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EMPIRICAL RESEARCH ON TRADE LIBERALIZATION WITH IMPERFECT COMPETITION: A SURVEY

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ABSTRACT

This paper attempts a synthetic census of the calibration/counterfactual style of empirical research on the benefits of trade liberalization with imperfect competition and scale economies. Computable-general-equilibrium studies are surveyed, as are a large number of partial-equilibrium studies in the same style. Microeconomic foundations common to almost all of the studies are discussed algebraically, and the corresponding general-equilibrium structure is discussed graphically.

The first typical conclusion from the studies surveyed is that calculated gains in national purchasing power are usually two to three times the size of those estimated in traditional frameworks with perfect competition. Only occasionally are welfare losses calculated from trade liberalization, although such losses are quite possible in theory, as a large recent literature has shown.

The second typical conclusion is that calculated adjustment pressures from trade liberalization are considerably higher than implied in most commentary, and higher also than estimates from traditional models. Adjustment pressures describe stimuli for workers to shift activities, for firms to grow or die, for industries to expand or contract, and for trading-partner shares to be altered.

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I. INTRODUCTION, OVERVIEW, AND CONCLUSIONS

The theory of trade policy has changed markedly in the past ten years or so. One of the fundamental reasons is that the international trading environment itself has changed.

Imperfectly competitive behavior seems increasingly relevant and perfect competition less. Technological advantage, scale economies, and multinational corporations seem to be playing growing roles in international trade. Governments own some of the multinationals and champion others, often pitting themselves against each other as competitive promoters and defenders of their own firms. Equilibrium in global markets seems often to be determined by small numbers of large strategically self-conscious agents (firms and governments), not by large numbers of small agents competing at arms length. Such oligopolistic equilibria have a quite different character than perfectly competitive equilibria, and respond to government policy initiatives quite differently.

In part these changes are a reflection of the changing composition of trade, as documented for example, by the OECD (1987b). As a share of total trade and production for 14 large OECD countries, resource- and labor-intensive commodities have been shrinking steadily, and science-based, scale-intensive, and differentiated commodities and services have been growing; "intra-industry" trade has jumped dramatically in the 1980s after remaining constant during the 1970s.

The most important reason for the present survey of early empirical research under imperfect competition is that it is necessarily an <u>empirical</u> question whether or not an economy gains from trade liberalization in this environment. The easy presumption of gains from perfectly competitive mindsets

vanishes under imperfect competition. Yet as discussed in more detail below, early empirical research has generated a replacement presumption: as a rule, trade liberalization still leads to gains, and when they are there, they are two to three times larger than those estimated under perfect competition.[1]

Section II of the survey discusses the theoretical background for the empirical research in three ways: verbally, algebraically, and graphically. The algebra and graphics are admittedly stylized, and the examples discussed are decidedly hypothetical. Yet the approach aims for clarity and accessibility, and its purpose is to distill a set of pure, unmixed elements that underlie the effects of trade policy under imperfect competition.[2]

The pure elements from Section II are joined in various combinations in the more realistic and less stylized empirical work surveyed in Section III. Indeed the purpose of the distillation in Section II is to allow decomposition and comprehension of the empirical results of Section III. The theoretical elements are building blocks; the empirical studies are buildings -- scale models, to be sure, still only approximations to reality, but approximations that depend at least on data and generalized wisdom on how the economic world works.

In this spirit, Section IV completes the survey with some directions for building better scale models -- more interesting, more practical, and more useful for private decision-making and the assessment of policy.

The most important conclusion from the research surveyed is that simultaneous reduction of barriers to international and internal competition creates sizeable and mutually reinforcing increases in an economy's real income. There are exceptions, however. Such benefits are not virtually "guaranteed," in the way that they are in traditional textbook models of market economies with undistorted, perfect competition. Exceptions notwithstanding, the rule is that

trade liberalization still generates significant gains under imperfect competition with scale economies.

Although there are sizeable estimated gains, these studies suggest a second conclusion: the blessings are not unmixed. Trade liberalization can cause significant adjustment pressure -- probably on firms and workers most heavily, but possibly also on entire industrial sectors and historically important trading partners. This research does not support the blithe dismissal of adjustment pressure popular among those who emphasize specialization among mildly differentiated product lines. In that case, its burden would be light, focussed on specialization within firms and two-way intra-industry trade. Such effects are certainly there in the estimates, but so also are forced exits of marginal firms, moderate stimuli for workers to move from sector to sector, and sharp changes in trading patterns among traditional trading partners.

The most important research question for the future is whether these conclusions will continue to hold in the more refined extensions of empirical research that are discussed in Section IV, and if so, how policy should be shaped in their light.

II. THEORETICAL BACKGROUND

Both theory and empirical research on trade policy under imperfect competition have borrowed heavily from industrial organization. It is useful first to summarize some partial- and general-equilibrium thinking about elementary industrial organization, and then to show how trade policy matters in the typical empirical study.

A. Microeconomic Structure

Most empirical studies of trade policy under imperfect competition use a very straightforward, yet very flexible, model of firm and industry behavior.[3] The model includes many realistic features, and also many familiar and robust economic relationships. For example, a sensible firm will keep on producing and marketing a product until the extra revenue it earns from selling another unit just covers the extra cost of producing it. This familiar equality between "marginal revenue" and "marginal cost" implies a realistic kind of mark-up pricing, after some algebraic manipulation:

$$(1) \qquad \frac{p - c}{p} = \frac{1}{e};$$

where p and c are the product's price and marginal cost, and where e is the elasticity (responsiveness) of demand that the firm perceives when it changes its price (defined positively).[4] Sensible firms will charge a mark-up over marginal cost (p - c), which when expressed as a proportion of price, is simply the reciprocal of the perceived demand elasticity. Elasticity governs market power. A firm facing an elasticity of 2 will mark up price so that it doubles marginal cost. One facing 3 will mark up price 50 percent above marginal cost. Perfect competitors facing infinitely elastic demand will enjoy no market

power and no mark-up, but will be induced to price at exactly marginal cost (including of course the marginal cost of management, risk-bearing, and other entreprenurial activity).

In imperfectly competitive settings, the first interesting question is how one firm's market power depends on the actions of its rivals. This can even be measured, and provides a first index of imperfect competition for empirical purposes. For example, suppose that n similar rival firms sell q units each of the same product in the same market. Then the total amount sold (nq) will in equilibrium be willingly purchased by buyers according to a market demand schedule:

$$nq = A - Bp, \tag{2}$$

where A and B can be considered constants. This market demand schedule has its own elasticity E, which can be shown to equal the reciprocal of $A/Bp - 1$.[5]

E, the market demand elasticity, will not in general be equal to e, each firm's perceived demand elasticity. It is helpful to see their relationship and the interdependence of each firm's market power along a continuum ordered by an "imperfection weight" w:

$$\frac{1}{e} = w\left(\frac{1}{E}\right). \tag{3}$$

At one extreme, for perfectly competitive firms, $w = 0$; imperfect competition plays no role, and firms are independent. At the other extreme, for a monopolist, $w=1$, and e <u>is</u> E. For a tight collusion of n firms, acting as if they were one to maximize joint profits, w also = 1, and each firm faces an e that is equal to E. With less intensely collusive competition, w falls between 0 and 1, and each firm's market power depends moderately on that of its rivals. When w

is empirically estimated (see Bresnahan (1987)), it serves as one measure of the imperfection of competition.

A very important intermediate degree of imperfect competition is called Cournot competition. It is a useful empirical reference point, in which w equals each firm's share of the overall market ($w = q/nq = 1/n$, and hence $e = nE$). Cournot competition is what emerges when each firm perceives as given the outputs of its rivals and then optimally decides on its own output.[6] "Cournot pricing," often encountered in empirical studies, is marking up price above marginal cost by the reciprocal of nE, the product of a firm's market share and the overall market elasticity.

The intensity of competition, measured by w, is one important dimension of imperfect competition. A second is profitability, connoting excess profits -- profits above the normal amount necessary to keep entreprenurial resources committed. Unhindered ("free") entry and exit of firms drives excess profit rates per unit of output, r, close to zero in the long run.[7] In that case, the market structure is described as "monopolistically competitive." If n cannot vary, but is fixed by barriers to entry (or exit), then r is variable, and the market structure is called oligopolistic.

The excess profit rate r is defined more precisely as the proportion by which price lies above average cost per unit of product. Average cost is the sum of variable and fixed cost (f). Empirical studies often assume constant variable cost per unit, making

$$(4) \qquad r = \frac{p - c - f/q}{p} .$$

When free entry and exit drives excess profits to zero, (4) implies that $(p-c)/p = f/pq$. In this case, a firm's mark-up over marginal cost from

equation (1) is not arbitrary, but necessary to pay fixed cost per dollar of output. Market power is then merely the power to pay off one's fixed commitments to operate--legal incorporation and retainer fees, plant construction and maintenance, market research, licensing, and so on. Sometimes a finer distinction is made between "sunk" fixed costs, like initial incorporation and irrecoverable construction costs, and recurrent fixed costs, like retainer fees and plant maintenance. Sunk fixed costs are paid one time, and will be spread over however many periods that a product is produced; recurrent fixed costs are paid every period.[8]

Built into (4), and into the definition of average cost, is increasing returns to scale, in this case the ability to spread fixed costs thinner and thinner over larger and larger outputs. The sector described by equations (1) - (4) can be seen in fact as a type of natural monopoly. On the face of it, it would be wasteful for a duopoly to use up resources worth 2f when a monopoly would require only f to supply the whole market.

B. General Equilibrium Structure and Trade Policy

International trade and trade policy affect this imperfectly competitive behavior in numerous ways. Three of the most important for policy debate and empirical work on economic welfare can be illustrated in a very simple diagrammatic generalization of the behavior to the whole economy. Trade policy has potential to accentuate or alleviate an economy's losses from: (1) distortionary pricing above marginal cost; (2) wasteful duplication of facilities or firms whose fixed costs cause a sector's average costs to be unduly high; (3) exploitative income transfers to foreign firms charging excess profits. After introducing the diagram, the case in which trade liberalization alleviates losses is discussed at length, followed by allusions to the remaining cases.

The diagram is admittedly stylized. But it clearly captures many of the significant contentious issues in trade policy under imperfect competition, and it reveals the most important ways that empirical models have attempted to quantify their importance.[9]

Figure 1 illustrates overall equilibrium for a hypothetical economy with one perfectly competitive sector, producing standardized goods (S), and a second imperfectly competitive sector, producing technology-intensive goods (T). The T sector will fit equations (1) - (4) above. Figure 1 can be taken initially to illustrate prohibitive trade barriers and a closed economy.[10]

In order to produce even the first unit of T-goods, a fixed cost of f must be borne. Resources that could have produced S_0S_1 of standardized goods must be diverted, say, to a research laboratory for T. The economy's production possibilities curve $S_0S_1T_1$ lies uniformly inside of a reference curve that would pertain without fixed costs, S_0T_0.[11] Furthermore, if two firms compete by setting up research laboratories in order to produce T goods, the economy's production possibility curve would lie even lower: $S_0S_2T_2$. The second research laboratory may involve a social waste of resources equal to f, and the second firm's entry into the T market is possibly an example of inefficient entry.[12]

Since imperfectly competitive firms mark up price above marginal cost, equilibrium is illustrated in Figure 1 by a point like Q_1 for monopolistic market structure, and Q_2 for a duopoly. Buyers determine purchases at Q_1 so that their satisfaction from the last dollar's worth of each good bought is equal -- illustrated by tangency between the relative price line p_{T1}/p_{S1} and the equal-welfare curve U_1. Imperfectly competitive mark-ups at Q_1 or Q_2 make the

relative price of T goods higher than the relative marginal cost of T goods, c_T/c_S, which is what the slope of the production possibilities curve represents. The wedge between the two dashed lines at Q_1 represents a wasteful price distortion.

Finally, it is quite possible, for example at Q_2, that both firms are earning excess profits.[13] But both may be paying a portion of potentially larger excess profits to a foreign patent holder whose innovation the two research laboratories are implementing -- a fixed fee, say, somewhat similar to the fixed costs f. In that case there is a transfer of excess profits abroad, and the economy's real income, OQ_3, is less than its real output OQ_2.

Q_0 is a hypothetical reference point that locates the competitive equilibrium for this economy in the absence of any fixed costs. At least f of fixed costs is, however, an assumed fact of life, and the fundamental cause of imperfect competition. Thus the best the economy could hope to do is attain the equilibrium (undrawn) on $S_0S_1T_1$ that just kisses (is tangent to) an equal welfare contour like U_0, but below it and above U_1.

Relative to that "best" equilibrium, imperfect competition in this stylized economy can reduce welfare for three reasons. Price distortions can reduce welfare to U_1. Inefficient entry of a second T firm seeking excess profits can create unduly small-scale production and high average cost, reducing welfare further to U_2. And net payments of excess profits to imperfect competitors abroad can reduce welfare still further to U_3.

Now we can identify some extra potential gains from trade for an economy with imperfect competition. Liberalization that opens this particular economy to trade has all its normal benefits and more. Freer trade normally allows an economy to increase welfare to, say, U_* by shifting production to a point like

P_* and consumption to a point like C_*, with exports of S and imports of T respectively equal to the vertical and horizontal distances between P_* and C_*. But freer trade in this case also: (1) reduces imperfectly competitive price distortions, as every domestic firm is forced to compete against new foreign rivals; (2) "rationalizes" the domestic industry by forcing exit of excessive firms that drive up average costs; (3) reduces transfers of excess profits abroad. The economy's gains from freer trade, counting its effects on imperfect competition, are more like the difference between U_3 and U_* than between U_0 and U_*.

This accounting, however, is one-sided. It neglects to convey that most imperfectly competitive behavior is a two-edged sword. It can "cut" in _favor_ of an economy as well as against it. Contrary to Figure 1, trade liberalization under imperfect competition is not guaranteed to produce extra benefits, either in theory or in practice. A simple alteration in the figure to make the economy an inherent exporter of T goods, instead of an importer, could show that: (1) mark-up pricing on imperfectly competitive exports can capture the same _benefits_ as the classic optimal tariff under perfect competition; (2) having two dominant producers that have already sunk 2f of fixed costs in an export market (Boeing and McDonnell-Douglas?) can deter undesirable entry by a foreign competitor (Airbus?) that could potentially reduce the exporter's national welfare (see Krugman (1987, pp. 135-136); and (3) an economy's imperfectly competitive firms may on balance be _collectors_ of excess profits on exports, which enhance its welfare. In this altered scenario, trade liberalization may reduce and even reverse the standard gains from trade. Trade liberalization may be detrimental to an economy, not beneficial, with imperfect competition.

Some of the elements in this fuller accounting, especially (3), are of course transfers from one economy to another. Thus from the viewpoint of all trading economies together, they are neither a gain nor a loss. Other elements, though, especially (1) and (2), apply at the global level as well: trade liberalization can be an effective instrument for disciplining distortionary forces and economizing on fixed resource costs -- or, occasionally, it can accentuate distortions and resource costs.

We can draw an important conclusion about imperfectly competitive environments. From a national viewpoint, it is necessarily an empirical question whether there are gains from trade liberalization or losses, gains from active trade intervention or losses. We will turn to research that attempts to answer that question after completing our inventory of extra trade-policy considerations forced by imperfect competition.

C. Some Additional Considerations

Evaluators of any trade policy initiative under imperfect competition, need to need to weigh its effects on (1) price distortions, (2) sectoral rationalization, and (3) profit transfers, as discussed above. In addition, evaluations need to be concerned with several other unique features.

(4) Adjustment Pressure and Trade Patterns. Trade liberalization under imperfect competition due to scale economies can cause much more dramatic, discontinuous changes in trade, production, and market structure than under perfect competition with zero fixed costs. Rationalization will usually imply that some plants or firms shut down, not just that they shrink. It may imply that a country loses all firms and production in a given sector.[14] For example, in Figure 1, a slight flattening of the dashed line $P_{*}C_{*}$, equivalent to a small drop in world prices of technology intensive goods, will cause the ideal pro-

duction point to jump discontinuously from near $P_{\star}$ to S_0, without traversing intermediate points of incomplete specialization.[15] Both exports of S and imports of T would nearly double. Very little increase in welfare would result, but the T-industry would vanish. A very small, not very costly import barrier could then cause the industry to re-appear suddenly. That suddenness is precisely the point: trade and trade policy in some cases have very powerful effects on the sectoral composition of a country's production and employment under imperfect competition, without necessarily affecting its long-run welfare much.[16] But in the short run, obviously, welfare could decline if firms became suddenly insolvent, capacity became temporarily unproductive, and employees faced long dislocation and the need to move or retrain.

Several commentators summarize this concern and provide evidence.[17] Others, however, discount the concern. They suggest that what happens instead is that rationalization causes each country's firms to specialize on narrowly defined <u>varieties</u> of a product, so that any dramatic changes in production and trade are of an "intra-industry" sort. A country may indeed cease producing large automobiles, but correspondingly increase its production and export of intermediate-sized models. Short-term adjustment costs will be minimal because the same firms produce both varieties of auto, each of which uses very similar plants, machinery, workers, and techniques.[18]

(5) <u>Product Variety</u>. Product variety is important in its own right. Rationalization across different varieties of similar products is a unique potential gain from trade liberalization under imperfect competition (Helpman (1984, pp. 355-362)). One benefit is availability. Trade liberalization may make certain varieties of a product available for the first time, a clear welfare gain. A related benefit is continuity. Trade liberalization may make

choices possible along a continuum of quality and performance characteristics, whereas gaps exist without it. "Just the right lathe" or "the perfect truck" for our route structure may have been unavailable or unduly expensive because of trade barriers. Continuity in turn can heighten the desirable competitive discipline provided by close substitutes for a product.[19]

There is a possibility, however, that trade liberalization might reduce variety. This possibility is most pronounced when each firm produces a set of varieties that do not "overlap" significantly with those of other firms.[20] Gains from increased varieties of foreign products should then be weighed against any losses from reduced varieties of domestic products caused by exit of domestic firms. The latter could possibly outweigh the former.

In general, however, it seems likely that trade liberalization will increase the "supply of variety" for all buyers. In fact, entirely new varietes may spring up, as global market sales of a new variety may be large enough to cover its fixed costs (f), but sub-global sales were not.

Finally, as implied by the examples above, variety is no frivolity. It is arguably more important to firms in purchases of capital equipment and intermediate components than to consumers. To increase variety in producer goods actually increases productivity and lowers resource costs.[21]

(6) <u>Cost Effects</u>. Trade liberalization reduces resource costs by increasing the availability and lowering the price of imported intermediate and capital goods. Both of these effects can be discussed in perfectly competitive analysis.[22] Imperfectly competitive behavior adds new considerations. Fixed costs themselves (f) may be reduced by importing research and development, legal and financial services, capital equipment, and so on. Fixed costs may become an irrelevant fact of life if production becomes specialized (for

example at S_0 in Figure 1). Entry may be encouraged when marginal costs (c) are reduced by cheaper imported inputs. Entry will in turn generally increase the perceived demand elasticities of incumbent firms (e) and reduce the price distortions caused by their mark-up pricing.

(7) Demand-side Effects. Almost all trade policy alters market demand curves. But such alterations have greater significance for imperfectly competitive behavior than for perfect competition, where firms' demand curves remain invariantly flat. Mere rotation of the market demand curves around an equilibrium point will change perceived elasticities (e) and the equilibrium -- even if no conventional "shift" occurs (Bresnahan (1987, pp. 38-39)). Changes in tariffs will usually change the elasticity of the market demand curve (E), and hence change the size of mark-ups and price distortions (which are invariant at zero, of course, under perfect competition). Voluntary restraint arrangements that prescribe market shares (such as in steel for many countries and in autos for some) can alter the power relationships among rivals dictated by equation (3). By implicitly guaranteeing market share, they can convert moderate competition into a tight collusion with no competition at all (w can rise to one).[23] Mark-ups would rise and price distortions would become worse.

Integrative trade liberalization --for example, liberalization that turns two separated national markets, with different firms competing in each, into one integrated common market -- almost certainly increases welfare (Smith and Venables (1988a), Markusen and Venables (1988)). Even if overall market elasticity E remains the same from adding together two demand curves like equation (2), the new presence of n_1+n_2 firms instead of n_1 or n_2 puts pressure on perceived elasticities (e) to rise, with consequently smaller mark-ups and price distortions.

Among almost all of these additional features of imperfect competition can be found reasons for a country's trade liberalization <u>and</u> reasons for its trade-policy activism. Which dominate and when is the necessarily empirical question to which we now turn.

III. EMPIRICAL RESEARCH

A. Overview

The first conclusion from early empirical research on these matters is that incorporating imperfectly competitive behavior, especially when motivated by scale economies, can make a significant difference to estimated effects of trade policy on economic welfare, industrial structure, and adjustment. Table 1 summarizes the studies discussed in Section C and Tables 3 and 4 below. The comparisons (small, moderate, large) are in every case to empirical research that assumes perfect competition and no fixed costs or scale economies. "Small" suggests little quantitative sensitivity to the inclusion of scale effects and imperfect competition; "large" suggests considerable sensitivity.

Table 2 further documents the importance of imperfect competition. It summarizes the results of several empirical studies capable of answering the question, "How would calculations have changed if fixed costs had been assumed to be zero and competition had been assumed perfect?"[24] In every case the calculations are estimates of the effect of various kinds of trade liberalization on the overall economic welfare of countries and regions. Economic welfare is defined as real income, a measure of the volume of goods and services that a given income can purchase, corresponding to the value of alternative U-curves in Figure 1.

The most important conclusion from Table 2 is that on balance, trade liberalization has strong positive effects on economic welfare that are due in significant part to rationalization of industrial structure and heightened market competitiveness. Cases in which the addition of imperfectly competitive behavior shrinks or reverses the benefits from trade liberalization appear to be the exception rather than the rule, especially under the assumption of free entry to and exit from economic activity.

Several other conclusions stand out in Tables 1 through 4. The first conclusion is that the quantitative importance of scale, fixed costs, and imperfect competition is greatest when there is free entry and exit. It is entry of new competitive firms, plants, and product lines, and exit of uncompetitive firms, plants, and product lines that create the largest change in average resource productivity, and hence in economic welfare.[25] The second conclusion is a result of the first. Calculated adjustment pressures are not trivial, by comparison with those estimated under perfect competition. They range on average from moderate to severe, contrary to popular wisdom about the ease of adjusting intra-industry trade to policy innovations.[26] These studies calculate significant pressures on workers to change industries and jobs, on firms to change outputs and activities, and on trading partners to change their trade patterns. The pressures nevertheless shrink toward levels of normal turnover and attrition if estimates are cumulated incrementally over five to ten year phase-in periods, as shown rigorously by Harris and Kwakwa (1988). The third conclusion is the potential for what might be termed "scale diversion" in those studies that vary the scope of participation in trade liberalization (Smith and Venables (1988a), Digby, Smith, and Venables (1988), Nguyen and Wigle (1988)). Small countries and firms that are included in liberalization are sometimes large gainers, even though rivals that are left out would realize scale economies even more dramatically if only they were included, too. For example, estimated welfare gains for Canada and Italy decline noticeably when Greece, Spain, Portugal, and developing countries are fully integrated into trade liberalization.

The policy implications corresponding to these conclusions would seem to be that simultaneous reduction of barriers to international and internal competition creates sizeable and mutually reinforcing benefits, but at the

expense of adjustment burdens, either across sectors or among trading partners, that cannot blithely be dismissed.

B. Quantitative Method

(1) Calibration/Counterfactuals. All of the research summarized in Tables 1-4 employs a variant of the behavioral structural discussed in Section II,[27] and a quantitative method sometimes described as a calibration/counterfactual experiment. A calibration/counterfactual is in essence an empirical analog to comparative statics, and is familiar from computable-general-equilibrum (CGE) studies[28] -- although applied here to partial-equilibrium studies as well. The method begins with assumptions about economic behavior (such as equations (1) - (4) above), and maintains them as true for purposes of quantitative analysis. It then uses econometric estimates and industry case studies to measure key behaviorial parameters. Since some parameters are subjective or have been estimated dubiously, there are always gaps. These can often be filled by assuming that the behavior accurately describes a real period, and using this period's data as a benchmark along with measured parameters to infer the values of missing, subjective, or dubious parameters. This inference is called "calibration," and amounts to making the assumed behavior and one period's data mutually consistent. The model's mechanics will consequently produce an equilibrium that matches reality for that one period. The counterfactual step is to change one (or more) of the parameters or data entries -- in this case trade policy -- and to calculate the new equilibrium that would have been generated by the model's mechanics. Values of variables in this new equilibrium are compared to their actual values -- "facts" are "countered" with hypothetical calculations -- and differences between them are

taken to be estimates of the effects of trade policy.[29] The similarity to comparative statics should be clear.

Calibration/counterfactual methods have compelling strengths, despite their simplicity, selective and judgmental use of data and econometric estimation, insistence on maintaining rather than testing hypotheses, and imprecise statistical robustness (Baldwin (1988c), Harrison et al. (1987)). In the research surveyed here, they complement the data with a flexible structure to describe imperfect competition generically. They impose sensible economic consistency on experimentation (that is, incentives are calculated and profitable opportunities are assumed to be seized). And they organize the interpretation of results around accepted descriptions of economic trends (although there are usually several such descriptions). Not "anything can happen."

These strengths notwithstanding, calibration/counterfactual methods are more art than science.[30] They provide less definitive results than econometric, data-intensive methods that characterize modern empirical research in industrial organization, surveyed by Bresnahan (1987). The intricacies and inadequacies of international and comparative national data for the moment preclude recourse to more sophisticated empirical methods in the study of trade policy.

(2) Partial- and General-Equilibrium Approaches. The studies summarized in Tables 3 and 4 are respectively "partial equilibrium" and "general-equilibrium" approaches. The latter take into account and calculate several potentially important economic effects that are neglected by the former.[31] These effects always involve how one sector's trade policy changes prices or costs in other sectors, either through intermediate purchases, or through impacts on the whole

economy's wages, rents, and costs of capital. For changes in trade policy within a single sector or small sub-set of sectors, as in Table 3, cross-sector and factor-price effects are arguably insignificant, and can be ignored. For across-the-board changes in trade policy, such as those underlying Table 4, cross-sector and factor-price effects are cumulatively large, and must be estimated.

The distinction, although important for many empirical purposes, turns out to be unimportant for purposes of this survey. Almost all conclusions about the special effects of trade policy under imperfect competition show up in both the partial-equilibrium and general-equilibrium studies.

C. Distinctive Features and Conclusions

Although the studies of Tables 3 and 4 share a common structure and quantitative method, each has distinctive features. Some of these features seem strengths to be emulated in future research; others seem weaknesses to be avoided. Conclusions are, of course, sensitive to these distinctive features.

Rodrik (1988) is an especially clear and accessible introduction to the mainstream of early empirical research on trade policy under imperfect competition. Its distinctive features are two-fold: (i) its consideration of quotas (most of the other studies are predominantly about tariffs); and (ii) its ability therefore to capture incentives and dis-incentives for rent-seeking in addition to the standard effects. Rodrik is one of the few researchers to address the "integer problem" empirically, the potentially important observation that free entry and exit may not guarantee zero excess profits.[32] When fixed costs are especially large, the marginal entrant may be deterred from entering, even though "free" to do so, because its anticipated

share of the positive excess profits will not cover its large fixed costs. Making allowance for free entry with ongoing positive profits is presumbaly quite important in empirical research like Rodrik's on developing countries with small numbers of firms,[33] or like Baldwin's and Krugman's (1987, 1988) on industries with unusually high fixed costs. They in fact adopt a similar approach.

Rodrik's results are noteworthy first for the large size of the estimated welfare effect. This may reflect his allowance for collusive (monopolistic) pricing. It may also signal that market-structure benefits of trade liberaliz-tion are greater in developing countries, as are more conventional benefits. Rodrik's result also show clearly the way that welfare effects are larger with free entry (which promotes rationalization) and collusion in the base period (which is undercut desirably by international competition).

Smith and Venables (1988a) is noteworthy first for its timely application to the European Community's intention to complete its internal market by 1992.[34] It is unique among the studies summarized in embodying the potential gains from increased product variety when trade is liberalized.[35] This is accomplished in essence by allowing firms free entry and exit not only among product cate-gories, but among "models" within a product category. Fixed costs, which depend on the number of models produced, may be spread not only across large volume of a given model (standard scale economies), but across models as well (an illustration of one kind of "economies of scope"). On average, this flexibility enhances ways that average fixed costs can be reduced, and Smith and Venables show somewhat larger welfare gains from trade liberalization with product (model) differentiation than without. Finally, their study allows a better tentative assessment than others of the important question of "market

segmentation" -- how to define the market demand in equation (2) above. Most of the other studies merely assume either that (2) describes a national demand curve and use corresponding estimates of its parameters, or that (2) describes a global market, with quite different estimated parameters.[36] Smith and Venables, as well as Brown and Stern (1988a), do calculations both ways, and show that the results are quantitatively very sensitive to the segmentation question. Of the roughly two percent rise in EC welfare that Smith and Venables estimate from completion of the EC's internal market, two thirds can be taken as a measure of abandonning the assumption of market segmentation. That makes market segmentation an important issue for ongoing research, rather than mere assumption.[37]

Digby, Smith, and Venables (1988) is a cognate study with many of the same distinctives as above. Its unique distinctives, however, include a simple way of analyzing voluntary export restraints (VERs) in the context of intermediate (Cournot) competition. It also illustrates the potential for perverse effects from trade liberalization via product variety; it concludes very cautiously (pp. 19-20) that removing Japanese auto VERs for Britain reduces the number of British models produced and exported to Europe -- so much so that EC welfare declines very slightly, although British welfare increases.

These studies are also notable for their estimates of moderately large adjustment pressures: a significant number of EC firms may exit due to full EC integration; some European automakers might lose up to 20 percent of their market if free trade with Japan were permitted. Yet, as Harris and Kwakwa (1988) suggest, the burden of such adjustment may not be overwhelming if trade liberalization is phased in over 5 to 10-year periods, as is often the case. Then the adjustment impetus per year during the transition is not that much greater than normal consolidation/merger rates for firms nor

job-move/attrition rates for workers.

Dixit's (1988) study is unique among those from Tables 3 and 4 in assuming only imperfectly competitive behavior, and not (necessarily) increasing returns to scale, hence allowing an assessment of how one contributes independent of the other.[38] By incorporating the potential for an explicit pro-competition policy (e.g., anti-trust), proxied by a production subsidy, Dixit is able to demonstrate the important and familiar point that international trade policy is often a second-best way of accomplishing a government's goals. In the presence of an optimal pro-competition policy, there are only small remaining imperfectly competitive gains to capture by trade policy, in the neighborhood of one tenth to one thirtieth of one percent of consumption![39] Dixit's hypothetical policies do, however, have moderately large effects on profits and market shares -- measured by elasticities often above one. Thus these may be effective mercantilistic transfer devices, however small their welfare effects, and may cause non-trivial adjustment pressures.

Dixit's study is also distinctive in observing why excess profits may exist in reality, but be hard to detect quantitatively. Excess "profits" may be disguised in a sector's above-average wages and salaries compared to other sectors, and insulated by labor-market barriers. Dixit shows that the larger are such disguised profits, the larger is the scope for active trade policy to create significant welfare gains. In a hypothetical extreme where half of labor compensation is disguised excess profits, Dixit's calculated gains to optimal pro-competition policy grow to 3 percent of consumption, and the calculated gains from optimal tariffs increase several times over. But these tariff gains are still well below one half of one percent. The important message is that empirical calculations are quite sensitive to the amount of

"rent" reflected in factor costs; Eaton (1988) elaborates. Other studies, in contrast to Dixit's, tend to take wage or cost data to reflect genuine resource costs, without any imperfectly competitive rent component.[40]

Baldwin's and Krugman's distinctive contribution, in both (1988) and (1987) is to capture some rudimentary dynamics of international competition,[41] in which firms compete first to establish pre-emptive capacity or R&D necessary to build a product, and subsequently compete over price (in Bertrand fashion) or over market share. Their documentation makes it difficult to discern the independent contribution that this dynamic structure makes to their striking results in the (1988) paper, in which extreme Japanese import protection in 16K RAM chips is immensely successful, although welfare-reducing, export promotion. Essentially, Japanese market closure to imports allows it to displace the United States as the dominantly competitive world producer and exporter.[42]

Owen's seminal (1983) study is implicitly dynamic in a similar way, since capacity is assumed subject to continuous replenishment and expansion. But Owen's theory and quantitative method, while in the spirit of the more recent studies, are generally more primitive.[43] His meticulous case studies, on the other hand, set a standard of sophistication that is unparalleled. Owen's other unique feature, in contrast to subsequent studies, is to treat asymmetries among "firms" (or plants)[44] explicitly. In the simplest framework, he allows firms to differ in size only (q in equations (1)-(4)), but hence in average cost and profit also (see equation (4)). Unspecified barriers to competition are assumed to keep the large, low-cost, high-profit firms from displacing the small, high-cost, no-profit firms. Yet any reduction in these barriers, such as creation and expansion of the European Economic Community, exposes the small, marginal firms to losses and drives them out of business

(marginal exporting firms, as well as marginal import competitors). That is what leads to Owen's distinctive conclusion: trade liberalization leads to significant consolidation through the extinction of marginal, small activities.[45] Therein lies both his moderately large estimated welfare effects and his potentially serious calculated adjustment pressures.

The studies by Richard Harris and David Cox, from which Canada (1988) with its supporting documentation[46] descends, are seminal for a number of the other general-equilibrium studies. They with Wigle (1988) have underlined the quantitative importance of the imperfectly competitive pricing behavior discussed above. All employ a conventional form of monopolistically competitive pricing, often equivalent to the Bertrand assumptions noted above. Yet all employ additionally a controversial form of collusive pricing described as "focal" or Eastman-Stykolt (1967) pricing. With discretion by sector, prices are assumed to be a variously weighted average of the two pricing rules.

Focal pricing embodies two characteristics that heighten the importance of imperfect competition for trade policy, and increase calculations of the welfare gains from trade liberalization. One is that all domestic firms implicitly collude -- without any competitive deviation to undercut the average price of their rivals. The second is that these firms implicitly collude with all their foreign rivals, too -- by setting a price that is essentially equal to the world price plus any transport and transfer costs (including tariffs) between Canada and the "world." Most commentators agree that these characteristics prejudice the empirical research toward finding large benefits from trade liberalization (e.g., see Deardorff (1986, p. 314)), especially when Canadian liberalization is matched by its trading partners. In that case, liberalization directly and mechanically lowers the collusive focal price charged by all Canadian firms, whether export-oriented or import-competitive,

rationalizing all industries by forcing some firms to exit and incumbents to reduce mark-ups and increase scale by moving down their average cost curves.[47] Corresponding to the estimated enhancement of benefits due to focal pricing is an accentuation of adjustment burdens in several of these studies.

Brown and Stern (1988a,b), Wigle (1988), and Markusen and Wigle (1987) all calculate smaller welfare effects and adjustment pressures from very similar trade-policy experiments with less or no recourse to focal pricing. But Brown and Stern are reluctant to see their own welfare calculations as more than approximate since their model embodies an indefinite wage distortion (rigidity), while nevertheless requiring long-run full employment, as do the other general-equilibrium studies.[48] Brown's and Stern's distinctives otherwise are two. Their (1988b) estimates rest on a sensible judgmental partitioning of sectors into five types, depending on the intensity of competition, on market segmentation (whether a sector's market demand is global or merely national), and on whether there is free entry or not. Most of the other studies, including their (1988a) paper, assume a less realistic symmetry in these dimensions across all manufacturing sectors.[49] Secondly, Brown and Stern highlight difference in the factor content of fixed and variable costs in rationalization, showing its potential importance for estimates of welfare change, and (implicitly) for adjustment burdens from trade liberalization.[50]

Nguyen and Wigle (1988) analyze global trade liberalization in an adaptation of Whalley's (1985) model to imperfect competition. As is true there as well, terms-of-trade effects swamp other sources of welfare change. This appears to be the result of allowing changes in trade policy to alter each country's equilibrium current-account balance, and by necessity its equilibrium capital-account balance.[51] The more realistic and conventional alternative (in theory, as well as in other CGE models, such as those of Brown and Stern (1988a,b),

Deardorff and Stern (1986), and Devarajan and Rodrik (1988)) requires that the terms of trade settle at a value that leaves the equilibrium current account balance unaffected by inter-sectoral and border policies like trade liberalization.[52] In most cases, requiring this would appear greatly to reduce Whalley's estimated terms-of-trade impacts from trade policy and the corresponding welfare effects (Richardson (1986, p. 374)). Presumably the same is true of the Nguyen-Wigle calculations.[53]

The Cox-Harris-Canada general equilibrium studies are distinctive in allowing productive capital to be mobile across borders, unlike traditional analysis.[54] Documentation is inadequate to determine, however, how this assumption changes the calculated effects of trade policy under imperfect competition.[55] The question is important and topical for the European Community today, for example, and for all regions that simultaneously liberalize trade and investment policies, such as Canada and the United States recently.

In addition to the representative studies highlighted above and in Tables 3 and 4, there are several more recent and/or provisional contributions that share the same methodology.

Harris and Kwakwa (1988) is a significant elaboration of the Cox-Harris-Canada studies.[56] The elaboration aims to re-calculate the effects of trade liberalization on Canada in a framework that features explicit ten-year phase-in and underlying growth of the economy. Populations of both workers and firms are assumed to be growing, as are the economy's capital stock and external net claims/indebtedness. Key elements of the Harris-Kwakwa framework are imperfect inter-sectoral factor mobility, resulting in potential for medium-run wage and profit differences across sectors, sluggish wage adjustment, and forward-looking (for only one period, however) sectoral investment and entry decisions.

The most important conclusion of the Harris-Kwakwa study is the greatly reduced calculation of worker adjustment costs. The natural turnover rates that are embedded in the growth calibration dominate the incipient worker dislocation from trade liberalization phased over ten years. Real wages actually increase almost immediately for almost all workers. Among other conclusions is reduced industry rationalization relative to calculations in the early Harris-Cox-Canada variants.[57] Welfare effects from trade liberalization are, however, not calculable until conceptual difficulties are resolved.[58]

Daltung, Eskeland, and Norman (1987) is a pair of equilibrium studies of optimal policy for two Norwegian industries: skis, in which product differentiation and variety play distinctive roles; and Caribbean cruise shipping, in which capacity pre-commitments, and whether they are sunk or not, is the key issue. Their skeptical assessment of the case for policy intervention is based on unique information shortcomings that would undermine its efficacy, for example, firms' incentives to dissemble and withhold information about their own costs.

Lee (1988) is a general-equilibrium study of Japanese trade and industrial policies. Its structure is distinctive in _not_ assuming mobility of productive capital across its four sectors, but its conclusions are quantitatively comparable to those of the research above. Ngowsirimanee (1988) is a general-equilibrium study of Thailand's trade and industrial policies. Its structure is distinctive in its explicit provision for trade liberalization to alter variety, and for its conclusion that increased variety contributes much more to welfare gains than industrial rationalization. Gunasekera and Tyers (1988) find industrial rationalization, by contrast, to be a much more significant source of potential Korean gains from trade liberalization (as large as seven

percent of real income). Their general-equilibrium study is a close relative of the Cox-Harris-Canada studies discussed above, and may suffer from the same tendency toward quantitative overstatement. Devarajan and Rodrik (1988) is a general-equilibrium study of unilateral tariff removal in Cameroon. Its structure is distinctive in allowing calculations of welfare and adjustment effects both when imperfect competition is accompanied by scale economies and when it is not. The addition of modest scale economies nearly doubles the welfare gains (from one to two percent), but also aggravates the incidence and severity of adjustment that is imposed on the manufacturing industries. Finally Horridge (1987a,b) and Cory and Horridge (1985) are careful and extensive studies of how hypothetical scale economies and imperfect competition could influence results from the widely used Australian CGE model, ORANI. The influence is usually considerable, but highly sensitive to various assumptions that are implemented quantitatively.

D. Closely Related Research

A number of recent papers quantify elements of the behavioral structure underlying the research summarized above. While all relate to trade policy, not all estimate its effects directly. Levinsohn (1987) and Levinsohn and Feenstra (1988), for example, develop techniques to discover which auto models are close substitutes for each other, and implement them for a sample of domestic and foreign models. Even though policy does not enter explicily, they point out (1988, p. 1) that "... policy implications abound ... Would an oil import fee affect one firm more adversely than other firms? ... Will an import quota on Korean automobiles benefit domestic firms or are Japanese firms the primary beneficiaries?" A long series of indirectly relevant studies is the industrial organization tradition of empirically comparing summary measures

of domestic competitive performance on the one hand (e.g. mark-ups) to international competitive exposure on the other (e.g. import shares).[59]

More directly tied to policy are papers that identify the quality upgrading that often accompanies quantitative trade barriers, and that attempt to estimate its welfare effects.[60] Quality upgrading is merely one example of firms "entering" or exiting from models or varieties, as discussed above. Similarly tied to policy are papers that estimate the "pass-through" from a change in trade barriers into domestic prices. Under many of the imperfectly competitive pricing rules described above, it can be shown that a rise in barriers or in world prices will not pass point for point into higher domestic prices; only a fraction will "pass through," and that fraction can be estimated. Furthermore different pricing rules and imperfectly competitive behavior generate different degrees of pass through, so that pass-through estimates by industry can be used to make inferences about market structure.[61]

Finally, two strands of research with very different behavioral mechanisms are nevertheless related to that summarized above. One is early research that assumes excess profits are passed on into wages above some normal level (Dickens and Lang (1988), Katz and Summers (1988)). It focuses on how imperfectly competitive labor markets might respond to trade policy, but has not yet been cast with adequate theoretical or empirical structure. The second is inter-temporal CGE research that is typically competitive in its assumed market behavior and is only recently being carried out for open economies.[62] With one exception[63], the research has initially focussed on taxes, tax reform, expected taxes, investment, and capital flows. But it is reasonably straightforward to consider tariffs and other trade barriers, and only slightly more complex to incorporate imperfectly competitive behavior, scale economies, and elementary labor-market dynamics (in the fashion of Harris and Kwakwa (1988)).[64]

IV. RESEARCH POTENTIAL

Until a few years ago, there was at best only a sparse smattering of empirical research on trade policy under imperfect competition. Recent research that has been the subject of this survey represents a natural first step -- a set of projects that most economists would undertake first because of the ready availability of models, methods, and data. More difficult, but presumably far more interesting research lies ahead. With some good fortune, it may prove practical and relevant to policy.

(1) Empirical research would be valuable on elementary yet general and flexible models of dynamic imperfect competition, perhaps empirical analogs to the theoretical framework of Grossman and Helpman (1988a,b). There an economy's primary resources are allocated to research, intermediate producer goods, and final products, with the first two serving as inputs to the third and embodying a very natural form of learning-by-doing scale economies. Or, for another example, models in the fashion of Baldwin and Krugman (1988) might be refined to become models where fixed costs are (or are linked to) a "first-stage" international investment decision, behaviorally detailed, and where the rest of the behavior describes "second-stage" output and pricing decisions.[65] As a result of such research, the independent effects of trade policy on research or investment decisions could be distilled, as could a refined view of how trade policy affects the usual variables "contingently" -- e.g., differently when research is done or investments are made in response to the trade policy than when they are not. A dynamic project could be carried on profitably in empirical industry studies, and then possibly in a general-equilibrium setting. Several researchers featured in Section III already have

rudimentary capability to calculate how trade policy affects international and sectoral investment.

(2) The size and interdependence of overall markets, and the number and character of firms competing in each, have special influences on estimates of the effects of trade policy under imperfect competition, influences that they do not have in traditional approaches. Since size of market and density/character of competition are key aspects that differentiate global multilateral liberalization from regional "mini-lateral" liberalization (Canada-United States Free Trade Agreement, 1992 in the EC), empirical models with imperfectly competitive structure ought to have a special role in evaluating the relative merits of global and alternative regional policy initiatives. Techniques from industrial-organization research on the questions of "market definition," applied widely in antitrust analysis (Bresnahan (1987, pp. 65 ff.); see also Rogowsky (1988) and Scott (1982)), are the natural tools with which to start. The economics of mergers among firms and mergers among markets are interdependent, in principle and increasingly in practice. An important element of "market definition" is the presence of imperfect substitutes for the good in question and the related markets in which they are sold. Much less empirical than theoretical work has been done on these issues of substitutability and variety, which are important not only in their own right, but for their impact on calculations of adjustment costs, described below.[66]

(3) One of the most politically relevant questions in trade liberalization is its transitional adjustment costs. Opinions vary, and theory can support several conclusions. Rationalization that takes place among sectors may have heavy adjustment costs, especially under imperfect competition. Rationalization that takes place within a sector, among varieties of differentiated products, may have minimal adjustment costs. Rationalization that takes place among

firms of varying productivity and diversification may have moderate adjustment costs that should not be ignored in empirical assessments of policy changes. A merging of empirical research on structural adjustment and on trade policy under imperfect competition seems especially timely, for example, on how imperfect competition affects the speed and degree of industry down-sizing (do "recession cartels" enhance performance measures for a declining industry?).

(4) Methodological merging of empirical research on industrial organization and on trade policy under imperfect competition seems equally timely. Modern industrial organization methods are richer, more demanding, and more revealing than those employed in early trade policy research, as implied, for instance, by Bresnahan (1987) or in the useful survey in EC (1988, Ch. 6-7). The next steps seem to rest on data development, especially time-series and longitudinal data that would be comparable across borders, and on imitating the more powerful and sophisticated methods already in use in industrial organization.[67] Promising in this regard is a five-country longitudinal study of firms exposed to significant trade liberalization, being undertaken by World Bank researchers.[68] The project focuses on how such liberalization alters measures of competitive performance such as mark-up pricing, realization of scale economies, and rates of total factor productivity. The panel of firms (across countries and over time) is rich enough to permit the econometrics of panels to be employed, with formal attention to familiar characteristics such as truncation, selectivity bias, and cross-equation constraints.

(5) Empirical work on open-economy imperfect competition with asymmetric firms is needed, as is more empirical work with product differentiation and potential gains from variety. The same is true in general of empirical research in industrial organization (Bresnahan (1987, pp. 66-67)). Product differen-

tiation itself is a reason for asymmetries and a competitive instrument among firms. The welfare effects of changes in variety and quality induced by policy are not yet clearly conceived or measured, and welfare effects calculated from price changes alone may seriously mislead when price, variety, and quality are jointly determined and interdependent.

(6) How industrial structure, market competitiveness, and trade policy affect macroeconomic performance in growth, productivity, capital formation, or trade balance is still undetermined. It is a question of great practical importance as well as research interest. Careful comparative studies of this question require a rich historical data base, one that is comparable across countries, and conceptual structuring beyond what has been done so far.

(7) Special data and measurement weaknesses confront empirical research under imperfect competition. Progress in measuring the following variables would be very valuable: (a) costs--fixed (sunk and recurring), variable, marginal--and their allocation across products, divisions, etc.; (b) non-tariff barriers to trade, including policy barriers but also natural barriers such as transport costs, marketing costs, and other transfer costs.

The menu above seems diverse and full, yet also attractive, feasible, and practical, given current models, methods, and measurement. This survey may become quickly and happily obsolete!

NOTES

[1]"Gains" are measured by an economy's real income, its aggregate purchasing power over goods and services of all kinds. Only empirical work capable of generating this measurement is surveyed. Ignored, therefore, is the extensive anecdotal and evidentiary literature on trade and industrial policy (see Norton (1986) for a survey). Hazledine (1988) and Norman (1988) are surveys of the methods and models that concern this paper, but not of the quantitative results or their implications for trade policy.

[2]More sophisticated and detailed theoretical surveys exist in Grossman and Richardson (1985), Helpman (1984), Helpman and Krugman (1985), Krugman (1985, 1986a,b), Markusen (1985), and Venables (1985).

[3]Rodrik (1988, Section 3) is a good example, quite parallel to the treatment here. See also Norman (1988).

[4]The elasticity of a firm's demand for units of its product, q, is the percent change in quantity demanded for every percent change in its price: $e \equiv (\Delta q/q) \div (\Delta p/p)$. Marginal revenue in this notation is defined as $\Delta(pq)$, which for small changes is approximately equal to $p(1-1/e)$. The mark-up expressed as a proportion of price is usually called the Lerner index of market power.

[5]The elasticity of market demand, E, is the percent change in market quantity demanded for every percent change in market price: $E \equiv (\Delta nq/nq) \div (\Delta p/p)$, which $= (\Delta nq/\Delta p) \cdot (p/nq)$, which $= -B \cdot (p/nq) = -B \cdot (p/A-Bp)$, which when defined positively $= 1/(A/Bp - 1)$.

[6]If it is correct in its perceptions, then when it sells an extra unit it will force the market price received by itself and all other firms to decline by 1/B. Hence it will perceive its own elasticity of demand, e, to be equal to

B•p/q, which is exactly equal to nE (see note 5). Bresnahan (1987, pp. 13, 74 passim) summarizes evidence in support of the view that the degree of competition associated with Cournot assumptions is empirically relevant, whatever one thinks of the rationality of the behavior. The unweighted average of estimated perceived elasticities (e) from his Table 1 is a little over 3 (using mid-points of intervals), higher than most estimated market demand elasticities (E), but well below the very large (infinite) estimates associated with perfect competition.

[7] Zero may not be attained exactly if competition from the marginal entrant would make excess profits negative. This point is discussed further when Rodrik's (1988) work is described in Section IIIC.

[8] The distinction is quite important for studying the dynamics of industrial structure, e.g., exactly when firms enter and exit an activity. But it has been less important in most early empirical research on trade policy under imperfect competition, which has focussed on estimating differences in long-run equilibria consistent with different trade policies.

[9] The diagram is in fact the foundation for empirical estimates used by the Canadian government in negotiating the pending Canada-U.S. Free Trade Agreement, and in convincing the Canadian public of its benefits (Canada (1988)).

[10] Markusen (1985) provides a similar treatment.

[11] $S_0S_1T_1$ is also no longer uniformly bowed out from the origin, given the S_0S_1 segment, creating the flavor of the non-convex production possibilities curves that are often associated with economies of scale.

[12] The statement is merely illustrative. The possibility of excessive research and development is easily demonstrated under imperfectly competitive behavior. On the other hand, increased competition in producing research and development is often thought to increase its quantity and quality.

[13]The ratio of average cost of T to S goods must lie between the slopes of the price line and the marginal cost line in this kind of model.

[14]Whether it is firms, plants, or product lines that disappear depends on whether fixed costs (f) are associated with firms, plants, or product lines. The adjustment burdens are probably greatest for the first and least for the third, but only a little of the empirical research surveyed sheds light on this question. Both Owen (1983) and Baldwin and Gorecki (1985, 1986) find that scale economies associated with plants seem more important for many measures of economic performance (e.g., bilateral trade balances, cost competitiveness) than those associated with firms and product lines. But their rich analyses also highlight many exceptions to this generalization, and do not specifically address the issue of adjustment.

[15]The potential for sharper adjustment pressures is due to the reduced likelihood of diversified, non-specialized production in the presence of fixed costs. The point can be seen in Figure 2, a re-drawing of Figure 1, and can be easily generalized to more realistic settings with many sectors. In the absence of fixed costs, the country's production remains diversified for all price ratios between m_0 and m_0'. When fixed costs are f, the country remains diversified for a much narrower band of price ratios, between m_1 and m_1'; when fixed costs are 2f, even narrower, between m_2 and m_2'.

[16]This is what the theoretical literature implies when it concludes that trade patterns and the distribution of industries among trading partners is "indeterminate" under scale economies and imperfect competition (see Krugman (1985, pp. 7-8, 23-24, 43), Helpman (1984, p. 359)). The factor content of trade _is_ determinate however. The factor content is the bundle of labor, capital, and other primary factor services embodied in exports and imports.

This determinacy implies that long-run equilibrium differences among countries in factor rewards will not be affected much by volatility in production and trade patterns caused by imperfect competition. But short-run dislocation and adjustment may nevertheless be frequent, burdensome, and welfare-reducing.

[17]Harris (1985, pp. 165-166; 1986, pp. 241-242), modified to account for normal turnover in Harris and Kwakwa (1988); Shea (1988); Wonnacott (1987, pp. 33-40); and Wonnacott with Hill (1987, Appendix B, C).

[18]In Figure 1, if S and T were two varieties of a product with very similar production technologies, then the curves ST would be virtually straight lines. Moving resources from one corner to the other would be very easy, especially within the same firm.

[19]More precisely, new availability of a close substitute for the product with demand behavior given by equations (1) and (2) will generally shift those functions in ways that increase their respective elasticities, e and E. This causes a decline in distortionary mark-ups, and a possible departure of marginal, inefficient firms that are no longer able to cover fixed costs out of reduced mark-ups (see the discussion of equation (4) above.)

[20]"Overlap" is defined by cross-price elasticities of demand. The condition is that buyers find alternative varieties of a given firm to be closer substitutes for each other than for competitors' varieties ("a Ford product of some kind is always better than a General Motors product of any kind"). Horridge (1987a, p. 50) describes this as a "split" pattern of tastes, in contrast to an "interleaved" pattern (small cars produced by any firm are closer substitutes for each other than for large cars, and similarly for large cars), in which trade liberalization almost certainly increases variety. For further discussion, see Horridge (1987a, pp. 31-39), Digby, Smith, and Venables (1988,

pp. 20-24), and the pioneering work of Levinsohn (1987) and Levinsohn and Feenstra (1988), discussed in Section III.

[21]Such effects play a foundational role in the innovative theory of international trade and economic growth that has been developed recently by Grossman and Helpman (1988a, b).

[22]There is some evidence, however, that these common effects are accentuated in models with imperfectly competitive behavior: see Harris (1986), Devarajan and Rodrik (1988), and Eichengreen and Goulder (1988a).

[23]See Krishna (1985) for a discussion of this conclusion under Bertrand competition. Bertrand competition is an intermediate degree of imperfection in the sense of equation (3), where firms choose prices of differentiated product varieties under the perception that rivals' prices are given.

[24]The comparisons are somewhat rough in several cases because perfectly competitive estimates were made in an admittedly crude way. This is especially true of Rodrik (1987) and Smith and Venables (1988a).

[25]Norman (1988) finds, however, that under free entry and exit the calculations summarized in Tables 1-4 are much more sensitive quantitatively to alternative parameter values and behavioral specifications than when there is a fixed number of firms.

[26]However, only a few of the studies in the tables, notably Smith and Venables (1988a) and Digby, Smith, and Venables (1988) incorporate product variety adequately enough to allow independent calculations of both interindustry and intra-industry adjustment (they do not actually perform such a decomposition). Thus the conclusion that these studies calculate significant adjustment pressures may be weakened by adequate modelling of variety in subsequent research.

[27]One of the more surprising technical conclusions of the survey is in fact how common is the basic structure of the theoretical model underlying the various empirical studies. Within that basic structure, however, are important differences in specification and parameterization. These are summarized well by Hazledine (1988) and Norman (1988), as well as in the detailed discussion of Section IIIC.

[28]Srinivasan and Whalley (1986) is the most relevant survey for trade policy. See also Borges (1986), Shoven and Whalley (1984), and a large cliometric literature that uses the method. Burniaux et al. (1988) is a quite recent and synthetic example of CGE research, in this case applied to agriculture.

[29]Most of the studies in Tables 1-4 use the following procedure. Trade policy is taken to be either some change in international differences in prices (p), or some change in the properties of the market demand curve (equation (2)), in the case of quotas. Most studies rely on econometric estimates and industry data to measure the market demand behavior reflected in equation (2): average price, average quantity produced, market demand elasticity (E), etc. Then the behavior summarized by equations (1) and (3) is "calibrated" in one of two ways. In the first, an assumption about inter-firm dependence (w) is made in (3), e.g., firms are collusive, or they are Cournot competitors, or .... Then the representative firm's perceived demand elasticity is inferred (i.e., e is inferred by (3) from an assumed w and an estimated E). Finally the inferred e and measured price are used in (1) to infer marginal cost (c), which is often not easy to measure. When marginal cost is measurable, however, usually from engineering or econometric studies, a second way of calibrating is often adopted. The measured c and measured p are used in (1) to infer e,

the firm's perceived demand elasticity. It in turn, combined with estimates of E, implies a value for the intensity of competition, w, "calibrating" it instea of assuming it, using equation (3). Whichever method is used to establish c, e, and w, the values of marginal cost and prices can be used with equation (4): either to infer fixed costs, f, given data on excess profits r or the assumptio that they are zero (free entry and exit); or to infer excess profits r, given engineering or econometric estimates of fixed costs, f. Occasionally, the value of a hard-to-measure trade policy is itself inferred using these techniques, as in the work of Baldwin and Krugman (1987, 1988).

[30]Hence almost all the studies below perform elaborate sensitivity analysis with respect to key parameters. Some of these sensitivity analyses are multi-dimensional, e.g. in Markusen and Wigle (1988), and techniques for refining these are described by Wigle (1986) and by Bernheim, Scholz, and Shoven (1988).

[31]See Dixit and Grossman (1986), for example, in the context of trade polic under imperfect competition.

[32]Harris (1988, p. 178) includes a graphical treatment of the "integer problem."

[33]See also Devarajan's and Rodrik's (1988) general-equilibrium study of trade liberalization for Cameroon. It appears that Rodrik calibrates his (1988) model so that excess profits in the benchmark are exactly zero, and the number of existing base-period firms "just fits." Excess profits show up in hi counterfactual equilibrium, and are thus wholly attributed to the effects of trade liberalization. A more persuasive experiment might have been to assume that the benchmark featured the typical (average) "integer problem" in each industry -- that is, to assume that excess profits <u>did</u> exist in the base-perioc data, but at a level that would have been driven to zero by the entry of a firm exactly one half the size of the representative incumbent firm.

[34]It is, in fact, discussed at length in EC (1988, Chapter 9).

[35]See also Goto (1987).

[36]The technical difference is that when (2) describes a national demand curve, then its cross-price elasticities with respect to similar products in other national markets range from zero (the case of "marget segmentation") to finite values (characterized as the "Armington assumption," after one of its early developers). As such cross-price elasticities go to their limiting (infinitely large) values, however, then nationality of sales no longer differentiates a product, and (2) must define a global market. See Brown (1987), Brown and Stern (1988a), and Markusen and Venables (1988) for additional discussion.

[37]Cognate studies to Smith and Venables (1988a), with similar distinctives, include Smith and Venables (1988b) and Venables and Smith (1986, 1987).

[38]The small size of Dixit's welfare calculations make it appear that scale economies, and not imperfect competition per se, is carrying the weight of quantitative significance. Devarajan and Rodrik (1988), by contrast, find roughly equal weight.

[39]Digby, Smith, and Venables (1988, pp. 13-16, 18-19) ratify Dixit's point in a very similar way. They find that the welfare cost of VERs is two to three times as large as that of a tariff that had the same effect on production.

[40]Cognate studies to Dixit (1988), with similar distinctives, include Dixit (1987c), Goto (1985, 1986, 1987), and Laussel, Montet, and Peguin-Feissolle (1988).

[41]Although Baldwin's and Krugman's papers are the only genuinely dynamic approaches, they still allow no scope for an allegedly important dynamic linkage: the (external? internal?) benefits that spill over from one genera-

tion of semiconductors or aircraft onto another, thus increasing the power of trade policy for one generation of product to have "desirable" effects on several generations of products.

[42]In fact, under free trade, Baldwin and Krugman estimate no Japanese producers at all! Richard Baldwin has written that this result is sensitive to the dynamic structure, and that Japanese firms would survive under free trade if learning-by-doing effects were half as large as assumed.

[43]Even more so is the study by Hazledine and Wigington (1987), albeit also in the spirit of studies summarized in Tables 1-4. Their analysis aggregates firms into three national sub-groups, assumes that the Japanese are price leaders, and calculates the effect of removing Japanese VERs in the Canadian market for three mechanical rules of price parallelism: North American producers are assumed alternatively to lower their prices by one-half, one-quarter, or none of the percentage by which Japanese producers lower theirs. Furthermore, Hazledine and Wigington simply assume target market shares that Japanese producers would desire without VERs (and also without the presence of Korean imports); from those assumptions, pricing behavior follows quite straightforwardly through estimates of demand price elasticities.

[44]Owen is properly agnostic on whether fixed costs and scale economies are associated with firms, plants or product lines, as discussed in note 14. "Firms" is the term used in the text above to maintain continuity, but very similar points are made by Owen with regard to "plants" and "product lines."

[45]Daltung, Eskeland, and Norman (1987) also allow some asymmetries in firm size, but in the particular case of the Norwegian ski industry, they assume that the largest firm has the highest costs.

[46]See Harris (1988), Letourneau, Lester, and Robidoux (1988), and Lester (1987). The cognate papers by Harris and Cox include Harris (1984, 1986), Harris with Cox (1984), Cox and Harris (1985, 1986), and are summarized in Harris (1985). Gunasekera and Tyers (1988) is a cognate study of Korea.

[47]In sensitivity tests of the model of Canada (1988), the Canada-U.S. free trade arrangements apparently predict Canadian rationalization only when the weight on focal pricing, as opposed to conventional pricing, exceeds zero. See also Cory and Horridge (1985, pp. 60-61), who find extreme sensitivity of their results to the weight on focal pricing. Deardorff (1986) and Hazledine (1988) explain why. They also comment on the anomaly of collusion that is adequate to maintain a common price but inadequate to defend against entry.

[48]The assumed wage distortion in Brown's and Stern's model, however, would make it an ideal general-equilibrium setting to sensitize calculations to Dixit's concern that excess profits may be disguised in above-average wages. Dixit's concern is a strong conviction in research by Katz and Summers (1988) and Dickens and Lang (1988), discussed below.

[49]The symmetric approach, however, does allow them to show (1988a, pp.28-29) how sectoral output and employment adjustment, while small to modest under both perfect and imperfect competition, is several times larger under the latter. This suggests again the important possibility that adjustment pressures from trade liberalization may be worse under imperfectly competitive than perfectly competitive market structures.

[50]Its importance is only potential in their (1988b) study, however, since their calculated change in the relative price of capital to labor is miniscule. They lean toward fixed cost being largely capital cost. Harris has disagreed, interpreting the decline in labor to output ratios that he finds as firms

approach minimum efficient scale, as indirect evidence of heavy labor content in fixed cost. The issue is again obviously empirical, with physical capacity costs being heavily capital, and research and development being heavily labor. It illustrates how traditional questions about the inherent capital or labor intensity of one sector relative to another may depend on the scale of an average firm, plant, or production run, with "factor intensity reversals" possibly taking place at different scales of operation.

[51]Whalley (1985, p. 270) and Nguyen, Whalley, and Wigle (1988, p. 7) rationalize this as (indefinite) alteration in each period's domestic purchases or sales of capital goods that are left in place instead of shipped across borders. But there is no portfolio or other economic behavior specified to determine such purchases and sales -- their value seems instead to be established recursively by explicit demand and supply behavior for all other goods, spelled out elsewhere in the model.

[52]The current-account balance is determined by inter-temporal considerations the long run, both in theory and (arguably) in reality, not by indefinite sectoral and border policies. See Arndt and Richardson (1987) and McCulloch and Richardson (1986).

[53]Cognate studies to Nguyen and Wigle (1988), with similar distinctives, include Wigle (1988) and Markusen and Wigle (1987, 1988).

[54]An exception is Brown and Stern (1987), a perfectly competitive approach with the same allowance.

[55]Richard Harris reports in correspondence that David Cox's thesis examined this issue in great detail, finding very little quantitative sensitivity of results from his experiments to the presence or absence of capital mobility.

[56]This study, and presumably Kwakwa (1988) as well, still rest on the focal pricing assumption discussed above, although in a more subtle way.

Focal pricing helps determine expected future prices, and hence also expected future excess profits and decisions to enter/exit.

[57]Unilateral liberalization by Canada is estimated to cause average output per firm to rise roughly 5 percent after 20 periods versus Table 4's 41 percent, calculated in Cox and Harris (1985) from an admittedly higher base-period level of trade barriers.

[58]Although populations are assumed to grow, birth and death are not explicitly specified, so that evaluations of real income by generation, by cohort, or even by individual are not possible. Of course similar conceptual problems lie unexposed and neglected during whatever time interval separates the two equilibria (pre- and post-policy-change) that are the sole focus of comparison in more conventional static calibration/counterfactual studies.

[59]Richard E. Caves and students have been constant contributors to this sort of research; Caves (1988) is a recent example; Caves (1985) is a reflective survey. See also Baldwin and Gorecki (1985, 1986) and Tybout (1987).

[60]Anderson (1988, Aw and Roberts (1988), Boorstein and Feenstra (1987), Feenstra (1988b).

[61]See Feenstra (1987) for an illustration of this kind of work. Pass-through studies featuring imperfect competition have been much more abundant for exchange rates than for trade policy, however. Empirical illustrations are numerous, and the following is a recent sample: Baldwin (1988a,b), Dixit (1987a,b), Froot and Klemperer (1988), Harrison (1988), Knetter (1988), Kreinin, Martin, and Sheehy (1987), and Mann (1987).

[62]Eichengreen and Goulder (1988a,b,c) for the United States, Sachs and Boone (1988) for Japan, and similar work in progress by Susan M. Collins and Sachs for Korea.

[63]The exception is the report by Eichengreen and Goulder (1988a, Section VA.), which calculates the effects of permanent and temporary changes in tariffs, both anticipated and unanticipated, in the short, medium, and long runs.

[64]The Eichengreen-Goulder work features policy-induced changes in sectoral capital stocks, determined by optimal response to expected future variables, given a goal of maximizing the value of the firm. But implicit entry and exit of firms is uninteresting in light of their atomistic size under perfectly competitive assumptions. The Harris-Kwakwa work features policy-induced entry and exit of firms, but rudimentary inter-temporal optimization. Incremental changes in sectoral capital stocks (investment and disinvestment) are determined by empirically pre-specified parameters, such as an elasticity of entry with respect to excess profits expected one period ahead, and such as a rate of real depreciation of the capital stock.

[65]Venables reports that empirical implementation of the two-stage model in his (1988) paper is in progress. Capacity is assumed there to be determined in the first stage and price or output in the second.

[66]See note 26 above.

[67]An example is duality relationships, as applied simply to international economic questions by Applebaum and Kohli (1979), Diewert (1983, 1985), and Fare, Logan, and Lovell (1986)).

[68]Tybout (1987) is a project description, and Corbo, de Melo, and Tybout (1988) is one of the early outputs of the project, which is being co-directed by de Melo and Tybout. The countries involved are Chile, Colombia, Ivory Coast, Morocco, and Turkey.

FIGURE 1 A STYLIZED ECONOMY UNDER IMPERFECT COMPETITION

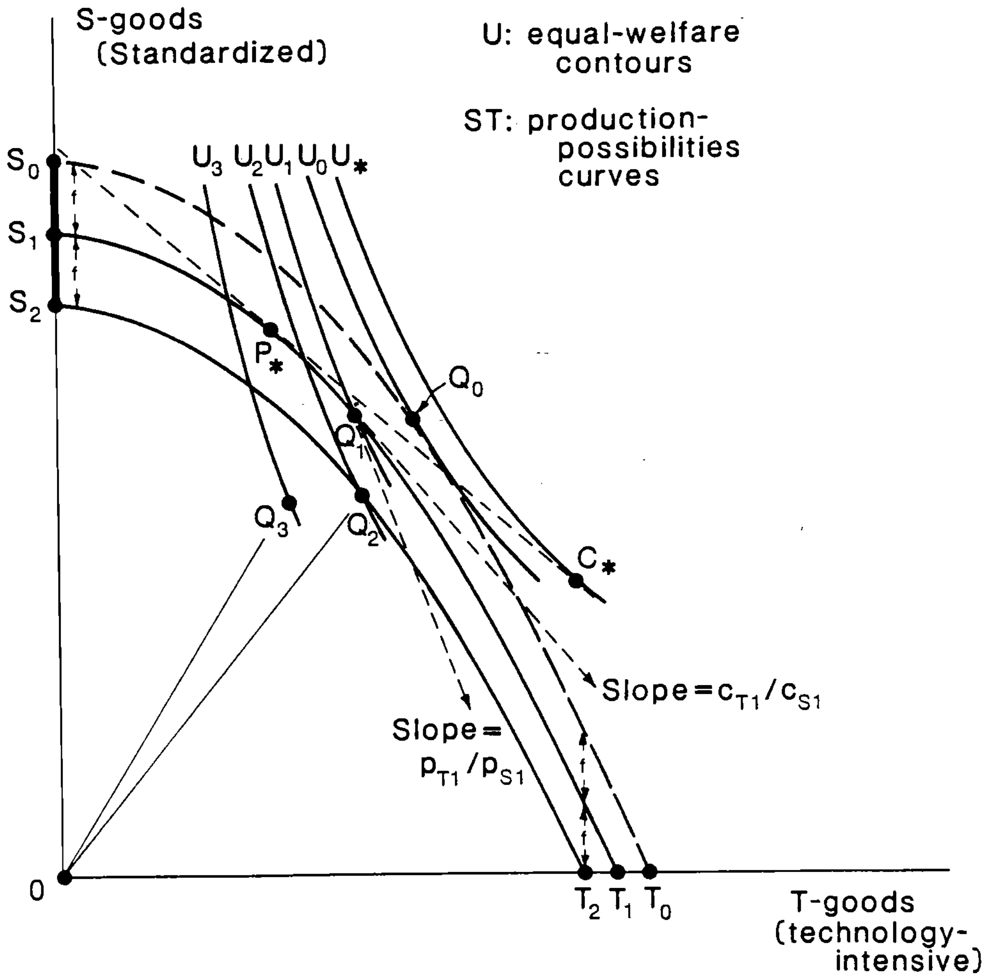

FIGURE 2

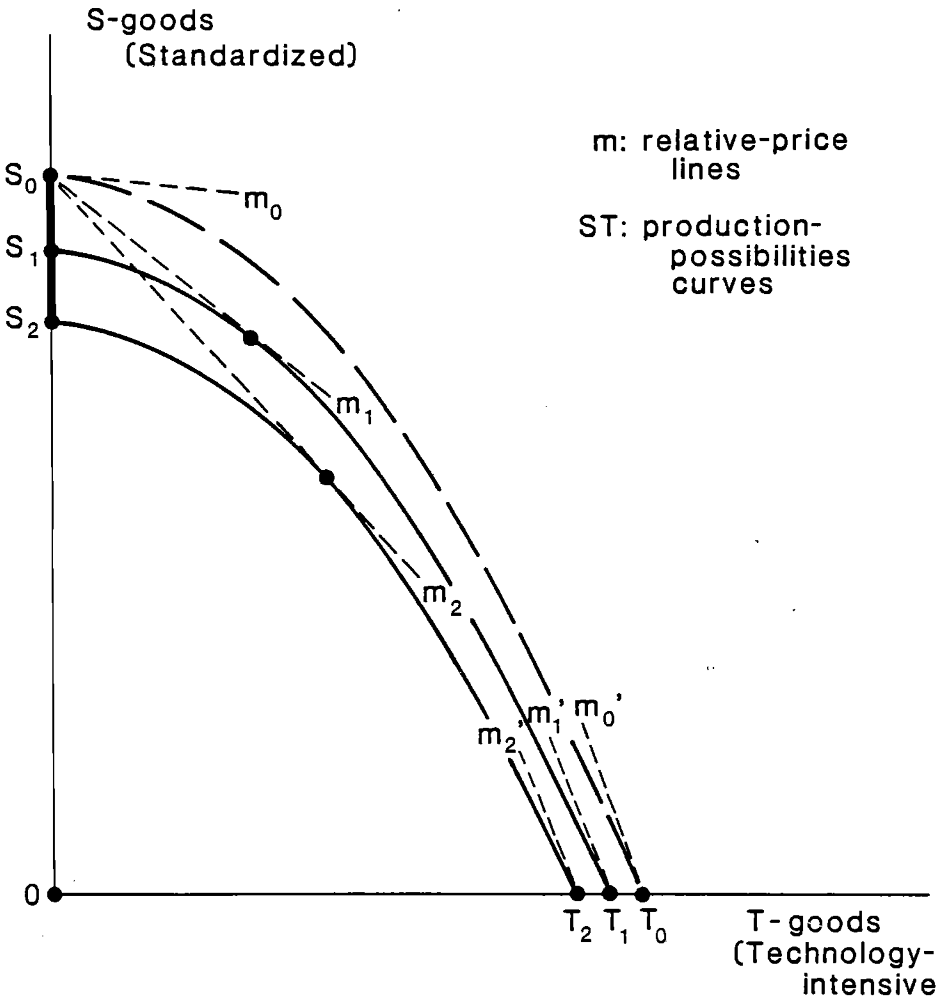

TABLE 1

SUMMARY RESULTS

EMPIRICAL RESEARCH ON TRADE POLICY
UNDER IMPERFECT COMPETITION

	SIZE[1] OF EFFECTS ON...		
RESEARCH	ECONOMIC WELFARE[2]	MARKET STRUCTURE[3]	ADJUSTMENT STIMULI[4]
Rodrik (1987)	moderate to large	moderate	moderate
Smith and Venables (1988a)	moderate	moderate	moderate to large
Digby, Smith, and Venables (1988)	moderate	moderate	moderate to large
Dixit (1988)	small	small	moderate
Baldwin and Krugman (1988)	?	large	large
Owen (1983)	moderate	moderate	moderate
Cox and Harris (1985)	large	large	large
Canada (1988)	moderate	moderate	small
Brown and Stern (1988b)	small to moderate	small to moderate	small to moderate
Nguyen and Wigle (1988)	small to moderate	moderate	moderate

[1]Approximate measure of responsiveness per "unit" of policy change (i.e. a rough elasticity). "Moderate" suggests responsiveness roughly twice as large as found in studies assuming perfect competition.

[2]Economic welfare effect of the policy change expressed as a percentage of the relevant sectoral or aggregate consumption.

[3]Effects on costs, profits, number and size of firms.

[4]Effects on a country's output mix across sectors and/or trade patterns across trading partners.

Source: Tables 3, 4 and text.

TABLE 2

WELFARE EFFECTS[1]
OF TRADE POLICIES

UNDER PERFECTLY AND IMPERFECTLY
COMPETITIVE[2] ASSUMPTIONS

(PERCENTAGE CHANGE IN REAL CONSUMPTION)

Study/ Experiment	Calculated Economic Welfare Impact Under: Perfect Competition	Calculated Economic Welfare Impact Under: Imperfect Competition	Effect on Calculation from Imperfect Competition[3]
Brown and Stern (1988a), Canada-U.S. free trade area.			
Canada	-0.015	1.177	1.192
U.S.	0.045	0.027	-0.018
Rest of World	-0.005	-0.004	0.001
Harris (1984), unilateral Canadian liberalization, reciprocated Canadian liberalization, effects on Canada.			
Unilateral	0.0	4.1	4.1
Reciprocated	2.4	8.6	6.2
Rodrik (1988),[4] 10 percent loosening of import quotas, effects on Turkey.			
No entry/exit			
Autos	6.3	2.6	-3.7
Tires	2.9	0.6	-2.3
Electrical appliances	1.0	-0.5	-1.5
Free entry/exit			
Autos	6.3	5.2	-1.1
Tires	2.9	4.1	1.2
Electrical appliances	1.0	1.2	0.2

TABLE 2 (continued)

Study/ Experiment	Calculated Economic Welfare Impact Under		Effect on Calculation from Imperfect Competition[3]
	Perfect Competition	Imperfect Competition	
Smith and Venables (1988a),[4] cut in transport/transfer costs among EC members equal to 2.5 percent of value of trade, effects on EC as a whole.			
No entry/exit			
Cement, lime, plaster	0.04	-0.10	-0.14
Pharmaceutical products	0.25	0.29	0.04
Artificial, synthetic fibres	0.91	0.99	0.08
Machine tools	0.56	0.84	0.28
Office machinery	0.59	0.88	0.29
Electric motors, generators	0.22	0.29	0.07
Electrical household appliances	0.49	0.64	0.14
Motor vehicles	0.62	0.83	0.21
Carpets, lineoleum	0.47	0.67	0.20
Footwear	0.27	0.35	0.08
Free entry/exit			
Cement, lime, plaster	0.04	0.02	-0.02
Pharmaceutical products	0.25	0.29	0.04
Artificial, synthetic fibres	0.91	1.17	0.26
Machine tools	0.56	0.82	0.26
Office machinery	0.59	1.31	0.72
Electric motors, generators	0.22	0.29	0.07
Electrical household appliances	0.49	0.70	0.21
Motor vehicles	0.62	0.95	0.33
Carpets, linoleum	0.47	0.74	0.27
Footwear	0.27	0.37	0.10

TABLE 2 (Continued)

Notes

[1]Calculated change in economic welfare as a percentage of GNP or GDP, except for Rodrik (1988) and Smith and Venables (1988a), where the calculated welfare effect is scaled by consumption within the industry indicated.

[2]Version reflected in table. Brown and Stern (1988a): monopolistic competition. Harris (1984): non-product differentiation. Rodrik (1988): Cournot pricing. Smith and Venables (1988a): Cournot pricing, models per firm constant.

[3]Second column minus first column.

[4]Column 1 estimates under perfect competition are especially rough approximations, by the authors' own admission, but useful for an order of magnitude.

Sources:

Brown and Stern (1988a, Table 3), scaled by 1976 base GDPs implied by Deardorff and Stern (1986, Table 4.4, pp. 54-55): Canada--195,737; U.S. -- 1,737,250; Rest of World -- 3,020,124.

Harris (1984, Table 2, p. 1028).

Rodrik (1988, Tables 5-7).

Smith and Venables (1988a, Table 3, p. 1514).

TABLE 3

PARTIAL-EQUILIBRIUM

EMPIRICAL RESEARCH ON TRADE POLICY UNDER IMPERFECT COMPETITION

RESEARCH AND POLICY CHANGE	EFFECTS		
	ECONOMIC WELFARE[1]	MARKET STRUCTURE	SECTORAL STRUCTURE OR TRADE PATTERN
Rodrik (1988)			
Policy change:	Proportional change:		
Unilateral loosening of Turkish import quotas by 10 percent. Data base: various years, 1970s, early 1980s late 1970s, early 1980s	i. a. 0.9 b. 2.4 ii. a. 3.5 b. 6.9 Average effect across three sectors.	i. With fixed number of firms, profit/sales rates fall by 2-3 percentage points.	i. Moderate adjustment pressure. Output per firm falls 6-9 percent under Cournot pricing, but only 2-3 percent under collusive pricing.
Sector/market: 3 sectors/Turkey Pricing rule: a. Cournot pricing b. Collusive joint profit-maximizing. Entry/exit: i. none; ii. free Product variety: differentiation by nation of supply Morphology: static		ii. One firm exits each sector uniformly, leaving 2, 3, and 7 incumbents (respectively for autos, tires, and appliances), each of which increases output despite lower sectoral output.	ii. Moderate adjustment pressure. One firm always exits. Most incumbent's outputs rise more than 10 percent, up to 50 percent (autos, collusive pricing).

TABLE 3, Continued
PARTIAL-EQUILIBRIUM

EMPIRICAL RESEARCH ON
TRADE POLICY UNDER
IMPERFECT COMPETITION

RESEARCH AND POLICY CHANGE	EFFECTS: ECONOMIC WELFARE[1]	EFFECTS: MARKET STRUCTURE	EFFECTS: SECTORAL STRUCTURE OR TRADE PATTERN
Smith and Venables (1988)			
Policy change:	Proportional change:		
a. cut in transport and transfer costs among EC members equal to 2.5 percent of value of trade.	a.i. 0.57 Average ii. 0.67 effect on EC across	a. Average costs fall uniformly, up to 1 percent without entry and up to 3 or 4 percent (fibres, office machinery) with free entry.	a. Modest sectoral adjustment pressure based on electrical household appliances (other sectors not given). National output rises as much as 6.4 percent (Italy) or falls by as much as 4.9 percent (U.K.). Trade among EC members rises 22-25 percent; imports from non-EC fall 6-8 percent.
b. same cut as a. with market segmentation removed.	b. i. 1.78 ten ii. 2.12 sectors	b. Average costs fall uniformly up to 2.7 percent (office machinery) without entry, and up to 4.3 percent (fibres) with free entry. Significant exit takes place, by nearly 30 percent of firms. Remaining firms increase in size as much as 50 percent.	
Data base: 1982			
Sector/market: 10 sectors/5 EC markets, 1 rest-of-world market			b. Moderate sectoral adjustment pressure based on electrical household appliances (other sectors not given). National output rises as much as 20 percent for smaller EC members, and falls as much as one percent for Italy. Heavy adjustment pressure on firms because of significant exit.
Pricing rule: Cournot pricing (also Bertrand for illustration). Entry/exit: i. none; ii. free. Product variety: differentiation across firms and within (models), market segmentation due to transport and transfer costs. Morphology: static			

TABLE 3, CONTINUED

PARTIAL-EQUILIBRIUM

EMPIRICAL RESEARCH ON TRADE POLICY UNDER IMPERFECT COMPETITION

RESEARCH AND POLICY CHANGE	EFFECTS: ECONOMIC WELFARE[1]	EFFECTS: MARKET STRUCTURE	EFFECTS: SECTORAL STRUCTURE OR TRADE PATTERN
Digby, Smith, and Venables (1988)			
Policy change:	Proportional change:		
Removal of Japanese VERs		a. Prices decline almost 1 percent on average for non-Japanese firms, 8 percent for Japanese. Mark-ups decline accordingly. But average costs rise almost 1 percent for non-Japanese firms, and profits fall accordingly.	a. Moderate adjustment pressure. Non-Japanese firms lose 4-9 percent of previous sales; Japanese firms gain 57 percent over previous sales.
a. in Britain	a. 2.1 (Britain)		
b. in all EC members	b. 2.0 (Britain) 2.5 (France) -0.9 (Germany) 4.2 (Italy) 2.5 (Japan)	b. Prices decline up to 2 percent on average for non-Japanese firms, and 26 (France) and 52 (Italy) percent for Japanese. Mark-ups decline accordingly. But average costs rise up to 2 percent for non-Japanese firms and profits fall accordingly.	b. Moderate to heavy adjustment pressure. Non-Japanese firms lose 4-22 percent of previous sales; Japanese sales increase six-fold (France) and more than 100-fold (Italy).
Data base: 1985			
Sector/market: passenger automobiles/5 EC markets, Japan, 1 rest-of-world market.			
Pricing rule: Cournot pricing modified for VER. Entry/exit: none Product variety: differentiation across firms and within (models), market segmentation due to transport and transfer costs. Morphology: static			

TABLE 3, CONTINUED

PARTIAL-EQUILIBRIUM

EMPIRICAL RESEARCH ON TRADE POLICY UNDER IMPERFECT COMPETITION

RESEARCH AND POLICY CHANGE	EFFECTS: ECONOMIC WELFARE[1]	EFFECTS: MARKET STRUCTURE	EFFECTS: SECTORAL STRUCTURE OR TRADE PATTERN
Dixit (1988)			
Policy change:	Proportional change:		
Replace $100 U.S. tariff with optimal tariff and/or production subsidy.	1979: 0.14 (optimal tariff of $570 with zero subsidy) 0.55 (optimal tariff of $408 with optimal subsidy)	1979: U.S. profits rise at most 23 percent; Japanese profits fall at most 33 percent.	1979: U.S. auto sales rise at most 11 percent (0.9 mil. units); Japanese exports fall at most 18 percent (0.3 mil. units).
Data base: 1979, 1980.			
Sector/market: U.S. passenger autos.	1980: 0.03 (optimal tariff of $298 with zero subsidy) 0.14 (optimal tariff of $211 with optimal subsidy)	1980: U.S. profits rise at most 12 percent; Japanese profits fall at most 16 percent. optimal subsidy)	1980: U.S. auto sales rise at most 6 percent (0.4 mil. units); Japanese exports fall at most 8 percent (0.2 mil. units).
Pricing rule: variable mark up over marginal cost. Entry/exit: none Product variety: differentiation by nation of supply. Morphology: static			

TABLE 3, CONTINUED

PARTIAL-EQUILIBRIUM

EMPIRICAL RESEARCH ON TRADE POLICY UNDER IMPERFECT COMPETITION

RESEARCH AND POLICY CHANGE	EFFECTS: ECONOMIC WELFARE[1]	EFFECTS: MARKET STRUCTURE	EFFECTS: SECTORAL STRUCTURE OR TRADE PATTERN
Baldwin and Krugman (1988)			
Policy change:	Proportional change:		
a. Removal of alleged Japanese closure of internal market (approximated by 27% tariff).	a. > 0 (U.S.) > 0 (Japan)	a. Number of firms falls from 9 (6 U.S., 3J) to 7 (all U.S.); average output per firm rises; average cost falls.	a. Extreme adjustment pressure. Japanese firms never start to become competitive; equilibrium production and exports are zero. U.S. firms serve entirety of
b. Retaliatory U.S. closure of internal market (trade war, approximated by 100 percent tariffs in each).	b. < 0 (U.S.) > 0 (Japan)	b. Number of firms rises from 9 (6 U.S., 3J) to 12 (7 U.S., 5J); average output per firm falls; average cost rises.	b. Moderate adjustment pressure compared to base case. Japanese firms lose 0.19 share of sales in U.S.; U.S. firms lose 0.14 share of sales in Japan.
Data base: 1976-84			
Sector/market: 16K RAM chips in U.S. and Japan			
Pricing rule: markup over marginal cost pricing. Entry/exit: free Product variety: none, homogeneous products, but market segmentation due to transport costs and policy. Morphology: dynamic — two-stage competition in capacity, then price (Bertrand).			

TABLE 3, CONTINUED

PARTIAL-EQUILIBRIUM

EMPIRICAL RESEARCH ON TRADE POLICY UNDER IMPERFECT COMPETITION

RESEARCH AND POLICY CHANGE	EFFECTS		
	ECONOMIC WELFARE[1]	MARKET STRUCTURE	SECTORAL STRUCTURE OR TRADE PATTERN
Owen (1983)			
Policy change: Formation/ expansion of EEC	Proportional change: 2.0 to 2.5 Average effect on EEC across three sectors.	Average costs fall 1.8-2.3, 1.5-2.0, 0.0-0.1 percent for washing machines, autos, and trucks, respectively.	Intra-EC-- trade assumed to rise 40-50 percent.
Data base: 1976-84			Extreme adjustment pressure on marginal firms that exit
Sector/market: 3 sectors/4 countries		Marginal firms exit in significant numbers (washing machines, Italy)	
Pricing rule: variable markup over marginal cost. Entry/exit: free. Product variety: differentiation by nation of supply. Morphology: implicitly dynamic, static sales competition based on continuous competition in capacity formation.			

TABLE 3, CONTINUED

n.a. = not applicable or not available.

[1] Economic welfare effect of the policy change expressed as a percentage of sectoral consumption. Average effects across sectors of multi-sectoral studies are not weighted. Baldwin and Krugman (1988) figures could not be computed on a comparable basis given data limitation.

Sources of numerical calculations are available from the author on request.

TABLE 4

GENERAL-EQUILIBRIUM

EMPIRICAL RESEARCH ON TRADE POLICY UNDER IMPERFECT COMPETITION

RESEARCH AND POLICY CHANGE	EFFECTS		
	ECONOMIC WELFARE[1]	MARKET STRUCTURE	SECTORAL STRUCTURE OR TRADE PATTERN
Cox and Harris (1985)			
Policy change: Eliminate tariffs and selected NTBs a. of Canada (unilateral). b. of Canada and world (multi-lateral).	Proportional change: a. 4.1 (Canada) b. 8.6 (Canada)	Average output per firm: a. rises 41 percent b. rises 67 percent	Considerable adjustment pressure. 4-6 percent of workers are forced to change their industry of employment. As many as half of the firms in a sector exit. Trade volumes, both imports and exports grow on average 50 percent (unilateral liberalization) to 90 percent (multilateral liberalization).
Data base: 1976			
Sectors: 29 Primary factors: 2 Regions: 2			
Pricing rules: in 20 manufacturing sectors, weighted average of: (i) collusive pricing at landed (tariff-inclusive) world price, and (ii) monopolistic competitive pricing; competitive in 9 sectors. Entry/exit: free Product variety: differentiation by nation of supply.			

TABLE 4, CONTINUED

GENERAL-EQUILIBRIUM

EMPIRICAL RESEARCH ON TRADE POLICY UNDER IMPERFECT COMPETITION

RESEARCH AND POLICY CHANGE	EFFECTS		
	ECONOMIC WELFARE[1]	MARKET STRUCTURE	SECTORAL STRUCTURE OR TRADE PATTERN
Canada (1988)			
Policy change: Eliminate tariffs and selected NTBs on bilateral Canada-U.S. trade only	Proportional change: 2.5 (Canada)	Average costs (manufacturing) fall roughly 10 percent.	Little adjustment pressure. Only 1.3 percent of workers are forced to change their industry of employment. Trade volume, both exports and imports, rises 16 percent with the U.S. and 6 percent with the rest of the world.
Data base: 1981 but 1987 trade barriers.			
Sectors: 88 Primary Factors: 2 Regions: 3			
Pricing rules: collusive at landed (tariff-inclusive) world price for import-competitive manufactures (60 percent); average-cost, contestable-markets pricing for export-oriented manufactures; competitive otherwise. Entry/exit: Free for import-competitive manufactures; none for export-oriented manufactures. Product variety: differentiation by nation of supply.			

TABLE 4, CONTINUED

GENERAL-EQUILIBRIUM

EMPIRICAL RESEARCH ON TRADE POLICY UNDER IMPERFECT COMPETITION

RESEARCH AND POLICY CHANGE	EFFECTS: ECONOMIC WELFARE[1]	EFFECTS: MARKET STRUCTURE	EFFECTS: SECTORAL STRUCTURE OR TRADE PATTERN
Brown and Stern (1988b)			
Policy change: Eliminate tariffs on bilateral Canada-U.S. trade only.	Proportional change: 1.1 (Canada) 0.1 (U.S.) -0.0 (Rest of World)	Average size of firm: Canada: grows modestly (4 to 20 percent) in only 4/24 sectors, and falls sharply (35 percent) in textiles. Otherwise little change. U.S.: little change, with slightly more than 1 percent growth in paper products, and electrical machinery, and 4 percent growth in textiles.	Modest adjustment pressure in Canada, little in the U.S. Employment changes in Canada are greater than 1 percent in 22/29 sectors, greater than 5 percent in 13/29, and greater than 10 percent in 8/29. Employment changes in th U.S. are greater than 1 percent in 4/29 sectors. (Note: sectoral output parallels employment because factor prices were little changed.) Large changes in bilateral trade. Canadian imports from U.S. rise more than 25 percent in 20/22 tradeables sectors, and more than 50 percent in 11/22. Rest of world imports from Canada and U.S. fall in aggregate by roughly the rise in each country's bilateral imports.
Data base: 1976, but post-Tokyo Round tariff rates. Sectors: 29 Primary Factors: 2 Regions: 4 Pricing rules: competitive, monopolistically competitive, Cournot, varying judgmentally across sectors. Entry/exit: free or none, varying judgmentally across sectors Product variety: differentiation by firm only.			

TABLE 4, CONTINUED

GENERAL-EQUILIBRIUM

EMPIRICAL RESEARCH ON TRADE POLICY UNDER IMPERFECT COMPETITION

RESEARCH AND POLICY CHANGE	EFFECTS: ECONOMIC WELFARE[1]	EFFECTS: MARKET STRUCTURE	EFFECTS: SECTORAL STRUCTURE OR TRADE PATTERN
Nguyen and Wigle (1988)			
Policy change: Eliminate tariffs and selected NTBs a. among all regions b. among DCs only	Proportional change: a. 1.5 (large DCs) 0.7 (small DCs) -0.0 (others) b. -0.2 (large DCs) 0.3 (small DCs) 2.9 (others)	Average size of firm: (Manufactures) a. Grows modestly (large DCs). Falls sharply (Canada). Falls modestly (small DCs) b. Grows modestly (large DCs). Grows sharply (Canada). Falls modestly (LDCs and NICs, except machinery and transport grows sharply in LDCs). Average mumber of Firms: (Manufactures) Approximate negative of trends in average size.	Modest adjustment pressure. Modest changes (below 10 percent) in output of manufacturing sectors in almost all regions. Average size and number of firms vary negatively and have quantitatively offsetting effects.
Data base: 1977(?) Sectors: 6 Primary Factors: 2 Regions: 8 Pricing rules: virtually monopolistically competitive in manufacturing, competitive otherwise. Entry/exit: free. Product variety: differentiation by nation of supply.			

TABLE 4, CONTINUED

n.a. = not applicable or not available.

[1]Economic welfare effect of the policy change expressed as a percentage of GNP, GDP, or aggregate spending.

Sources of numerical calculations are available from the author on request.

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APPENDIX

ACRONYMS AND MEANINGS

Acronym	Meaning
CGE	Computable General Equilibrium
DC	Developed country
EC	European Communities
EEC	European Economic Community
GDP	Gross domestic product
GNP	Gross national product
LDC	Developing country
NIC	Newly industrializing country
NTB	Non-tariff barrier
OECD	Organization for Economic Cooperation and Development
OPEC	Organization of Petroleum Exporting Countries
R&D	Research and Development
VER	Voluntary Export Restraint
VRA	Voluntary Restraint Arrangement