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The Economic Effects of Widespread Application of Antidumping Duties to Import Pricing

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and
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Simulation results provide a quantitative argument against the imposition of antidumping duties.

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This paper — a product of the Trade Policy Division, Country Economics Department — is part of a larger effort in PRE to understand the economics of the emergence of "fairness" as a standard for regulating international trade, its implications for the continued openness of the international trading system, and its continued functioning as an important vehicle for development. This was funded by the research project on "Regulations Against Unfair Imports: Effects on Developing Countries" (RPO 675-52). Copies are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Nellie Artis, room N10-013, extension 37947 (41 pages). October 1991.

Conway and Dhar develop a model to address a theoretical issue: what is the impact of widespread dumping and the use of antidumping duties on the exporting and importing countries?

They take as their null hypothesis the typical response that dumping is an unfair trade practice and that appropriate antidumping duty restores outcomes obtained through fair trade (the predumping outcome). They compare that to the alternative hypothesis that antidumping duties do not eliminate the distortions to the world economy inherent in dumping behavior but rather introduce a protectionary distortion that can further reduce the welfare of trading partners.

After indicating analytically and through simulations the impact of dumping behavior and antidumping duty retaliation on exporting and importing countries, Conway and Dhar conclude that:

- The credible threat to impose antidumping duties promptly and in an amount equal to the dumping margin can dissuade exporting firms from undertaking dumping activity. But instances of dumping and the imposition of antidumping duties indicate that the duties have failed at that task.

- The imposition of antidumping duties does not have the impact often assigned to it — to offset completely the price impact of dumping and return the world economy to the predumping equilibrium. Rather, when imposed they act more as protective policies to insulate the import-competing sector from competition and as optimal tariffs to improve the purchasing power of all residents of the importing country. They do not end the dumping because they do not remedy the root cause: market segmentation and the difference in perceived price elasticity of demand in the two markets.

- Although dumping is undertaken by private firms, it cannot occur without the cooperation of the exporter government. Both segmentation of foreign from domestic markets and restrictions on entry of firms are necessary to assure the profitability of dumping. The former can be guaranteed through trade restrictions on the reimport of the dumped good; the latter may be a component of industrial policy. Removal of these preconditions will eliminate dumping.

- Antidumping quotas appear to be an attractive alternative to antidumping duties in attaining a fair trade outcome. In fact, they introduce the possibility of a third distortion in the world trading economy through their encouragement of collusion in the dumping sector, and are welfare-reducing in comparison with antidumping duties. Negotiated export restrictions have similar and in some cases more pronounced drawbacks.

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The Economic Effects of Widespread Application of Anti-dumping Duties to Import Pricing

Table of Contents

To be included in Finger, J., ed.: The Economics of Antidumping: Studies of Enforcement and of Effects on Developing-Country Industries.

Introduction

Dumping occurs when a firm charges a price in the foreign market below its price in the domestic market when it supplies the identical good to both markets.[1] Provisions within the GATT allow member countries to impose anti-dumping (AD) duties to counteract this behavior and return the price of the dumped goods to its "fair value". The increasing incidence of dumping allegations and imposition of anti-dumping (AD) duties indicate that dumping of exports in foreign markets is a growing concern in international trade and policy discussions. The other studies of this volume have presented in quite impressive detail the evolution and present ubiquity of AD investigations and duties in import-competing countries, and have also addressed the issue of whether these trends truly indicate a rise in dumping activity. In this paper we focus on a separate, more theoretical issue: what is the impact of widespread dumping and use of AD duties on the exporting and importing economies?

A typical response to this question in policy discussions has been that dumping is an unfair trade practice and the appropriate AD duty restores outcomes obtained through fair trade (i.e., the pre-dumping outcome). We take this response as our null hypothesis and compare it to the alternative hypothesis that AD duties do not eliminate the distortions to the world economy inherent in dumping behavior but rather introduce a protectionary distortion that can further reduce the welfare of trading partners. This latter distortion has an impact similar to that of protective trade policies like tariffs or quotas. Our analysis will first examine the relevant theoretical evidence on dumping and the incidence of AD duties. We focus on dumping as a response to segmentation of domestic from foreign markets, the so-called "classic theory of price discrimination" (Deardorff, 1988, 24). Then we specify an archetypal computable general equilibrium (CGE) model in which dumping is rational firm-level behavior to compare the quantitative effects of AD duties on the economies relative to the effects of both fair trade (i.e., non-dumping) and of other protective policies.

Our analysis indicates that while the credible threat of imposition of AD duties can maintain the world economy at a fair-trade equilibrium, actual imposition in response to observed dumping is less likely to do so. This difference hinges on the distinction between Type I and Type II AD duties made in the introductory chapter of this volume. Type II AD duties are those imposed immediately to counteract 100 percent of an observed dumping margin and removed promptly on the cessation of dumping: a rational firm confronted with an otherwise-profitable dumping opportunity and these AD duties will forgo the opportunity and fair trade will be maintained.

The protectionary distortions of AD duties occur when they are in fact imposed in response to observed dumping. These observed duties will have elements of Type I AD duties: those imposed with less direct temporal or sectoral connection to dumping activity, or that counteract only a fraction of the dumping margin. These will not deter dumping behavior, and will introduce additional relative-price distortions into the world trading economy. The relative price structure in international trade and in the exporting country with dumping and AD duties will thus be quite different from that in the absence of dumping.

The revenue effects of an observed AD duty provide another reason that the fair-trade outcome is not maintained. When AD duties are imposed in response to observed dumping behavior on a substantial share of imports the resulting revenues from the duties provide a substantial transfer from the exporting country to the importing country that will affect economic decisions in both countries. These conclusions together suggest that the null hypothesis will not hold and raise the possibility that the net effect of dumping and the imposition of AD duties will in fact be quite protectionist for the importing country. Simulations with the CGE model support these conclusions and indicate that the protectionist effects of AD duties can be quantitatively quite significant.

AD duties, whether threatened or imposed, are efforts to regulate international trade. Other possibilities exist for such regulation, including

imposition of quotas and negotiation of voluntary export restraints. We compare and contrast the quantitative impact of these with that of AD duties using data from the CGE simulations. We do not consider here export subsidies, the other trade practice often cited as unfair and countervailable under the GATT. The methodology and tests employed here are easily transferable to that case. de Melo and Roland-Holst (1990) provide a useful CGE analysis of the impact of export subsidy on trade.

Given its reduced welfare, the government in the exporting country may well want to reduce the barriers that allowed market segmentation and thus remove the rationale for dumping, We discuss two methods: trade liberalization to allow dumped goods to be re-imported at the lower price, or an industrial policy liberalization to encourage firm entry into the dumping sector. Either will be successful in stopping dumping at its source, although the second involves an increase in fixed costs in this model that is itself welfare-reducing.

Analytical Discussion of Dumping and AD Duties.

There is a substantial existing literature on economic rationales for dumping. The earliest discussions concluded that dumping would be profit-maximizing for the private firm if the price elasticity of demand is larger in absolute value in the export market than in the home market and if the two markets could be segmented -- i.e., prevented from cross-trading with each other. This "classic theory" was first described by Viner (1923) and Barone (1921); Robinson (1933) identified it as discriminating monopolistic behavior. More recent analyses, as discussed below, have incorporated oligopoly theory with the Viner/Robinson insight to explain inter-industry trade, or what Brander and Krugman (1983) call "reciprocal dumping". Dixit (1987) provides another analysis of dumping behavior in an oligopolistic setting. More recently, analysts have advanced other theories of dumping as an intertemporal phenomenon. Ethier (1982) and Davies and McGuiness (1982) suggest in this vein that dumping as the sale of products below average or even marginal cost can be a rational response to a temporary downswing of goods demand.

Williamson (1977) and Areeda and Turner (1978) consider predatory dumping, where temporary dumping below average or marginal cost can increase the discounted value of total profits. Dumping in this case drives competitors out of the market and thus permits monopoly pricing in future periods that increases the discounted value of the entire stream of present and future profits. We focus on the classic theory as expounded in the preceding articles in our synopsis of the impact of dumping and AD duties. We believe, however, that a useful extension to this work would be to model similarly the intertemporal theories of dumping. The following conclusions are restated in mathematical form in Annex A.

Dumping as a rational response to market segmentation

The Viner/Robinson insight on dumping behavior is a simple application of the microeconomic theory of price discrimination. Consider a firm with no competition and with purchasers in two markets. If there is no market segmentation, the firm cannot discriminate against purchasers in either market; sales at a higher price in market one would be undercut by repurchases from buyers in market two, and vice versa. Its best strategy is then to set a unique price for the two markets together at a level that maximizes its profits. The price-setting rule (or equivalently for our purposes, its quantity setting rule that generates the desired price) is the standard monopoly condition that the marginal revenue from selling an additional unit must equal the marginal cost of producing that unit. Marginal revenue depends upon the price elasticity of demand for the product (Δ); in this case Δ is a weighted average of the price elasticities of demand in the two markets (Δ_x, Δ_h). Price exceeds marginal revenue, with the gap between the two narrowing as demand grows more elastic (as the price elasticity of demand grows in absolute value).

Viner, Barone and Robinson observed that if the two markets are segmented and the price elasticities of demand in the two markets differ, the firm can earn even higher profit by setting different prices in the two markets. In this case, the firm should set the marginal revenue in market x

equal to marginal cost of production and the marginal revenue in market h equal to that same marginal cost. If demand is more elastic in market x, then the profit-maximizing price for the identical good will be less than the price charged in market h. If market x is the export market while market h is the home market, then profit-maximizing behavior leads to dumping. The dumping margin, or the percentage difference in the two prices, will depend upon the difference in price elasticities of demand.

More recent analyses of dumping behavior (e.g., Brander and Krugman (1983), Dixit (1988)) have extended this insight to the case of oligopolistic or monopolistically competitive industries. In these instances the firm must consider not only the market demand elasticity but also the share of that market it will be able to capture or retain from the competition. The profit-maximizing decision is similar to the earlier case for both the non-segmented and segmented markets, but the marginal revenue in the criterion is replaced with a perceived marginal revenue. This perception reflects the firm's perception of each market's price elasticity of demand to changes in its price and must incorporate some notion of how the competitor firms will respond. The interactions of these firms can be described in a number of ways, and as Eaton and Grossman (1986) point out the results obtained may be sensitive to the method chosen. We choose to employ the conditions of a Cournot-Nash equilibrium with symmetric firms, and in this case find that the firm's perceived price elasticities of demand (δ_x, δ_h) are related to the number of firms competing in the market (n_h, n_x) and to the market elasticities (Δ_x, Δ_h) in the form $\delta_i = n_i\Delta_i$, i=h,x.[2] The perceived price elasticities thus rise both with the market elasticities and with the number of competing firms. These δ_i are used by the firm in setting prices in the two markets, and when $|\delta_x| > |\delta_h|$ dumping will occur. Intuitively, increasing the number of firms reduces the wedge between price and marginal cost.

Dumping is made possible by two preconditions: the opportunity to sell the same good for two prices in the two markets, and a difference in perceived elasticity of demand in the two markets. The first must be a product of trade

policy, for without some trade restriction the trade of goods would eliminate this opportunity. The second may be due either to reasons of market demand differences or to different degrees of competition in the two markets.

National welfare is ambiguously affected by dumping activity. Welfare accruing from the dumping sector has two components: the consumer surplus from domestic consumption and the profits earned by producers on domestic and foreign sales. Part of the increased profits earned by producers is a transfer from consumers, and will thus not be a net addition to welfare. For welfare to rise the increase in profits from foreign sales must exceed the reduction in consumer surplus.

Welfare in the importing country is improved by dumping. Profits for the import-competing firms fall but serve as a transfer to consumers in that country. The added increase in consumer surplus from the availability of lower-priced imports leads to the improvement in welfare.

The impact of AD duties

The importing country is entitled under the GATT and obliged by law in many countries to impose an AD duty to counteract the effect of dumping. Its purpose can be outlined by reference to the home (P_h) and export (P_x) prices of the dumped good and the resulting dumping margin ($DM = (P_h - P_x)/P_x$). The price of the dumped good in the importing country is P_f, and if the real exchange rate of the importing country is e_f the following relationship links these.

$$(1) \qquad P_h = (1 + DM)\, P_x = P_f / e_f$$

Given this relationship, an AD duty equal to DM placed on the dumped import would raise its price in the importing country to $e_f P_h$ and remove the exporter's advantage in the importing market introduced by dumping.

This does not necessarily return the world economy to the fair trade equilibrium, because it leaves in place the fundamental segmentation of markets that makes dumping possible. That segmentation allows the dumping

firm to set its prices differentially to maximize profits. This point is most clearly made by considering firm behavior when the AD duty is perceived as being Type I due to long lags in implementation, long lags in repeal once dumping has stopped, or uncertainty about whether AD duties will be assessed once dumping begins. In this instance profit-maximizing behavior defines a strict relationship between P_h and P_x that can be written

$$(2) \qquad P_h = (1 + [(\delta_h - \delta_x)/\delta_x(\delta_h+1)])\ P_x$$

If we compare equations (1) and (2) it is evident that the term in braces defines the dumping margin, and its components are not factors that are reversed by the imposition of the Type I AD duty. The firm accepts the duty as a cost of doing business independent of its dumping activity and as such is not deterred from dumping.

What then does the Type I AD duty do? Since it cannot close the wedge between P_h and P_x, it rather will put pressure on P_h and P_x to fall, on e_f to fall (or appreciate) and will provide protection for P_f to rise. This will further distort the relative prices in both economies and in the trade between the economies; i.e., it will have the customary effects associated with protective tariffs.

At the opposite extreme, the threat of a Type II AD duty is effective in maintaining the world economy at its fair-trade equilibrium.[3] Beginning with no market segmentation (our definition of fair trade), a rational firm faced with the opportunity of segmented markets and the threat of a Type II duty will find its interests best served by maintaining its fair-trade behavior. Any move to raise the domestic price P_h to exploit the segmented markets would raise P_f in the export market as well, restricting the size of that market without passing on the increase in price through the export price P_x. This anticipated loss to the exporting firm induced by the Type II AD duty causes the firm to revise equation (2) and to conclude that it cannot improve upon $P_h = P_x$ at the fair-trade equilibrium.

AD duties thus share on a smaller scale a property of nuclear weapons. Threat of their use can induce desirable behavior. However, once they are deployed they leave existing distortions intact and introduce new disasters. This independent distortionary effect is noted in the economics literature. Deardorff (1988, 27) notes in his survey of classic dumping that "...it would appear that restrictions against dumping from the importing country's point of view make no economic sense. This conclusion is reinforced if one considers specifically the welfare of the importing country." Dixit (1988) finds no rationale for AD duty imposition in an oligopolistic version of the classic dumping model.

AD quotas, voluntary export restrictions and negotiated settlements

Given the problems in reattaining the fair trading outcome through use of AD duties, policy-makers may well be tempted to employ an AD quota of imports from the dumping country at the fair-trade (i.e., pre-dumping) level. This will maintain imports at the fair-trade level, but will not remove the market segmentation and the incentive to dump. Setting up a single quota-holder could lead to positive welfare gains for the importing country, but the more likely scenario of competition among importing-country residents to import under the quota will leave most of the profits in the hands of the exporting firms. This would lead to larger diversions from the fair-trade outcome, and a quantitative example is presented in the subsequent simulations section. This policy therefore retains the distortions of market segmentation and of protection (as evidenced by the tariff-equivalent of the quota).

An extreme example of this latter effect occurs under the voluntary export restriction; the exporting firms will in this case capture the entire profit from export sales. This restriction may in fact encourage collusion among the competitors to such an extent that they begin to act as monopolists in the export market. This would lead to restrictions of exports to levels lower than those at the fair-trade equilibrium, since the number of competitors would be reduced to n_h+1, and the resultant higher prices in the export market.[4]

Negotiated settlements of AD duty cases are another outcome that the theory would predict. Exporting firms unsure of the Type of AD duty they face (I or II) would dump in the export market. Once the importing country threatened a Type II response to the dumping, the exporting firms could reach agreements leading to a cessation of dumping at a negotiated price in the export market. This could be the fair-trade price, leaving the exporters with the profits incurred until the Type II duty was imposed; it could also be a higher price that reflects the collusion of the exporting firms in the negotiation process.

General-equilibrium considerations

The discussion to this point has taken as given a number of variables that should more properly be considered endogenous in a discussion of the effects of dumping and AD duties. We mention each here, but detailed analysis will be presented in the context of the simulation model and its results.

Wages. Dumping that expands the production of its sector will put upward pressure on wages in conditions of full employment. In cases of less-than-full employment the cost function should include the shadow wage, and this also will be rising. Dumping need not expand the production in its sector, however; concomitantly with an increase in sales on foreign markets there is a reduction in sales to the domestic market due to higher P_h. The net result on output and employment is ambiguous.

Relative prices in other sectors. Dumping is a sector-specific activity, but through its impact on national income and factor allocation will also affect prices in other sectors. This will lead to altered demand and supply decisions in all sectors.

Income effects of the policy. Dumping will change the allocation of income both within and across countries. In the exporting economy the dumping-sector profits will rise relative to other sectoral profits and to wages; in the importing economy the converse will occur. These income effects will change demand for all goods, both at home and abroad. Additionally, to the extent that the winners from this policy have different consumption

patterns than the losers, there will be additional shifts in demand due to the income redistribution.

Other government policies. There are two sets of policies in the dumping country that generate the dumping opportunity. Trade policies must insulate the dumping country from the importing country; otherwise, goods would simply flow back from where they were dumped to the home market at their lower price. Also, industrial policies or other barriers must protect the existing producers from domestic competition. Change in either of these will radically alter behavior in the dumping sector and by extension in the economy as a whole. This is evident in the derivation underlying equation (2): factors that influence the size of the δ_i will influence the size of the dumping margin. One obvious policy change is to remove market segmentation: then all firms can sell in all markets ($n_h = n_x$) and the wedge between P_h and P_x disappears. Another is to allow firm entry into the dumping sector; as n_h becomes large it approaches n_x even though market segmentation remains.

A CGE Model of Dumping and AD Retaliation.

In this section we specify a CGE model of international trade to investigate the quantitative impact of dumping and AD duties on the trading economies and to compare that with the impact of protective policies. This model of three trading regions is not calibrated to represent any specific set of economies, but rather to provide a quantification of the effects of such commercial policies within a theoretical trade model.

The model for each country is quite similar to other CGE models, especially those inspired by World Bank research (see Dervis, de Melo and Robinson (1982) or de Melo and Tarr (1989)) although with less sectoral detail. Each country is characterized by monopolistic competition in one trading sector, and in that we follow the work of Rodrik and Devarajan (1989).

There are, however, two areas in which this model departs sharply from the existing literature. First, it is designed "from the inside out"; instead of calibrating the model to replicate the observed behavior of a specific

country, we begin as in trade theory with endowments, technology and tastes and have derived the implied behavior.

Second, it endogenizes the trade pattern between the three regions. In one set of simulations we look at two of the countries in isolation, so that the export demand relevant to country A is simply the import demand of country B. This removes a source of possible inconsistency in the other, single-country, models and introduces explicitly the game-theoretic behavior at the base of retaliatory commercial policy as discussed here.[5] In the subsequent simulations we examine trading behavior of these two countries between each other and with a large third region that sets world prices. This specification of trading patterns is chosen to approximate more closely the incidence of dumping in countries small relative to the world market.[6]

We present the salient features of the model in Table 1.

There are three goods produced and consumed, of which two are traded. Of the two traded goods, one is a decreasing-cost industry. This good is denoted T1; the pattern of endowments assumed of productive factors implies that country B is its comparative-advantage producer. Country A has the comparative advantage in a constant-cost industry producing the good T2. The large world region is the next lowest-cost producer of each traded good. Each country also produces a non-traded good NT.

The production and demand structure of the economies generates excess demands and supplies of traded goods. With no segmentation, dumping is not allowed in equilibrium, so that the export price (P_x) equals the domestic sale price (P_h). The dumping equilibrium is identical to that under fair trade except that in country B P_x is less than P_h. With Type I AD duties country-A excess supply also shifts down so that the exchange rate-adjusted world price differs from both P_{xB} and P_{fA} by the amount of the intervention. There would of course be shifts in these excess supply and demand curves due to general-equilibrium effects of policy shifts, and we abstract from those in the diagram for clarity. They are, however, captured in the simulation results.

Consideration of dumping requires assumptions as well about the form of market segmentation among the three regions. The T1 producers of country B are assumed to be able to segment both domestic and country-A markets from large-country suppliers; there are thus three different prices for T1, even when converted into a common currency. In equilibrium the dumping country also finds it profitable to export T1 at the world price to the third country and imports T2 in return. Country A's market is closed to resale of T1 in the third country.

The analytical discussion above highlighted the importance of the number of firms competing in determining the dumping margin and thus the characteristics of equilibrium in the world economy. We specify the technology of T1 production to require a fixed-cost investment; this introduces a rationale for monopolistic competition or oligopolistic behavior and a finite number of firms supported in each market. Such decreasing-cost technology is not essential to dumping, but its assumption provides an easy way to compare our results with those of Brander and Krugman (1983), Dixit (1988) and others. In our initial simulations we further assume that T1 production is limited to two firms in each economy. The number of firms competing in each market will differ from this; with no market segmentation all four firms will compete in each country, while with market segmentation the competition in the dumping country is limited to the two home firms (n_h = 2) while the two face the competition of the two foreign firms in their export market (n_f = 4). In subsequent simulations we relax these assumptions to allow for firm entry in the dumping sector of the T1-exporting country.

The results that follow are organized by international trading structure: autarky, trade with no market segmentation, dumping, dumping <u>cum</u> AD duty, and equivalent tariff in the absence of dumping. Examination of the null and alternative hypotheses require comparison of the dumping/AD duty and equivalent tariff scenarios with the no-market-segmentation scenario; the tables making that comparison are thus presented in terms of percentage deviations of variables from their no-market-segmentation values. For the

null hypothesis to hold, there should be no difference between the no-market-segmentation and dumping/AD duty scenarios. It is rejected in favor of the alternative if the dumping/AD duty and equivalent tariff scenarios diverge in a systematic way from the no-market-segmentation case with any non-systematic variation attributable to the continued phenomenon of dumping. If they diverge in an unsystematic fashion then the alternative hypothesis should be respecified.

Autarky

When the two economies are examined in autarky, they reveal the desired pattern of comparative advantage as illustrated in Table 2. Country B has the lower relative price of the good T1 and country A correspondingly has the lower relative price of T2.[7] The profits per firm in the two countries in the oligopolistic T1 sector are 17.83 in B and 15.47 in A, respectively.

Trading equilibrium

International trade causes the expected changes in sectoral production and income structure as indicated in the final column of Table 2. Country B specializes in production of T1 while country A specializes in T2. The returns to the relatively abundant factors (K in country A, L2 in country B) rise, while those of the relatively scarce factors (L2 in country A, K in country B) fall. Relative prices of the comparative-advantage good rise in each country. Since the non-traded good is treated as a numeraire in each country, trade defines a real exchange rate (ER/ERA) relating those numeraires.

Country A imports 18.99 units of T1 and exports 23.53 units of T2. Trade is balanced between the two countries. Welfare rises in both countries. GNP measured in units of NT proves to be a misleading indicator of welfare; it rises by only .6 percent in country B and in country A falls by 8.6 percent, but in both cases purchasing power rises by more due to the fall in the price of tradeable goods.

We created this reference equilibrium with no market segmentation through simulation of trade between countries A and B alone. We now create a large third region with relative prices identical to those achieved in this equilibrium. Thus, the "fair trade" outcome is one of trade only between A and B; one measure of the degree to which dumping and AD duties bring about equilibria different from this reference will be the importance of trade with the third region.

Dumping

The earlier theoretical sections demonstrated that a divergence between perceived price elasticity of demand in the two trading economies will provide a rationale for dumping. This divergence is in evidence in the present model in the market for T1; even though the market elasticity of demand is always equal to -1, the difference in the number of competing firms leads to a perceived foreign elasticity ($\delta_x = -4$) greater in absolute value than the perceived home elasticity ($\delta_h = -2$) for producers in country B. Table 3 illustrates in its second column the percentage deviation from the trading equilibrium resulting from dumping in the segmented markets in the absence of an AD duty retaliation.

When market segmentation allows the export price to diverge from the domestic price the T1 producers in country B will create a dumping margin of .50 to maximize firm-level profits. This margin is absorbed by both domestic consumers and foreign consumers, as the consumer price of T1 rises 20.3 percent in country B while it falls 4.4 percent in country A. This enables T1 producers in country B to increase profits per firm by 14.1 percent.

The opportunity to dump does not lead to an increase in output of T1 in country B. Although exports increase with the dumping strategy, domestic consumption falls by more and leads to a 4.4 percent drop in T1 output. GNP rises in the dumping country, but that is an artifact of the artificially high price of T1; welfare as measured by actual consumption quantities falls by 3.3 percent as losses in consumers' surplus outweighed profit-taking in the dumping sector. Factor prices move very little in response to the decision to

dump; there is a slight fall in the return to L2, the factor used intensively in production of the dumped good, in response to the cut in production. The lower prices of T1 in the foreign market also bring about a 5.9 percent depreciation of the country-B real exchange rate (ER/ERA).

The importing country receives conflicting signals on the impact of dumping. Measures often taken as indicative of the effect of dumping on the economy will indicate a strongly negative impact. For example, there is evidence of "material injury" as required for retaliation under GATT Article VI: imports of the dumped good grow by 15.8 percent, and the market share of foreign firms in total consumption rises from 41 to 45 percent. However, these give a misleading signal of overall welfare: dumping leads to a 1.5 percent increase in welfare in country A due mainly to the drop in the average price of T1. There is in fact a slight increase in T1 production and profits in the importing country. The quantity demanded for consumption rises faster than exports due to increased purchasing power. This is an artifact of the Armington assumption of imperfect substitutability between the imports and domestically produced T1 and understates the potential for material injury.

Anti-dumping duties

Given the clear indication of dumping behavior in the model and the "threat of material injury" evident in imports and market share, country A would be entitled under the GATT (and obliged under the laws of many countries) to impose an AD duty on country B's exports of T1.

If the exporting firms perceived country A as credibly committed to immediate imposition of a Type II AD duty in response to dumping then the duty would have its desired effect. Simulation of this case would include no price discrimination by the exporting firms and no imposition of AD duty by the importing country -- in other words, the outcome would be identical to that in the fair-trade equilibrium of column 1 in Table 3.

However, imposition of a Type I AD duty by country A equal to the dumping margin generates a new equilibrium illustrated by the percentage changes listed in the third columns of Table 3. (These are percentage changes

relative to the initial trading benchmark.) These simulations make the point quite forcefully that use of the AD duty to retaliate against existing dumping does not re-establish the pre-dumping equilibrium. Dumping will coexist with the AD duty, introducing a second distortion to the world trading economy. The degree of dumping may be altered or not, as noted in the theoretical section, but the end result is an outcome with striking protective elements.

The major impact of the AD duty occurs in its effect on international trading volumes and on the real exchange rates. The optimal dumping margin remains the same at .50. Country B's export of T1 to country A falls over 27 percent relative to its initial level, while exports to the rest of the world rise from zero to 9.7 units. Country B's imports from country A also fall by over 27 percent, while imports from the rest of the world rise to 12 units. Country B's real exchange rate with A appreciates by 19.4 percent relative to the fair-trade equilibrium. This indicates that country B's purchasing power is enhanced relative to that of country A. Consumer prices of T1 in B rise by 20.3 percent, just as in the case of dumping alone, while consumption of T1 there falls 15.5 percent.

In the dumping country, profits per firm fall in NT numeraire after the Type I duty, but remain 12.8 percent above the fair-trade equilibrium level. The quantity of T1 produced falls slightly relative to the dumping case. GNP falls slightly, and welfare improves slightly, relative to the case of dumping alone. The AD duty will thus not discourage the profit-maximizing producer, but will impose a loss on country B through the terms-of-trade deterioration.

In the importing country, the AD duty provides some support to T1 producers: profits per firm rise slightly, as do output and employment, when compared to the dumping equilibrium. Despite the duty, the consumer prices of T1 in NT numeraire fall relative to the dumping case due to the real appreciation of the country-A exchange rate. There is also evidence of the Stolper-Samuelson effect, as the tariff on imports lowers the return to the abundant factor K. The net effect on welfare of the AD duty is negative, with

welfare falling below that of the initial equilibrium and a fortiori below that of the dumping scenario.

The general-equilibrium effects of dumping and AD duties are evident in the evolution of the other tradeable good market. Dumping alone led to an increase in T2 output in the dumping country and a fall in the importing country in response to substitution away from or into T1. Trade in T2 fell relative to the non-dumping case because of the lower value of T1 exports. When the AD duty is introduced the major loser is the T2 sector in country A; output falls mainly because of the fall in exports to country B. The government income from the AD duty is rebated to consumers, and is sizeable at 3.4 percent of GNP.

Examination of Null and Alternative Hypotheses

We reiterate our null hypothesis: that dumping cum AD duty returns the world economy to the pre-dumping equilibrium. This is examined relative to the alternative hypothesis that the AD duty works as a protective duty in its effects on the importing and exporting economies and does not eliminate the distortions due to dumping. A recurrent theme of this volume has been the manner in which the AD duty provides camouflage for the introduction of protection. In the final scenario documented in Table 3 we consider the impact of a 50 percent tariff in the absence of pre-existent dumping. Given the existence of a large third region prepared to provide the traded goods at the fair-trade terms of trade, it is not surprising that such a tariff by country A on country B's goods has no effect on the two countries' domestic economies. Its only effect is to greatly stimulate trade with the rest of the world, with all trade between A and B replaced by trade with the rest of the world. The tariff thus collects no revenue, but does divert trade to the third market.

The null hypothesis holds for the case of an anticipated Type II duty. As we noted in the text, the equilibrium resulting from market segmentation

and a credible Type II AD duty is identical to that of fair trade in this model.

In the case of Type I duties examination of the third column of Tables 3 indicates that the null hypothesis does not hold. The dumping/AD duty scenario maintains large deviations in a broad array of variables from their values in the non-segmented trading equilibrium. The Type I AD duty cannot affect the terms of trade, and has less impact on the real exchange rate, but nevertheless worsens in most cases the swings in variables away from their trading equilibrium due to dumping.

The alternative hypothesis that an AD duty is simply a targeted protective tariff does not help to explain the domestic distortions in countries A and B in the dumping/AD duty equilibrium, but its evidence of trade rerouting does provide an explanation for the rapid growth in trade with the rest of the world. The observed dumping/Type I AD duty equilibrum is thus marked by characteristics both of protection and of the dumping margin maintained by the exporting country.

Figures 1 through 3 reiterate the lessons of this hypothesis test. In Figure 1 the welfare effects of dumping and AD duties are summarized for the two trading economies separately as well as jointly. There are large gains from trade in the move from autarky to fair trade. Dumping reduces joint welfare, although the importing country wins big and the dumping country loses big from that activity. Imposition of the Type I AD duty brings about a still further fall in joint welfare, with the importing country losing from its AD duty imposition while the dumping country gains.

Why does country B dump these goods if it reduces its welfare? Figure 2 illustrates the reason in the changes in profits of T1-producers in the two countries. Fair trade leads to an improvement in profits in country B relative to autarky, and to a precipitous decline in profits in country A. Dumping further improves firm-level profits in country B, while the imposition of AD duties has a slight negative impact there. Country-A profits are little affected by either of these innovations.

These changes in commercial policy have a large impact on the volume and pattern of trade. Figure 3 illustrates these changes through examination of the pattern of exports of T1 by country B. Fair trade brings about a large expansion in exports to country A, while (by construction) exports to the rest of the world remain at zero. The market segmentation that leads to dumping increases the volume of trade in T1, and also opens up some shipment to the rest of the world. Imposition of the AD duty leads to a large shift in the pattern of trade, with much more exported to the rest of the world, and a much smaller effect on export volume.

AD duties vs. AD quotas in restoring the initial trading outcome

Recent theoretical research has suggested that quotas and tariffs will lead to different trading equilibria even though they are specified to provide identical partial-equilibrium protection. For example, Syropoulos (1990) demonstrates that in a dynamic setting quotas can be pro-competitive while tariffs do not have that effect. The key to that paradoxical result is the impact of the policy on market structure; in Syropoulos' case the quota leads to greater competition among foreign exporters. Evidence on "quality upgrading" in US imports suggests that quotas will on the contrary have an anti-competitive effect that tariffs will not due to reduced competition among foreign exporters.

We examine the difference in impact of tariffs and quotas in our simulation model. The tariff that is purported to restore fair trade is that equal to the dumping margin; the quota with equivalent effect will limit imports to the pre-dumping quantity. Results of simulations that compare these two policies are presented in Table 4.

With the imposition of the quota the profit-maximizing condition of the dumping firm is changed, and the new condition will depend upon the effect of imposition of the quota on expectations of competition. Many alternative assumptions about this are possible; we assumed that with the quota the exporting firms viewed themselves as the only competitors in the quota-limited

export market. This made the export market an extension of the domestic market and led to identical domestic-currency pricing decisions for the two. The third column of Table 4 indicates the effects of this quota in the CGE model. The price in both markets was set at the monopolistic price of the domestic market. The dumping country B found the quota preferable to the AD duty in terms of welfare. The importing country A would have achieved the desired result of eliminating evidence of dumping, but will suffer a welfare loss relative both to fair trade and to the AD duty.

The quota is set at the fair-trade equilibrium level. It proves to be non-binding in the new equilibrium, as the exporting firms choose to export less than permitted, but at a higher price. In the theoretical section we discussed the anti-competitive incentives of quotas, and these results illustrate that concept. Firm-level profits rise sharply in country B relative to the fair-trade level, while firm-level output and profits in the importing country fall. Thus, although some indicators of injury in the importing country -- the increased exports and loss of market share -- are reversed by the quota, other more important indicators of injury appear.

Negotiated voluntary export restrictions (VER) carry the anti-competitive nature of quotas another step. With the quota, there is still some competition among exporting firms in the export market, while with a VER there is an incentive for those exporters to collude in choosing a monopolistic price and quantity for export. We model this by maintaining market segmentation and using numerical optimization of the model to choose the price on exports that maximized firm-level profits. The resulting AD VER scenario is characterized by reverse-dumping, with an export price exceeding the domestic price. This results from the competition among two firms in the domestic market but the collusion -- implicitly a monopolistic firm - in the export market. The effects of the AD quota on the importing country are intensified by this, and consumer prices of T1 rise above the levels reached with the AD duty in place. Producers of T1 in the importing country lose both through lower production and lower profits while the nation as a whole

experiences a large fall in welfare. In country B the reverse holds, with output and profits in the T1 sector rising. Welfare in country B in fact rises above its fair trade level as it exploits its monopoly power in the T1 market due to the market segmentation.

The net result of these alternative forms of anti-dumping regulation is an improvement in exporter-country welfare and reduction in importer-country welfare relative to the AD-duty scenario and less support to import competitors than in the AD-duty scenario.

An Extension: The Impact of Trade on Market Structure

The preceding results were predicated upon a fixed number of firms in each economy. In the absence of government restrictions to entry, this rigidity would not in general hold, especially in the presence of super-normal profits in the T1 sector. An alternative assumption would be to let entry occur until those profits were eliminated, and we investigate that possibility in this section.

The first variant we explore is the possibility that the number of firms in the dumping country is fixed while the number in the importing country is not. In the short run trade and a fortiori dumping should lead to losses by the firms in the importing country; in the longer run the number of firms should shrink to reflect the new realities. As the first panel of Table 5 illustrates, the trading equilibrium leads to a marginal shrinkage of the number of firms in country A from the autarkic 2 to 1.66. Subsequent introduction of dumping, AD duties and equivalent tariffs have very small effects. The impact on the variables discussed in the previous section is also quite small, with welfare rising slightly in this long-run equilibrium as fewer fixed costs are incurred.

A second simulation illustrates the importance of government restrictions on entry into the T1 sector in country B. The fixed costs of production in the T1 sector serve as a barrier to entry in both countries; however, they are not the binding barrier in country B in the preceding

simulations. If entry is allowed to bid profits to zero, the market structure changes markedly: in place of the 2 firms in country B and 2 in country A, the market supports 6.5 firms in country B and 3.67 firms in country A.[8]

This change in market structure has an ambiguous effect on welfare. The increase in the number of firms narrows the wedge between price and marginal cost in T1 production, and thus lowers the efficiency loss. However, the increase in the number of firms leads tc an increase in outlays for fixed costs; as these do not directly increase consumption they reduce welfare. In the scenarios with $n_h = 2$, the output of T1 per firm was 34.47 in country B; with free entry and $n_h = 6.5$, the output per firm becomes 11.67. Welfare in country B falls by 4.55 percent, while welfare in country A rises by 1.23 percent through the fall in T1 prices due to competition.

There are two important conclusions we draw from these results. First, if country B maintains the trade barriers that segmented the two markets in the previous example there will be less dumping. The difference in perceived trade elasticities has shifted and has lessened dumping's profitability. Second, free entry is an expensive way to eliminate dumping. The fixed costs incurred lead to an unnecessary fall in welfare.

Conclusions

We have indicated both in analytical form and through simulations the impact of dumping behavior and AD duty retaliation on the exporting and importing country. We draw the following conclusions:

-- the credible threat to impose anti-dumping (AD) duties promptly and in amount equal to the dumping margin can dissuade exporting firms from undertaking dumping activity. Observance of dumping and imposition of AD duties indicates, however, that the duties have failed at that task.

-- imposition of AD duties does not have the impact often assigned to it, i.e. to offset completely the price impact of dumping and return the world economy to the pre-dumping equilibrium. Rather, when imposed they act more as protective policies to insulate the import-competing sector from competition

and as optimal tariffs to improve the purchasing power of all residents of the importing country. They do not end the dumping because they do not remedy the root cause: the difference in perceived price elasticity of demand in the two markets and the market segmentation.

-- although dumping is undertaken by private firms, it cannot occur without the cooperation of the exporter government. Both segmentation of domestic from foreign markets and restrictions on entry of firms are necessary to assure the profitability of dumping. The former can be guaranteed through trade restrictions on the re-import of the dumped good, while the latter may be a component of industrial policy. Removal of these preconditions will eliminate dumping.

-- AD quotas appear to be an attractive alternative to AD duties in attaining a fair trade outcome. In fact, they introduce the possibility of a third distortion in the world trading economy through their encouragement of collusion in the dumping sector, and are welfare-reducing in simulations in comparison with AD duties. Negotiated export restrictions have similar, and in some cases more pronounced, drawbacks.

Our conclusions are drawn from the theoretical and simulation results of this paper, and as such are model-specific. We have performed sensitivity analysis with important parameters and obtained qualitatively identical results, but encourage further work to establish their generality. As the companion papers of this volume demonstrate, the allegations of dumping and imposition of anti-dumping duties has not diminished in recent years; it is important to recognize their true general-equilibrium implications when considering perpetuating that trend.

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Table 1 Features of the CGE Simulation Model

-- There are two countries: A and B.
-- There are three factors of production: capital (K), unskilled labor (L2) and skilled labor (L1).

-- There are three sectors: an increasing-returns tradeable (T1), a constant-returns tradeable (T2) and a non-tradeable (NT).

-- B has equal endowments of the three factors, while A has a preponderance of K and a shortage of L2.

	Country B	Country A
L1	200	200
L2	200	300
K	200	100

-- The production technology is Cobb-Douglas and identical in each country. The income shares of the three factors in production of the three goods is

	L1	K	L2
T1	.2	.2	.6
T2	.2	.6	.2
NT	.6	.2	.2

-- Demand for the goods is Cobb-Douglas and identical in each country; shares of income spent on the three goods are: T1 .3, T2 .4, NT .3.

-- These parameters are chosen so that B is relatively well endowed in those factors intensive in T1 production, while A is relatively well endowed in the factors intensive in T2 production. The relative prices of the two goods in autarky lead to A's export of T2 and B's export of T1.

-- The imported good is combined with the domestic good of the same name in an Armington CES composite consumption good. This function takes the form (for country B) of

$$CD = AM*(BM*IMP^{CM} + (1-BM)*DS^{CM})^{(1/CM)}$$

with CM = (SIGM-1)/SIGM and SIGM the substitution elasticity between domestic (DS) and foreign (IMP) goods in composite demand (CD). Parameter values are:

		Country B	Country A
AM:	T1	1.00	1.89
	T2	1.69	1.00
BM:	T1	--	0.30
	T2	0.24	--
SIGM:	T1	--	1.20
	T2	1.20	--

The AM and BM parameters were calculated to fit the initial conditions on prices and quantities that generated 20 units of T1 export by country B and 20 units of T2 export by country A. Country B's exports are constrained to equal country A's imports, and vice versa in the two-country scenario; in the three-country scenario only overall balance is required.

-- Imperfect competition is introduced by considering T1 to require an initial cost denominated in factors of production to begin production. These initial factors are assumed used in the proportions of directly productive factors, and are assumed to be 10 percent of the factor use in Country B (the lower-opportunity cost supplier of T1).

The number of firms is derived endogenously to be consistent with that degree of barrier to entry under the assumption of Cournot behavior.

An initial simulation using country B in autarky is run to define simultaneously the number of firms in operation and the fixed cost per firm in units of factors of production. The results are:

N = 2.0; FIXL1 = 1.136; FIXK = 1.000; FIXL2 = 4.167

That fixed cost is then presumed necessary for a firm in either country wishing to produce T1. Its pricing is oligopolistic, thus allowing super-normal profits (also derived endogenously).

-- Welfare is measured in each economy by a Graham-Mill welfare function (Cobb-Douglas in form) using the consumption quantities derived endogenously and the consumption shares given above.

Table 2 Autarky and Trade: Indications of Comparative Advantage and Welfare

	Autarky	Fair Trade	Percentage Increase
Country B: the exporter of T1			
Output			
T1	43.48	68.83	58.30
T2	101.66	77.53	-23.73
NT	80.24	80.72	0.60
Profit/firm	17.83	19.45	9.09
Consumption			
T1	43.48	49.84	14.62
T2	101.66	100.80	-0.85
NT	80.24	80.72	0.60
GNP	267.48	269.07	0.59
Consumer prices			
T1	1.85	1.62	-12.43
T2	1.05	1.07	1.90
NT	1.00	1.00	0.00
Marginal cost in production			
T1	0.92	0.98	6.52
T2	1.05	0.99	-5.71
NT	1.00	1.00	0.00
Factor Prices			
L1	0.39	0.39	0.00
L2	0.32	0.38	18.75
K	0.45	0.38	-15.56
Welfare	73.39	76.34	4.02
Indicators of comparative advantage			
Relative price of T1:	1.76		
Relative marginal cost of T1:	0.88		
Country A: the importer of T1			
Output			
T1	30.31	28.10	-7.29
T2	112.10	122.18	9.00
NT	75.14	68.70	-8.57
Profit/firm	15.47	2.54	-83.58
Consumption			
T1	30.31	46.28	52.68
T2	112.10	98.65	-12.00
NT	75.14	68.70	-8.57
GNP	250.46	229.02	-8.56

Consumer prices			
T1	2.48	1.48	-40.32
T2	0.89	0.93	4.49
NT	1.00	1.00	0.00
Marginal cost in production			
T1	1.24	1.25	0.08
T2	0.89	0.93	4.49
NT	1.00	1.00	0.00
Factor Prices			
L1	0.37	0.36	-2.70
L2	0.63	0.62	-1.59
K	0.28	0.30	7.14
Welfare	67.15	70.53	5.03
Indicators of comparative advantage:			
Relative price of T1:	2.79		
Relative marginal cost of T1:	1.39		

Characteristics of the Trading Equilibrium

World Prices		Goods Trade	
T1	1.36	T1	18.99
T2	1.10	T2	23.53
NT	1.00		
Exchange Rates			
ER	1.19		
ERA	0.84		

Simulations using a third large country were calibrated to yield results identical to those reported in the second column of this table.

Table 3 General-Equilibrium Impact of Dumping and Retaliatory Tariffs
Two countries facing the rest of the world
(Fair Trade benchmark in levels; other entries in percent changes)

	Fair Trade	Dumping	Dumping/ AD Duty	Equivalent Tariff
Country B: exporting T1				
Output				
T1	68.83	-4.37	-4.75	0.00
T2	77.53	2.00	2.50	0.00
NT	80.72	1.76	1.59	0.00
Profit/firm	19.45	14.13	12.80	0.00
Consumption				
T1	49.84	-15.40	-15.49	0.00
T2	100.80	2.98	6.52	0.00
NT	80.72	1.76	1.59	0.00
GNP	269.09	1.75	1.58	0.00
Consumer prices				
T1	1.62	20.32	20.32	0.00
T2	1.07	-1.40	-4.86	0.00
NT	1.00	0.00	0.00	0.00
Factor Prices				
L1	0.39	0.51	0.51	0.00
L2	0.38	-2.39	-2.39	0.00
K	0.38	0.52	0.78	0.00
Dumping Margin	0.00	0.50	0.50	0.00
Welfare	76.34	-3.26	-2.03	0.00
Country A: importing T1				
Output				
T1	28.10	0.82	1.10	0.00
T2	122.18	-0.27	-2.09	0.00
NT	68.70	0.03	2.88	0.00
Profit/firm	2.54	1.77	1.81	0.00
Consumption				
T1	46.29	4.95	-7.96	0.00
T2	98.65	0.10	3.97	0.00
NT	68.71	0.02	2.87	0.00
GNP	229.02	0.02	-0.55	0.00
Consumer prices				
T1	1.48	-4.39	12.09	0.00
T2	0.93	0.11	-0.86	0.00
NT	1.00	0.00	0.00	0.00

Factor Prices				
L1	0.36	-0.28	-1.11	0.00
L2	0.63	-0.16	-0.63	0.00
K	0.30	-0.67	-4.67	0.00
Tariff/Duty	0.00	0.00	0.50	0.50
Income transfer	0.00	0.00	-3.40	0.00
Welfare	70.53	1.51	-0.08	0.00
International Indicators				
World Prices				
T1	1.37	0.00	0.00	0.00
T2	1.10	0.00	0.00	0.00
NT	1.00	0.00	0.00	0.00
Exchange Rates				
ER	1.19	-5.71	-20.08	0.00
ERA	0.84	0.24	-0.71	0.00
World price:				
dumped goods		1.16	1.37	1.37
Goods trade (B to A):				
T1	18.99	15.85	-27.48	-100.00
T2	23.53	-1.79	-27.51	-100.00
Trade with rest of world:				
Country B				
Exports	0.00	1.66	9.67	18.99
Imports	0.00	1.98	11.97	23.53
Country A				
Exports	0.00	0.00	0.00	23.53
Imports	0.00	0.00	0.00	18.99

Table 4 General-Equilibrium Comparison of Anti-dumping Duties and Quotas
Two countries facing the rest of the world
(Fair-trade benchmark in levels; other entries in percent changes)

	Fair Trade	AD Duty	AD Quota	AD VER
Country B: exporting T1				
Output				
T1	68.83	-4.75	-11.16	-17.23
T2	77.53	2.50	4.66	7.25
NT	80.72	1.59	4.79	7.24
Profit/firm	19.45	12.80	38.41	57.75
Consumption				
T1	49.84	-15.49	-11.28	-7.76
T2	100.80	6.52	3.08	7.16
NT	80.72	1.59	4.79	7.24
GNP	269.09	1.58	4.78	7.23
Consumer prices				
T1	1.62	20.32	18.08	16.24
T2	1.07	-4.86	0.56	0.00
NT	1.00	0.00	0.00	0.00
Factor Prices				
L1	0.39	0.51	1.80	2.56
L2	0.38	-2.39	-6.58	-9.47
K	0.38	0.78	2.10	2.89
Dumping Margin	0.00	0.50	0.00	-0.37
Welfare	76.34	-2.03	-0.62	2.46
Country A: importing T1				
Output				
T1	28.10	1.10	-0.68	-3.10
T2	122.18	-2.09	0.21	1.02
NT	68.70	2.88	0.00	0.09
Profit/firm	2.54	1.81	-1.97	-7.87
Consumption				
T1	46.29	-7.96	-3.70	-16.07
T2	98.65	3.97	-0.08	-0.36
NT	68.70	2.87	0.00	0.09
GNP	229.02	-0.55	-0.02	-0.09
Consumer prices				
T1	1.48	12.09	4.12	19.39
T2	0.93	-0.86	0.00	0.00
NT	1.00	0.00	0.00	0.00

Factor Prices				
L1	0.36	-1.11	0.00	0.00
L2	0.63	-0.63	-0.63	-0.48
K	0.30	-4.67	0.00	0.00
AD Duty	0.00	0.50	0.00	0.00
Income transfer (% of GNP)	0.00	3.40	0.00	0.00
Welfare	70.53	-0.08	-1.16	-5.27
International indicators				
World Prices				
T1	1.37	0.00	0.00	0.00
T2	1.10	0.00	0.00	0.00
Exchange Rates				
ER	1.19	-20.08	3.36	0.25
ERA	0.84	-0.71	0.36	0.60
Goods Trade (B to A)				
T1	18.99	-27.48	-10.85	-42.08
T2	23.53	-27.51	1.40	6.75
Trade with the rest of the world (levels):				
Country B				
Exports	0.00	9.67	0.00	0.00
Imports	0.00	11.97	0.00	0.00
Country A				
Exports	0.00	0.00	0.00	0.00
Imports	0.00	0.00	0.00	0.00

Table 5 Dumping, AD Duties and Market Structure

(number of firms such that $\pi_{ij} = 0$)

For given structure in dumping country ($n_h = 2$):

	n_x
Trading equilibrium	3.66
Dumping equilibrium	3.68
Dumping/AD duty equilibrium	3.68
Equivalent tariff equilibrium	3.66

Variable market structure in both countries:

	n_x	n_h
Trading equilibrium	3.67	6.50

Figure 1

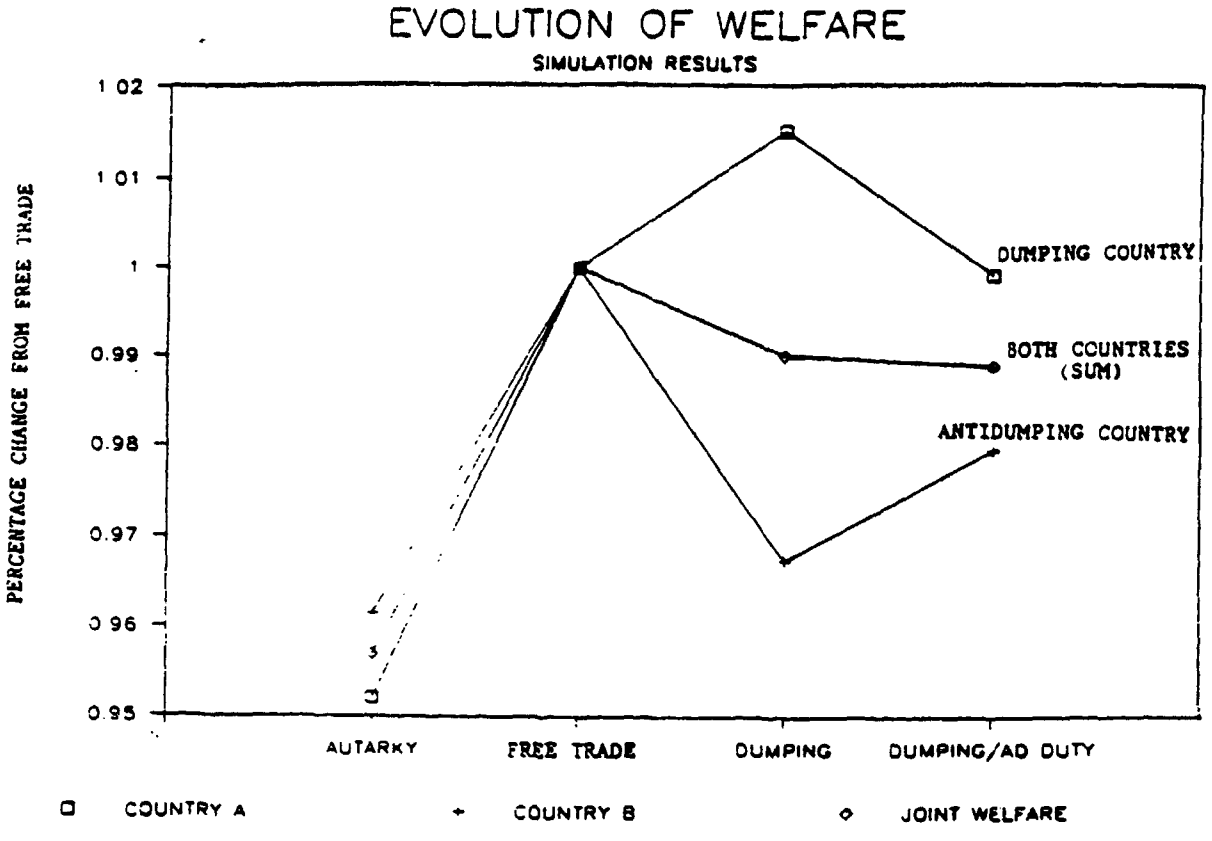

EVOLUTION OF WELFARE
SIMULATION RESULTS
PERCENTAGE CHANGE FROM FREE TRADE
1.02
1.01
1
0.99
0.98
0.97
0.96
0.95
DUMPING COUNTRY
BOTH COUNTRIES (SUM)
ANTIDUMPING COUNTRY
AUTARKY
FREE TRADE
DUMPING
DUMPING/AD DUTY
COUNTRY A
COUNTRY B
JOINT WELFARE

Figure 2

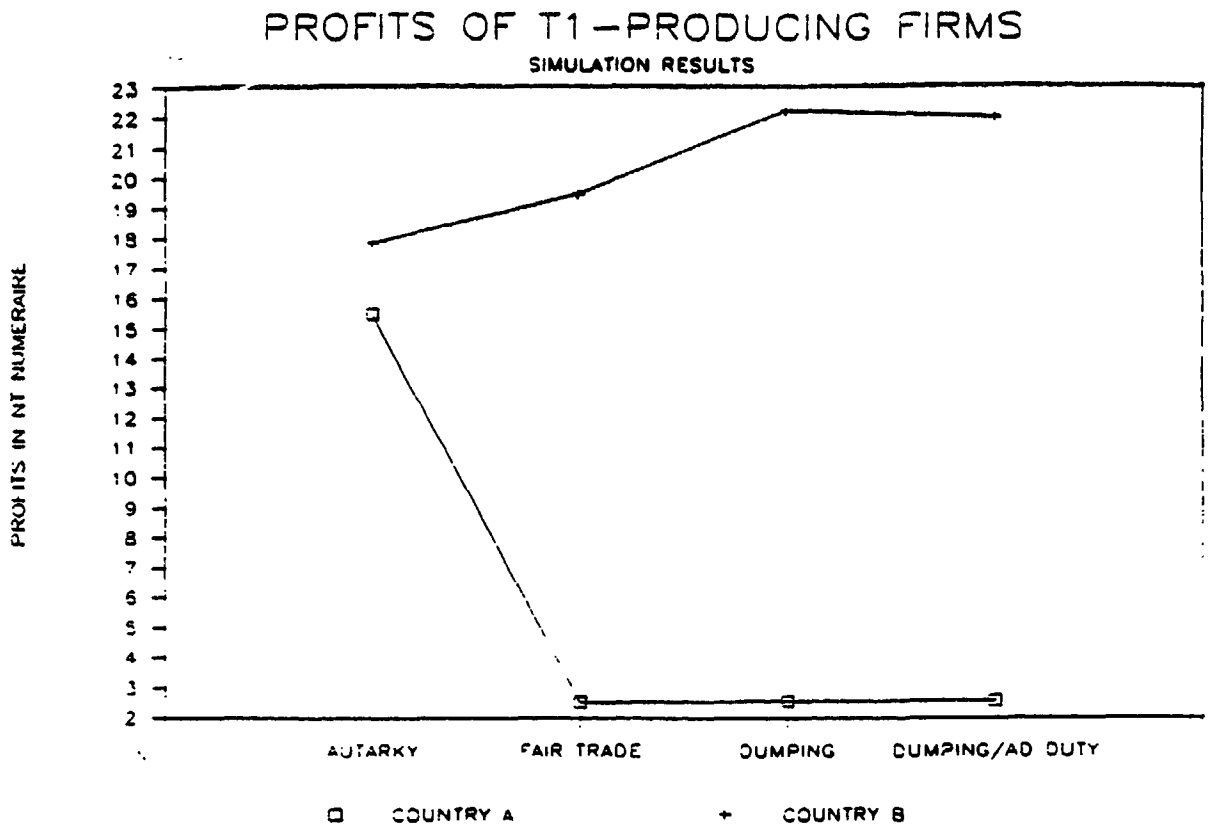
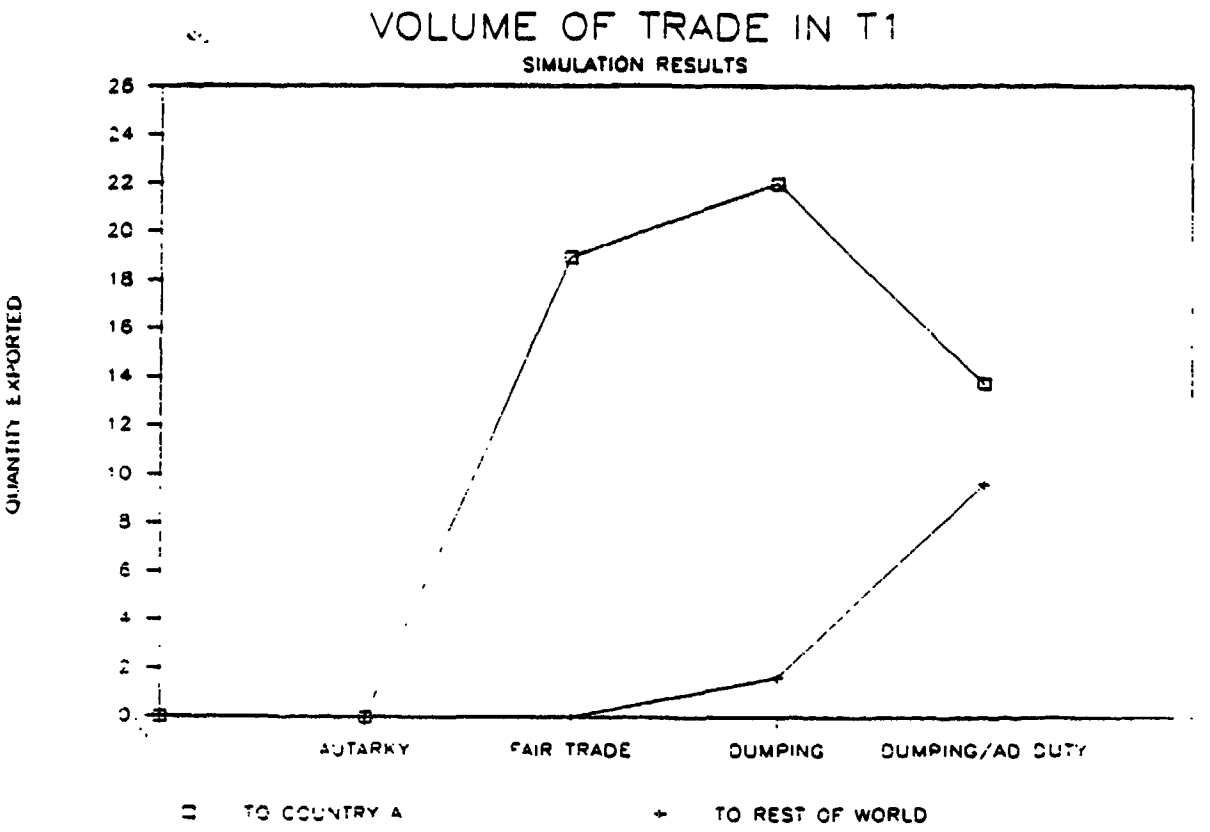

PROFITS OF T1—PRODUCING FIRMS
SIMULATION RESULTS
PROFITS IN NT NUMERAIRE
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
AUTARKY
FAIR TRADE
DUMPING
DUMPING/AD DUTY
COUNTRY A
COUNTRY B

Figure 3


VOLUME OF TRADE IN T1
SIMULATION RESULTS
QUANTITY EXPORTED
26
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AUTARKY
FAIR TRADE
DUMPING
DUMPING/AD DUTY
TO COUNTRY A
TO REST OF WORLD

Endnotes

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Annex A

A Mathematical Statement of Dumping/AD Duty Behavior

Dumping

We begin with a restatement of the Viner-Robinson result on dumping. In sector i of an economy, firm j generates real profits (π_{ij}).

$$(1) \qquad \pi_{ij} = P_i(q_i)q_{ij} - c_{ij}(w,q_{ij})$$

q_{ij} is the output per firm and is sold in the home (h_{ij}) and foreign (x_{ij}) markets. c_{ij} is the total cost of production per firm. $c_{ij}(.)$ is an increasing function of the economy-wide wage w, reflecting the optimal use of labor by the sector. It is increasing at a decreasing rate in q_{ij} if technology is governed by decreasing costs, and at an increasing rate if the technology has the increasing-cost property. P_i is the price of the final good. Aggregate quantities q_i, h_i and x_i are the summations over firms j; e.g., $q_i = \Sigma_j\, q_{ij}$.

If there is a single market for its output, this firm can maximize its profits by choosing an output level that will set marginal revenue equal to marginal cost. This can be restated in mathematical terms as

$$(2) \qquad P_i(1 + (1/\delta)) = mc_{ij}(w,q_{ij}).$$

The left-hand side of equation (3) is the marginal revenue of additional output with δ the price elasticity of demand for the product perceived by the firm. mc_{ij} is the marginal cost of producing that extra output (equal to the derivative of c_{ij} with respect to q_{ij}). δ will be negative, and P_i will thus exceed mc_{ij}. A natural definition of the elasticity of demand is based upon aggregate home (h_i) and foreign (x_i) sales of the sector-i good and the price elasticities of aggregate demand Δ_h, Δ_x.

$$(3) \qquad \delta = \Delta = ((q_i - x_i)/q_i)\ \Delta_h + (x_i/q_i)\ \Delta_x$$

The Viner/Robinson insight is that if Δ_h and Δ_x are different, then the marginal revenues from sales to the two markets will be different. The firm will gain if it can segment the market and sell its good for different prices in the two markets. In this case equation (2) is replaced by separate conditions of marginal revenue and marginal cost in the firm's two markets, with P_{xi} and P_{hi} the prices charged in the two markets.

$$(4a) \qquad P_{hi}(1 + (1/\Delta_h)) = mc_{ij}(w,q_{ij}).$$
$$(4b) \qquad P_{xi}(1 + (1/\Delta_x)) = mc_{ij}(w,q_{ij}).$$

Dumping is profit-enhancing when foreign demand is more price-elastic than domestic demand ($\Delta_h > \Delta_x$). This can be seen through an expansion of the profit function and insertion of mc_{ij} from equation (2):

$$(5) \qquad d\pi_{ij} = P_i(1+(1/\Delta_x))\ dx_{ij} + P_i(1+(1/\Delta_h))\ dh_{ij} - mc_{ij}(w,q_{ij})(dh_{ij} + dx_{ij})$$

$$= P_i[((1/\Delta_x)-(1/\Delta))\ dx_{ij} + ((1/\Delta_h)-(1/\Delta))]\ dh_{ij}$$
$$= P_i[(1/\Delta\Delta_x)(\Delta - \Delta_x)\ dx_{ij} + (1/\Delta\Delta_h)(\Delta - \Delta_h)\ dh_{ij}]$$

The firm can enhance its profits above those of the non-segmented case by expanding output in the market segment with the more elastic demand (here, the export market) and contracting output in the market segment with less elastic demand.

export market) and contracting output in the market segment with less elastic demand.

Analyses of dumping have extended this understanding of profit-maximizing behavior by recognizing that the perceived elasticity of demand δ is dependent upon market structure. When a firm must share its market with other firms, its perception of the price elasticity of demand for its product δ will differ from the market elasticity Δ. For a monopolistic firm, equations (4) would be appropriate, but the perceived elasticities of demand for oligopolistic firms will be greater in absolute value. We follow Dixit (1988) in examining a small number n_i of symmetric firms and in measuring their interactions through a conjectural variations parameter. The profit-maximizing choice of the non-discriminating oligopolist will be governed by an adjusted version of the marginal revenue-marginal cost condition of equation (2).

$$(6) \qquad P_i(1 - V_i(1/\Delta)) = mc_{ij}(w, q_{ij})$$

V_i is the coefficient of conjectural variation and indicates the extent to which the individual firm anticipates that other firms will respond to its choice of q_{ij}. The V_i is defined as in Dixit (1988) for the domestic market as

$$(7) \qquad V_i = [1 + (n_{hi} - 1)v_{hi} + n_{xi}v_{xi}]/n_{hi} .$$

n_{xi} is the number of foreign firms competing in home sector i. v_{hi} is the conjectured quantity response of other domestic firms to a unit increase in output by one firm and v_{xi} is the conjectured quantity response of foreign firms to a unit increase in output by one domestic firm. The interactions of these firms can be described in a number of ways, and as Eaton and Grossman (1986) point out the results obtained may be sensitive to the method chosen. We choose to employ the conditions of a Cournot-Nash equilibrium where $v_{hi} = v_{xi} = 0$ so that $V_i = 1/n_{hi}$. The perceived price elasticity of demand for each firm is then $\delta_h = n_{hi}\Delta_h$ and is larger in absolute value than the corresponding market elasticity.

The dumping firm will be able to discriminate between competition in the domestic market and competition in the foreign market. Its pricing policies will then differ by market, and can be described by a variant of equations (4).

$$(8a) \qquad P_{hi}(1 + (1/\delta_h)) = mc_{ij}(w, q_{ij}), \qquad \delta_h = n_{hi}\Delta_{hi}$$
$$(8b) \qquad P_{xi}(1 + (1/\delta_x)) = mc_{ij}(w, q_{ij}), \qquad \delta_x = n_{fi}\Delta_{xi}$$

This will lead to behavior more closely approximating competition than in the monopolistic case, but will still leave the wedge between price and marginal cost that induces welfare losses. Combination of these yields the wedge between P_{hi} and P_{xi} given in the text. Dumping will as before occur when foreign demand is perceived to be more price-elastic than domestic demand ($\delta_h < \delta_x$); this could be due to differences in market elasticities or in the number of firms in the target market. It will be profit-enhancing for reasoning similar to that illustrated in equation (5).

For dumping to be welfare-improving, the increased profits due to foreign sales must exceed the welfare losses due to higher domestic prices.

$$(9) \qquad \Omega_i = s_i(h_i) - P_i(h_i)\, h_i + \pi_i$$
$$\text{with } s_i(h_i) = \int_0^{h_i} P_i(u)\, du$$

and $P_i(h_i)$ the domestic inverse demand function for h_i. If the benchmark case is, as above, one in which no segmentation is possible, the change in sector-i welfare due to dumping is

$$(10) \qquad d\Omega_i = P_i\, dh_i - P_i(1-(1/\delta_h))\, dh_i + d\pi_i$$
$$= P_i\, dh_i + P_i(1/\delta\delta_x)(\delta - \delta_x)\, dx_i$$

The first term on the right-hand side of equation (10) is the loss in consumer surplus due to the reduction in sales to the home market ($dh_i < 0$). The second term indicates the Viner/Robinson insight, for if the perceived price elasticity of demand in the foreign market is greater in absolute value ($\delta_x < \delta$) then dumping will have a positive profit (and welfare) effect.

In the country receiving the dumped goods there is a corresponding tendency to reduced profits and increased welfare from sector i relative to the benchmark case of no market segmentation. The analysis is analogous to that outlined above; we state below the mathematical expressions evaluated at $x_i = 0$.

$$(11) \qquad d\pi_{fi} = (P_{fi}/q_{fi})\delta_x\, dx_i$$
$$(12) \qquad d\Omega_{fi} = (-1/\delta_x)\, dx_i$$

Profits fall in the importing country due to the fall in price occasioned by dumping. Welfare there rises, by contrast, for consumer surplus rises by more than the fall in profits.

AD Duties

When the temporal and causal link between AD duties is weak or uncertain, the eventual or uncertain imposition of AD duties will not change the firms' optimal conditions (8). However, the credible threat of an AD duty exactly offsetting the dumping margin will alter firm behavior in the export market.

1. Dumping, according to the GATT, could also be selling below cost in the export market even if the same is accurring in the domestic market. See Deardorff (1988) for more detail.

2. In a Cournot-Nash equilibrium each actor assumes that his competitors' choice will not respond to any change in his own choice. Dixit (1986) provides a useful discussion of alternative equilibrium concepts.

3. In game-theoretic terminology, with the Type I AD duty the exporting firms have Cournot-Nash conjectures about government imposition: they anticipate no use of AD duties in reaction to their decision to dump. With the Type II AD duty the government has made a credible commitment beforehand, perhaps through legislation, that it will promptly and completely counteract any dumping activity. The government thus has a "Stackelberg leader" position, with the firms behaving as "Stackelberg followers" in internalizing the government's credible commitment.

4. If this coordination also led to collusion in the domestic market there would be monopoly pricing there as well.

5. For example, export demands in single-country models are specified in an ad hoc fashion that may imply unrealistic parameters of demand for imports in the trading partner.

6. We have performed the following simulation exercises as well for trade between two countries in the absence of the third region. Those results are available on request.

7. These relative prices are 1.76 in country B vs. 2.79 in country A. It is more precise when looking at global welfare to examine the relative marginal costs of production, since the relative price of T1 in the two countries is perhaps dependent upon the industrial policy limiting the number of firms. Comparative advantage is revealed more starkly through that comparison: .88 in country A vs. 1.39 in country B.

8. We will not observe fractions of firms in the market. We provide the exact (if fractional) number of firms that would provide zero profits, but it is more realistic to assume that the equilibrium number of firms in the two markets would be 6 and 3, respectively, with firms that entered these markets reaping small positive profits.

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