Internal Returns to Scale as a Source of Comparative Advantage: The Evidence

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During the past 15 years many trade theorists have incorporated scale economies and imperfect competition into their models. This abandonment of perfect markets has profoundly changed the way that economists think about the determinants of trade flows and the effect of trade policies on performance. Below I selectively review the empirical evidence on both issues, focusing on the role of increasing internal returns to scale (IIRS).[1] To conserve space, I refer the reader to the working-paper version of this document (Tybout, 1993) for more extensive references.

I. IIRS as Basis for Trade

Trade models with IIRS go beyond traditional comparative-advantage arguments in many respects; I will concern myself with three. First, they establish a new basis for gains from specialization, one that exists even when trading partners have identical technologies and factor proportions. Second, they suggest that producers who enjoy large domestic demand for their products are at a competitive advantage in world markets. Third, using IIRS in the producer-goods industries, they identify some new possible linkages between trade, productivity, and growth.

A. *IIRS-Based Gains from Specialization*

When average production costs fall monotonically with plant size, the gains from trade are obvious. Each good can be produced most efficiently at a single plant, so it makes sense for each trading partner to specialize. The purest example of this type of trade is the contestable-markets model (Elhanan Helpman and Paul Krugman, 1985 Ch. 4). Increasing returns and the threat of entry ensure that, for a given market, there is only one producer for each product, and each producer prices at average cost. Trade effectively creates a single world market and thereby concentrates production of each good in a single firm.

A closely related example is the monopolistic competition (intraindustry trade) model (e.g., Helpman and Krugman, 1985 section III). It also is based on free entry and average-cost pricing, but it treats the number of product varieties as endogenously determined by the interplay between returns to scale and market size. Under autarky, the number of varieties in each country is small; trade gives consumers access to a richer menu. The scale efficiency of individual plants also improves if trade increases their demand elasticities.

What do we know empirically about these motivations for trade? The most robust finding is based on industry-level data: countries with similar endowments tend to engage relatively heavily in two-way trade of similar products. This finding is usually interpreted to support the monopolistic competition model, which predicts that much trade will be intraindustry when endowments are similar. However, the contestable-markets model predicts this too, given that data at the industry level typically

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[1]By IIRS, I mean that the elasticity of plant-level total cost with respect to output is less than 1 over some range. I will not discuss learning-by-doing effects, which are conceptually distinct.

span multiple products. One could even argue that the data reflect reciprocal dumping (James Brander and Krugman, 1983): identical countries spawn identical producers who penetrate each other's markets because they can price-discriminate. If this latter model explains the data, neither the gains from specialization nor those from greater product diversity need be present.

All of the models I mentioned above involve IIRS; so one might conclude that, at a minimum, the evidence I have cited implies that scale economies generate trade. However, econometric attempts to refine this evidence by quantifying the role of scale economies have generally proved uninformative.[2] As James Harrigan (1991) and Edward E. Leamer (1992) observe, the results do not rule out constant returns everywhere, with trade created solely by consumers who like diverse bundles of home and foreign varieties.

Part of the problem lies in the fact that these studies are only loosely motivated by theory. Almost all econometric studies that treat scale effects regress the Grubel-Lloyd index of intraindustry trade (Hubert G. Grubel and P. J. Lloyd, 1975) on characteristics of the trading partners, industry-specific scale-economy proxies, and other control variables. However, Helpman and Krugman's (1985) model of intraindustry trade implies that the Grubel-Lloyd index "does not vary with variations in scale economies [or] product differentiation..." (Harrigan, 1991 p. 3). Wilfred Ethier (1982 p. 390) reached a similar conclusion regarding trade in intermediate goods: "although the existence of internal scale economies and product differentiation are essential to the theory, the degree of such phenomena need not be an essential determinant of the degree of intraindustry trade." Hence, since all manufacturing technologies involve at least *some* fixed start-up costs, the data do not contain the type of variation necessary to reject these theories or to give empirical content to the role of increasing returns.

Generalizations of the analytical intraindustry trade models would lead to some predictions concerning the relation between the degree of scale economies and the extent of intraindustry trade. However, data limitations would remain. The scale-economy proxies (shares of employment at big plants, concentration measures, and price-cost margins) are themselves endogenous and are far from the theoretically appropriate technology parameters. Also, since scale-economy proxies do not vary much across time or location for a given industry, their coefficients are identified with cross-industry variation in the data. As Leamer (1992) has noted, cross-industry studies imply strong assumptions about the uniformity of demand structures across sectors.

B. *Home Market Size and International Competitiveness*

Krugman (1980, 1984) has argued in several contexts that plants with large home markets are better able to exploit scale economies and thus are more competitive abroad. On the surface, the evidence supporting this proposition seems compelling. Many studies report that exporters are typically larger than plants oriented toward the domestic market in the same industry. Similarly, controlling for domestic market size, there appears to be a positive association between industry-wide plant-size measures and the amount of export activity. These results could mean that bigness facilitates competitiveness in foreign markets. Further, bigger economies have bigger plants, so large domestic markets may confer a competitive advantage on potential exporters through IIRS.

Even without IIRS, however, those plants with relatively low marginal costs are likely to be larger and export more (e.g., Krugman, 1984); so the data may partly reflect cross-plant differences in learning-by-doing, R&D, region-specific externalities, capital-stock vintage, and luck. In fact, I believe

[2] Harrigan (1991) and Leamer (1992) also reach this conclusion; I draw upon them both in my discussion here.

that much of the observed correlation between size and exports is due to these factors: in most industries, IIRS only explains a small fraction of measured productivity variation.

C. *Indirect Productivity Effects*

As noted earlier, IIRS limits the number of product varieties that can be profitably produced under monopolistic competition. Trade relaxes this limit and thereby improves the welfare of consumers who like variety. Ethier (1982) observed that, if trade expands the variety of *producer* goods available, it could analogously improve productivity in the final-goods sectors. Others have embedded this insight in endogenous-growth models, showing how the range of product varieties—and hence productivity—might evolve through time in a way that depends on trade policy (e.g., Gene Grossman and Helpman, 1991).

Bits of evidence suggest that this deployment of the IIRS assumption may be empirically relevant. Several studies have found that intraindustry trade is relatively prominent in producer goods, so IIRS may be relatively important there. (Recall, however, the limitations of this kind of inference.) Also, Robert Feenstra et al. (1992) report that the use of new intermediate goods has significantly improved productivity growth for a sample of Korean manufacturing plants. Finally, in a large cross-section of countries, David Backus et al. (1992) report that the Grubel-Lloyd index of intraindustry trade in manufactured goods is significantly correlated with growth rates in per capita GDP. Nonetheless, a great deal of empirical work remains to be done before one can be confident of this kind of linkage among IIRS, productivity, and trade.

II. IIRS and the Gains from Trade

Economists care about understanding trade flows mainly because they want to identify potential welfare gains. Accordingly, rather than ask whether IIRS explains trade flows—certainly it explains *some*—it is perhaps more interesting to ask whether IIRS significantly changes the magnitude of the welfare effects of trade policy. Dynamic effects aside, this might happen for several reasons. First, if there is love of variety, trade with IIRS can make consumers of intermediate and final goods happier by increasing the menu of available products. Second, when IIRS creates entry barriers and profits, it may be possible to shift rents between countries. Finally, trade policy may improve the scale efficiency of production. In the space that remains I wish to review the evidence on this last possibility.

A. *The Evidence From Simulations*

Computable general equilibrium (CGE) models provide the main source of quantitative evidence on scale efficiency gains. Without attempting to be comprehensive, it is instructive to review some features of recent simulation exercises.[3] First, static CGE models with increasing returns commonly assume that the manufacturing sector exhibits substantial IIRS. These returns are typically *at least* as large as engineering studies suggest for plants at one-half minimum efficient scale, and often substantially more. So when the gains from trade liberalization are found to be small, it is usually because there is little change in plant size, and not because there are no scale economies to exploit. Second, in a number of studies, substantial increases in plant size *are* found, sometimes even in the industries that are net importers. Finally, and as a consequence, these studies leave the impression that the potential gains from scale-economy exploitation with trade liberalization can be substantial: 2 percent of GDP or more from manufacturing alone.

B. *Other Evidence*

Unfortunately, in several important respects, the patterns of size adjustment and

[3]See J. David Richardson (1989) for an early survey, Harry Flam (1992) for a survey of findings on European integration, and Drusilla Brown (1992) for a survey on North American integration.

scale-economy exploitation predicted by CGE models do not conform to other evidence. The first inconsistency arises because the returns-to-scale estimates that are used to calibrate these models are not share-weighted averages of returns to scale at the different plant sizes. That is, if all plants in an industry expand at some equal rate g (as they do in CGE models), the industry-wide rate of reduction in average cost is $g\sum_i \alpha_i(\varepsilon_i - 1)$ where α_i is the ith plant's share of total industry cost, and ε_i is the elasticity of total cost with respect to output at the ith plant. Hence returns to scale at the big plants are what matter most, and these are close to constant. (If small plants expand more rapidly than large plants, the scale effect is amplified, but there is an offsetting shift of market share toward smaller, relatively inefficient producers.)

To get some sense for the realized scale gains when share-weighted averages are used, Daniel Westbrook and I estimated production technologies from large panels of Mexican manufacturing plants (Tybout and Westbrook, 1992). We then used actual plant-specific growth rates to impute the scale-efficiency gains for each industry during Mexico's recent period of dramatic trade liberalization: 1984–1990.[4] We found that real output expanded substantially in most sectors and that the overall decline in real average costs was between 2 percent and 17 percent, depending on the industry. However, most of this cost savings came from other sources. The scale effects were greater than 2 percent of average cost in only three of the 20 industries studied, and in one of these instances the scale effects tended to *increase* unit costs. (Interestingly, market-share effects were generally important: production shifted toward the more efficient plants.) Of course the Mexican adjustment pattern cannot be attributed wholly to commercial policy, but the order of magnitude of our figures suggests that the scale efficiency gains from IIRS have been rather overdone in the simulation literature.

Even if the scale-economy estimates used in CGE models are appropriate, there is another reason to suspect that many are overstating the gains from liberalization: models with large gains predict widespread increases in plant size. As already noted, export activity and plant size are positively correlated; but trade liberalization also leads to heightened imports, and many econometric studies have found that import penetration is associated with *reduced* plant sizes, controlling for domestic demand. Studies correlating plant-size proxies with protection levels or intraindustry trade measures give conflicting messages.

Though each study I cite in this section is subject to criticism, together the evidence suggests that direct scale-efficiency effects are small. Thus, if IIRS does lead to large welfare gains, it is probably mainly because it leads to imperfectly competitive market structures. These, in turn, open the possibility that commercial policy will enrich product menus, shift rents, move producers toward marginal cost pricing, reduce waste, or influence rates of technological innovation and diffusion.

[4]The returns-to-scale estimates in Tybout and Westbrook (1992) implied downward-sloping average-cost curves that appeared to be broadly consistent with engineering estimates. Even if we double or *triple* the cost disadvantage ratios for each plant, however, our findings are qualitatively unchanged.

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