terminology may be useful for a descriptive categorization of country experiences--exceptions notwithstanding, restrictive trade regimes do tend to go hand in hand with macroeconomic instability--it confuses things for prescriptive purposes. When inferior technological performance is due to mismanagement of macroeconomic policy, countries should be told to change their exchange rate and fiscal policies; the inclusion of trade liberalization in the policy package--sometimes as the lead policy initiative--gives the upper hand to ideology over economics.

Increasing returns to scale. The third line of argument is based on economies of scale. More open trade regimes, it is argued, are conducive to lower overall costs since domestic firms can achieve larger levels of output by participating in world markets. In a broad general-equilibrium sense, this is of course true. Small, open economies are likely to specialize in a narrow range of products which they can produce and export at sufficient scale to be competitive. In more practical terms, as long as trade liberalization leads to an expansion (on average) of firms and sectors with increasing returns to scale (IRS), the conventional resource allocation benefits are magnified by

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8. See Sachs (1987) which stresses the distinction and its importance for the design of macro stabilization policies.

9. See, for example, Papageorgiou, Michaely, and Choksi (1986) which summarizes the findings of a multi-country study.

markets. It is telling that all significant cases of export boom in manufactures--Korea and Taiwan in the 1960s, Brazil in late 1960s and 1970s, Turkey in the 1980s--took place well before any significant trade liberalization had been attempted.[11] The Chilen trade liberalization, on the other hand, appears to have fostered exports of primary or primary-related products with little scope for IRS.

In section V below, I will discuss some of these arguments further and show why trade restrictions do not affect adversely the export incentives of protected firms. What is true is that with sufficiently restrictive levels of protection, trade policy may end up fostering an industry which is unable to compete abroad at any level of output. This, then, is an argument against "excessive" protection, rather than protection per se. The benefits from liberalization in this instance will derive predominantly from the contraction of industries with no underlying comparative advantage in the conventional sense, and not from an overall expansion of production runs and associated increases in overall productivity.

To summarize, I conclude that the first of these arguments (about X-efficiency) is rather contrived, the second (about macro stability) is largely irrelevant to trade policy, and the third (about IRS) is potentially important but incomplete. I will return to the more important of these arguments below. What about the empirical evidence?

Examining whether any broad cross-sectional correlations emerge between

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11. The experience of these countries strongly suggests that a realistic exchange-rate policy and a generous program of export subsidies, rather than trade liberalization per se, are the key ingredients for successful export performance.

trade regimes and TFP growth has proved to be a tempting exercise. A recent survey by Howard Pack (1986) suggests that the evidence from such studies is quite inconclusive: "to date there is no clear cut confirmation of the hypothesis that countries with an external orientation benefit from greater growth in technical efficiency in the component sectors of manufacturing" (p. 38). Bhagwati, a proponent of outward-orientation, has also concluded recently that there is little empirical or theoretical support for favoring export promotion over import substitution on grounds of scale economies, technical efficiency, or innovation (1988, pp. 39-40). In any case, the evidence surveyed by Pack and Bhagwati does not directly bear on the issues at hand, since none of the studies discriminates between trade policy and macro policy choices.[12] As argued above, causality cannot be attributed to trade policy proper if what one understands from "trade regimes" is the entire complex of trade and payments policies. To conclude, then, there is no convincing empirical evidence that less protectionist trade policies do better in terms of technical efficiency.

I now move on to a series of stylized models that investigate the relationship between trade policy and productivity. In light of the discussion above, my objective will be to make simple points in the context of simple models rather than to demonstrate the validity of a single general proposition.

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12. The leading studies are Bhagwati (1978, chap. 5), Chenery, Robinson and Syrquin (1986, chap. 6), Nishimuzu and Robinson (1984), and Krueger and Tuncer (1982).

III. Protection and Technological Catch-Up

I start with a case which shows the opposite of the orthodox argument. I consider a firm which invests in technological development to cut its costs, and ask: how will the rate of increase of productivity depend on the level of trade protection afforded to the firm? Once the backward bending entrpreneurial effort curve is ruled out, the answer is surprisingly general. The larger is the firm's market share, the greater is its investment in productivity-enhancing technology. As long as protection increases the firm's market share, then, trade restrictions improve the level of technical efficiency.

Let the firm have a monopoly at home. The case of domestic oligopoly will be considered in the next section. Its maximized flow profits can be written as

$$(1) \quad \pi(c, m) = \max_{q} \{qp(q, m) - cq\},$$

where c denotes the firm's (constant) marginal cost, q its output, p(.) the inverse demand function it faces at home, and m the quantity of imports allowed in. Import liberalization in this context will refer to increases in m. For the moment, I ignore the possibility that the firm may want to export. Let the foreign level of marginal costs be c^*, with $c > c^*$ initially. The firm can reduce its costs (all the way down to c^*) by investing resources in technology and overall tinkering. I model this by letting the firm choose the rate at which domestic costs decline, and denote this rate β. Then at any point in time, the cost level is given by:

$$(2)\quad c(t) = \begin{cases} c_o - \beta t, & t < T, \\ c^*, & t \geq T. \end{cases}$$

Here T denotes the time that elapses before the domestic firm fully catches up with foreign technology, and c_o represents the initial level of domestic costs. This implies $\beta = (1/T)(c_o - c^*)$, or:

$$(3)\quad c(t) = c_o - (t/T)(c_o - c^*), \quad \text{for } t \leq T.$$

The present discounted value of expenditures made on technological effort increases with β, and can be written simply as $\phi(\beta)$, with $\phi' > 0$ and $\phi'' > 0$.

What is of interest is the length of time it takes for the firm to catch up with foreign technology. Since both c(t) and β can be written as a function of T, the firm's objective function can also be stated as a function of T alone:

$$(4)\quad V(T) = \int_0^T \exp(-\rho t)\pi(c(t), m)dt + \int_T^\infty \exp(-\rho t)\pi(c^*, m)dt - \phi(\beta),$$

where ρ is the firm's discount factor. After simplifying, the first-order condition becomes:

$$(5)\quad V'(T) = \int_0^T \exp(-\rho t)t\pi_c(c(t), m)dt + \phi'(\beta) = 0.$$

This sets the marginal cost of technological effort equal to the discounted sum of its benefits over the catch-up period. Notice that equation (1) implies $\pi_c = -q$, so that the benefits of effort are directly proportional to the scale of domestic output. As long as $\phi'(.)$ is finite and strictly positive, and assuming the second-order condition is satisfied, the catch-up is completed within the open interval $(0, \infty)$.

To gauge the effects of trade policy, we can perform comparative statics with respect to m. Differentiating (5) yields:

$$(6)\quad dT/dm = -[V''(.)]^{-1} \{\int_0^T \exp(-\rho t) t \pi_{cm}(.) dt\}.$$

Since the second-order condition requires $V''(.)$ to be negative, the sign of this expression depends solely on π_{cm}. But from (1), $\pi_{cm} = -\partial q/\partial m$ so that π_{cm} is positive as long as import liberalization (an increase in imports) reduces the output of the domestic firm. Since this is the regular case, we can conclude that $dT/dm > 0$; a more liberal trade regime slows down the rate of increase of domestic productivity and delays technological catch-up. The economic mechanism at work here is simple. The larger the scale of output, the greater the benefits to the firm from a given reduction in costs. Since import liberalization shrinks the domestic firm's sales, it reduces the incentive to invest in technological effort.

The above ignored two possibilities: (a) the domestic firm may export, and (b) it may eventually overtake foreign competitors in productivity. We can incorporate both possibilities in the above framework by changing the formulation of technical progress at home. Suppose that the domestic firm can set its own target for the eventual level of productivity it reaches, $\bar{c}$. This target could lie above or below the foreign level of productivity, c^*. Its costs at any point in time are now written as follows:

$$(7)\quad c(t) = \bar{c} + (c_o - \bar{c})\exp(-\beta t)$$

The firm reaches $\bar{c}$ asymptotically as $t \to \infty$. We now assume β is exogenous ($1 > \beta > 0$), so that the firm's choice variable is $\bar{c}$. We rewrite the cost function for technological effort as $\phi(\bar{c})$, with $\phi' < 0$ and $\phi'' > 0$.

The firm's flow profit function is as in (1) when it decides not to export. When it does export, its flow profits are also a function of the foreign level of costs, c^*, so can be written generally as $\tilde{\pi}(c, c^*, m)$. As before, $\tilde{\pi}_c = -\tilde{q}$, the level of total output (domestic sales and exports combined). The point in time at which the firm becomes an exporter is determined endogenously. Let $\tilde{c}$ denote the level of productivity at which the firm just breaks even in world markets; $\tilde{c}$ is defined implicitly by the relation $\tilde{\pi}(\tilde{c}, c^*, m) - \pi(\tilde{c}, m) = 0$. When costs are lower than $\tilde{c}$, the firm's profits from foreign sales add on to existing profits in the domestic market. I will only look at the case where it pays to export eventually, i.e. where the firm's target level of costs ($\bar{c}$) is lower than $\tilde{c}$. As long as $\bar{c} < \tilde{c}$, there exists a finite length of time, T, after which the firm services both the domestic and the foreign markets. T is determined as follows: since $\tilde{c} = \bar{c} + (c_o - \bar{c})\exp(-\beta T)$ from (7),

$$(8) \quad T = (1/\beta)[\ln(c_o - \bar{c}) - \ln(\tilde{c} - \bar{c})].$$

The firm's objective function can now be stated as a function of the target level of productivity alone:

$$(9) \quad V(\bar{c}) = \int_0^T \exp(-\rho t)\pi(c(t), m)dt + \int_T^\infty \exp(-\rho t)\tilde{\pi}(c(t), c^*, m)dt - \phi(\bar{c}),$$

with c(t) and T defined as in (7) and (8). The first-order condition can be simplified to:

$$(10) \quad \int_0^\infty \exp(-\rho t)\pi_c(1-\exp(-\beta t))dt + \int_T^\infty \exp(-\rho t)[\tilde{\pi}_c - \pi_c](1-\exp(-\beta t))dt - \phi' = 0.$$

The marginal benefits of innovation are now larger as they are spread over a larger scale of output: $-[\tilde{\pi}_c - \pi_c]$ represents the net increase in output that

is made possible through exports. Hence the carrot of future exports adds to the incentive to enhance productivity.

Once again, we can investigate the effects of import liberalization on the rate of technical progress. Differentiation of (10) yields:

$$(11)\quad d\bar{c}/dm = -(V'')^{-1}\left(\int_0^T \exp(-\rho t)\pi_{cm}(1-\exp(-\beta t))dt + \int_T^\infty \exp(-\rho t)\tilde{\pi}_{cm}(1-\exp(-\beta t))dt\right),$$

where I have made use of the fact that $[\tilde{\pi}_c(\bar{c}) - \pi_c(\bar{c})] = 0$. V'' is negative from the second-order condition, so the sign of this expression depends on the signs of π_{cm} and $\tilde{\pi}_{cm}$. As long as increased foreign competition reduces the total output of the domestic firm, $d\bar{c}/dm > 0$, and liberalization is inimical to technical progress. The explanation is as before: while the export potential is now an added inducement for cutting costs, a policy that reduces the scale of domestic output diminishes the incentives to catch-up with foreign technology.

Finally, let us consider briefly the question of temporary versus permanent protection. Suppose the government commits itself to a path of trade policy such that trade is liberalized after a certain point in time, τ. How does this affect the behavior of the firm?

Ignoring with no loss of generality the role of exports, let the profit functions of the firm be written as $\pi(c, m)$ and $\pi(c, m')$, corresponding to pre- and post-liberalization periods. Liberalization implies $m' > m$. The firm maximizes its objective function:

$$(12)\quad V(\bar{c}) = \int_0^\tau \exp(-\rho t)\pi(c(t), m)dt + \int_\tau^\infty \exp(-\rho t)\pi(c(t), m')dt - \phi(\bar{c}),$$

The first-order condition is:

$$(13)\quad \int_0^{\tau} \exp(-\rho t)\pi_c(1-\exp(-\beta t))dt + \int_{\tau}^{\infty} \exp(-\rho t)\pi_c(1-\exp(-\beta t))dt - \phi' = 0.$$

We investigate what happens when the liberalization is brought forward in time (i.e. τ is reduced). The comparative statics yield:

$$(14)\quad d\bar{c}/d\tau = -(V'')^{-1}\,[\exp(-\rho\tau)(1-\exp(-\beta\tau))]\,\{\pi_c(c(\tau),\, m) - \pi_c(c(\tau),\, m')\}.$$

Since the level of domestic output is smaller when imports are liberalized ($\pi_c(c(\tau),\, m) - \pi_c(c(\tau),\, m') < 0$), we have $d\bar{c}/d\tau < 0$. Shortening the period over which temporary protection is granted reduces the firm's technological effort. This contradicts once again the conventional wisdom regarding the productivity-boosting effects of temporary, rather than permanent, protection.

In sum, simple partial-equilibrium models of technological catch-up point in the direction diametrically opposed to arguments made by liberalizers. While models of the sort analyzed here need not be taken overly seriously as an actual description of the process of innovation in developing countries, they certainly cast doubt on the productivity-enhancing effects of trade liberalization.

An important caveat to this line of reasoning has to do with the partial-equilibrium nature of the analysis. Protection enhances the profitability of firms in import-competing sectors, but acts as a tax on firms in exporting sectors. Unless there are under-utilized resources, protection cannot expand output in import-competing and exporting sectors simultaneously. Consequently, productivity gains in the former have to be weighed against foregone productivity improvements in the latter. An important implication, therefore, is that the analysis above cannot be used as a justification for indiscriminate, across-the board protection. A related caveat is that in the absence of some knowledge regarding the externalities involved in technological effort, we

cannot judge a faster technological catch-up induced by protection to be necessarily welfare-improving.[13] At best, then, there is a case for selective protection of industries where (a) the catch-up potential is largest, and (b) there exist positive spillovers to the rest of the economy.[14]

IV. The Role of Oligopoly

The framework utilized above abstracted from interactions among competing firms in the domestic market. The new trade theory has stressed such interactions as an important determinant of the effects of policy. Accordingly, I now concentrate on the implications of an oligopolistic market structure at home. The question to be analyzed is the same as before: how does protection influence the level of technical efficiency of firms?

The model that follows illustrates a rather simple and intuitive story. In an oligopolistic industry, incumbents could increase profits, in the absence of perfect collusion, if they could all somehow commit themselves to lower sales. In practice, centrifugal forces tend to prove too strong, and firms waste some of their profits by "excessive" competition. Now, one way that firms could credibly commit themselves to less agressive behavior is by choosing outdated or costly technology. By maintaining costs artificially high, they could facilitate collusion.

How does protection affect all this? As the level of protection increases,

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13. In fact, when no such externalities exist, trade protection can be shown to lead to welfare losses regardless of its effect on technological performance.

14. See Westphal (1982) for an interpretation of Korean technological development in terms of selective promotion of infant industries. On Korea, see also Dornbusch and Park (1987), pp. 402-406.

the profits forgone by excessive competition increase as well, so that the potential payoffs to a strategy of high costs rise. Therefore, as long as firms' strategic behavior is conducive to an increase in costs, protection serves to inflate costs even further. Notice that this argument is entirely different from any stated so far; the adverse effect on costs is purely the consequence of the nature of oligopolistic interactions among incumbent firms. For the liberalizers, this is of course good news. The bad news is that the argument is extremely brittle. As is common in models of oligopoly, it is easy to reverse the result by assuming a different mode of behavior on the part of firms.

To formalize the argument, let us consider a two-stage game being played by a pair of duopolists. In the first period, each firm undertakes a certain amount of investment in technological effort, denoted by k_i and k_j respectively, taking as given the decisions of its rival. In the second, the firms compete in the domestic market. At the beginning of the second period, k_i and k_j are predetermined, and the profit function of firm i looks as follows:

$$(15) \quad \pi^i(q_i, q_j, k_i) = p^i(q_i, q_j)q_i - c^i(q_i, k_i),$$

where $p^i(.)$ is the inverse demand function faced by firm i, and $c^i_k < 0$. Firm j's profit function is symmetric. For the moment I have supressed imports; trade policy will be discussed below in terms of changes in the form of the inverse demand function faced by the firms. The first-order condition is:

$$(16) \quad \pi^i_i + v^i\pi^i_j = 0,$$

where a subscript denotes a partial derivative with respect to the relevant argument, and v^i is firm i's conjecture regarding how firm j will respond to changes in the former's output (see Dixit, 1985). Equation (16) and its analogue for firm j define a pair of best-response functions $q_i(q_j, k_i)$ and $q_j(q_i, k_j)$, and an equilibrium which is a function only of the predetermined investment levels k_i and k_j. Therefore, the second period equilibrium can be expressed as $q_i = q_i^*(k_i, k_j)$ and $q_j = q_j^*(k_j, k_i)$.

In the first period, firms are fully cognizant of the effects of their investment decisions on the subsequent game, so choose k_i and k_j accordingly. Letting $\phi(.)$ stand for the cost of investment ($\phi'>0$, $\phi''>0$), the problem for firm i is:

$$(17)\quad \underset{k_i}{\text{Max}}\ \tilde{\pi}^i(k_i, k_j) = \pi^i(q_i^*(k_i, k_j), q_j^*(k_j, k_i), k_i) - \phi(k_i).$$

If the firm takes its rival's decision as given, the first-order condition for k_i is:

$$(18)\quad \pi_i^i(dq_i^*/dk_i) + \pi_j^i(dq_j^*/dk_i) + \pi_k^i - \phi' = 0.$$

Notice that firm j's output is sensitive to changes in k_i only insofar as the latter affects firm i's output. So we can write $dq_j^*/dk_i = (dq_j/dq_i)dq_i^*/dk_i$. Let us define r^j as the slope of firm j's best-response function, i.e. $r^j = (dq_j/dq_i)$. Then $dq_j^*/dk_i = r^j(dq_i^*/dk_i)$. Now making use of (16), we can re-write (18) as follows:

$$(19)\quad (r^j - v^i)\pi_j^i(dq_i^*/dk_i) + (\pi_k^i - \phi') = 0.$$

The second term in parentheses here captures the conventional trade-off between

the costs and benefits of technological effort. In the absence of oligopolistic interactions, this would be the only determinant of the level of investment in technological development. The first term, on the other hand, captures the strategic role of the choice of technology, and it is on this that I will now concentrate.

Under standard assumptions, a decrease in marginal costs will make a firm produce more ($dq_i^*/dk_i > 0$) and an increase in the rival's output will hurt profits ($\pi_j^i < 0$), so that the sign of the strategic effect depends solely on the sign of $(r^j - v^i)$.[15] This term is the difference between the actual slope of j's best-response function and the conjecture entertained by i, and is a familiar one in models of oligopoly. When firms behave too "agressively" in the second period, v^i will be negative and large, so that $(r^j - v^i) > 0$. This is the presumption when firms compete in Bertrand fashion (setting prices and taking the price of the rival as given), for example. In this instance, the strategic effect makes a <u>negative</u> contribution to the first-order condition in (19); the optimal level of k_i will now be <u>lower</u> than would have been the case in the absence of a strategic motive. Intuitively, it is in the interest of the firm to increase its costs as this blunts some of its agressiveness in the second period. And the same is true for its rival. The profits to the firms from a consequently greater degree of collusion can outweigh the losses in productivity. But from a social viewpoint, the costs of oligopoly are now exacerbated by technical inefficiency.

So far, this is standard material.[16] The only new wrinkle comes with the

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15. See Dixit (1985) for more on this.

16. See in particular Dixit (1986) and Bulow, Geanakoplos, and Klemperer

role of trade policy. How does trade liberalization affect the technological choice in this framework? First, and most obviously, it affects the base level of output on which cost savings are distributed. This is the effect discussed in the previous section. As shown earlier, trade liberalization will reduce the incentive to increase productivity on this account as long as domestic output is reduced. This is captured in the present framework by a reduction in π^i_k.[17]

Secondly, and this is the key point, liberalization reduces the excess profits available in the home market, and therefore may be expected to de-emphasize the strategic motive for under-investment in technology. The algebra here gets quite messy, but the point is simple enough. As can be seen from (19), the incentive to inflate costs is proportional to π^i_j, which equals $q_i(\partial p^i/\partial q_j)$ (see [15]). In symmetric equilibrium ($q_i=q_j$), $q_i(\partial p^i/\partial q_j)$ can also be written as p^i/ϵ, where ϵ is the price elasticity of demand facing each firm. As the domestic market is opened, we expect p^i to decrease and ϵ to increase (in absolute value). On both accounts, the strategic disincentive for technological effort becomes smaller. In the limit of free trade, ϵ goes to negative infinity, so that the strategic disincentive disappears altogether.

This line of reasoning provides one possible rationale for why the oligopolistic market structures created by protection may create a bias against technological effort. But, as stated at the outset, this argument is not particularly robust. It relies on the possibility that firms compete "too

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(1985).

17. Note that $\pi^i_k = -c^i_k$. A reduction in domestic output therefore reduces π^i_k as long as c^i_{kq} is negative, i.e. as long as increased investment in technology lowers the marginal cost of production.

agressively", which in the present framework is captured by $(r^j - v^i) > 0$. If instead, firms have "consistent" conjectures $(r^j - v^i = 0)$, the strategic motive disappears and the considerations discussed above no longer come into play. Moreover, when firms behave in Cournot (quantity-setting) fashion, $v^i = 0$ and a negatively-sloped reaction function $(r^j < 0)$ implies that the strategic incentive will work to enhance productivity.[18] With Cournot behavior in the second period, there will be over-investment in technology as each firm would like to pre-commit itself to a larger scale of output. Trade liberalization will now be doubly inimical to technological performance.

V. The Role of Economies of Scale

One of the most appealing arguments for trade liberalization is the one that has been mentioned at the beginning of the paper: liberalization may foster the rationalization of industry structure by forcing inefficient firms out. The maintained hypothesis here is that protection tends to crowd in too many firms producing at too low levels of output.

The industry-rationalization argument relies crucially on two features of the industry concerned: (a) economies of scale, and (b) free entry and exit. In the presence of these two, there is indeed a very good case for trade liberalization on the grounds of productivity. The argument goes as follows. With free entry, the domestic price has to equal the average cost of the representative firm since incumbents cannot make excess profits. With IRS, average costs are a declining function of firm-level output. Therefore, any

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18. See Eaton and Grossman (1986) for a systematic discussion on the importance of conjectures.

policy which tends to increase the domestic price (e.g. protection) will also increase the average cost level in the industry. The mechanism that enables this is the entry of additional firms, which squeezes the output of the incumbents and forces them up their average cost curves. Conversely, liberalization reduces the domestic price and leads some of the incumbents to leave the industry. The remaining firms have to produce at sufficiently greater scale for the reduced level of average costs to match the lower domestic price.

Notice that this industry-rationalization argument is based on partial-equilibrium reasoning. Once the likely changes in relative factor prices are taken into account, the force of the argument can be blunted somewhat. The reason is that these factor-price changes are likely to dampen (or reverse) the increase in firm-level output as prices fall. Consider the following likely scenario for developing countries. Suppose that the fixed costs of production (the basis for IRS) consist primarily of capital costs. Then, if trade liberalization reduces capital costs relative to wages sufficiently--as the Stolper-Samuelson theorem would predict for developing countries--average costs at unchanged output levels could fall so much that restoring the equality between price and average cost may require a reduction in the scale of production of the typical firm. The consequence, paradoxically, may be de-rationalization (see Brown and Stern, 1988).

Barring these general-equilibrium complications, the cost savings from industry rationalization can greatly magnify the traditional gains from liberalization (Harris, 1984). In an earlier paper, I carried out some simple partial-equilibrium simulations for three Turkish industries to assess the likely welfare effect of pertial quota liberalization under various scenarios of market conduct (Rodrik, 1988). The existence of IRS was assumed in each case,

and modeled by incorporating some fixed costs of production. Table 2 summarizes the relevant results for the case of Cournot conjectures. The numbers highlight the crucial role of free exit, when such exists. In all cases, the industry rationalization promoted by exit adds a considerable boost to the overall welfare effect, turning a negative outcome into a positive one in one instance.

In the presence of free entry and exit, a rather similar outcome could obtain even when IRS is not particularly important, as long as firms differ in their levels of productivity. There is evidence that such differences may be quite important in some developing countries and in some industries (Page, 1984). Large differences in productivity are of course sustainable only with trade protection. Under free entry, the domestic price equals the average cost of the marginal firm. With liberalization, the least efficient firms have to exit until the new marginal firm is defined by the level of productivity which equates its average cost with the (lower) domestic price. Just as in the IRS case, the average level of productivity rises with liberalization.

Enthusiasm for such arguments, however, has to be tempered by realism about market circumstances in developing countries. In practice, frictionless entry and exit are likely to be the exception rather than the rule. Exit is particularly problematic, as it implies a well-developed secondary market in capital equipment: if firms cannot dismantle and sell their operations--in other words, if capital is sunk--the productivity benefits of liberalization can be easily canceled. Firms will not exit until prices fall below average <u>variable</u> cost, and may not even do so then if they are cross-subsidized by affiliates in other sectors. On the other side of the ledger, depreciation of machinery and equipment may provide a natural form of exit over time. Market obstacles aside,

$$(20)\quad \mathcal{L} = p(q_d, m)q_d + p^*q_x - F - c(q_d + q_x) + \lambda(Q - q_d - q_x) + \mu_d q_d + \mu_x q_x,$$

where p^* is the (exogenous) world price, λ is the Lagrange multiplier for the capacity constraint, and μ_d and μ_x are the respective multipliers for the non-negativity constraints. The first-order condition for exports is:

$$(21)\quad p^* - c - \lambda + \mu_x = 0.$$

We can now distinguish two cases. In the first, $p^* < c$ so exports would not even cover marginal costs. Then $\mu_x > 0$ and $q_x = 0$. But when $p^* \geq c$, exports are worthwhile ($\mu_x = 0$), so that the firm increases its export sales all the way until the capacity constraint is hit and $\lambda > 0$.[20]

Notice that the firm's export incentives are not adversely affected by circumstances in the domestic market, and in particular by the extent of trade protection. If anything, trade protection is <u>conducive</u> to exports in the following sense: protection allows the firm to make some excess profits at home which can be used to cover its fixed costs; exports then become attractive even if the world price is <u>below</u> the firm's average cost (case two above). Protection allows some exports in a sector where, in the absence of protection, there may not have been any domestic production to begin with.

When we relax the assumption of constant marginal costs, the case for protection becomes even stronger. Suppose that IRS takes the form of decreasing marginal costs. Now protection allows the home firm to increase its domestic sales, and therefore to reduce its marginal cost. With a lower marginal cost,

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20. This assumes that the firm finds it profitable to produce in the home market.

the firm can become more competitive in world markets, and therefore increase its exports as well. This is Krugman's (1984) model of "import protection as export promotion". The sheltered home market provides the domestic firm with the cost savings needed to compete with larger rivals in world markets. Notice that this is a vision diametrically opposed to the one where free entry crowds in too many firms operating at high cost. Which story one believes in depends on one's priors regarding the ease of entry and exit and the effectiveness of entry restrictions imposed by governments.

VI. Concluding Remarks

My objective in this paper was to identify some of the arguments commonly made regarding the trade-productivity nexus, and to hold them to the analytical light. I have argued that many of these arguments lack coherence. We are far from having any systematic theories which link trade policy to technical efficiency. In particular, we do not have any good reason to expect that trade liberalization will generally be helpful to overall technological performance.

The usual call for more empirical evidence is perhaps more appropriate in this instance than in any other. As more countries experiment with trade reform, the universe of empirical studies should broaden. The challenge, however, is to escape the identification problem which has plagued all previous studies. In practice, the arguments for following sensible macroeconomic policies--realistic exchange rates and moderate fiscal deficits, in particular--are too often confused for arguments on behalf of trade liberalization. Partly as a result, countries that reform their trade policies often do so in the context of macro stabilization programs. When stabilization alleviates the foreign exchange bottleneck and capacity utilization increases, industry

typically experiences an increase in its measured productivity level. It becomes tempting to credit the improved productivity performance to trade policy.

Until more evidence becomes available, then, a healthy skepticism is in order. In the meantime, if truth-in-advertising were to apply to policy advice, each prescription for trade liberalization would be accompanied with a disclaimer: "Warning! Trade liberalization cannot be shown to enhance technical efficiency; nor has it been empirically demonstrated to do so."

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Table 1: The Comparative Role of Total Factor Productivity (TFP)

(percent)	Growth of value added	TFP: growth	TFP: share	factor inputs: growth	factor inputs: share
Average for developing countries	6.3	2.0	31.0	4.3	69.0
Average for developed countries	5.4	2.7	49.0	2.7	51.0

Source: Chenery, Robinson, and Syrquin (1986), Table 2-2.

Table 2: Effects of Partial Trade Liberalization with Scale Economies, Turkey, c. 1980

	Autos	Tires	Electrical appliances
Welfare Effects* with:			
fixed number of firms	2.6	0.6	-0.5
free exit	5.2	4.1	1.2

Note: * Increase in welfare, measured as a share of base consumption, arising from a ten percent quota liberalization.

Source: Rodrik (1988), Tables 5, 6, and 7.