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12 Market-Access Effects of Trade Liberalization: Evidence from the Canada-U.S. Free Trade Agreement

Keith Head and John Ries

While the Canada-U.S. Free Trade Agreement (FTA) of 1988 received much less attention in the United States than the follow-up agreement that included Mexico, it drew adamant criticism in Canada. The 1988 federal elections were considered a referendum on free trade with the United States. Although the party in favor of the FTA carried a majority, opposition to the agreement persisted. In the early 1990s, critics attributed the alleged loss of 350,000 manufacturing jobs to the elimination of tariffs between the countries. The purpose of this paper is to examine changes in Canadian and U.S. manufacturing industries and relate those changes to the removal of trade barriers. We use a generalized version of Krugman's (1980) trade model to predict the expected change in the relative size of Canada's manufacturing industries resulting from tariff reductions. Since the restrictive version of the theory appears unable to explain the main features of the data, we will also consider extensions of the model that allow for differences in cost and demand structures.

Import protection in Canada dates back to the National Economic Policy of 1878. In an effort to avoid being solely a nation of "hewers of wood and drawers of water," Canada imposed large tariffs on manufacturing imports. One hundred ten years later, successive GATT rounds had reduced average tariffs on goods to 4.5 percent. Nonetheless, the government provided significantly greater protection to a number of industries. The size and proximity of the United States suggested to many that even small tariff changes might have large consequences.

To date, there have been few studies of the actual effects of the FTA, partly

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since the data have only recently become available. Gaston and Trefler (1994), Hazledine (1994), and Statistics Canada (1993) are recent papers on the topic. These papers, which examine two-digit Standard Industrial Classification (SIC) manufacturing industries, have concentrated on documenting "what happened" without developing formal economic models. The Statistics Canada study finds correlations of −0.8 and −0.7 between initial tariffs and the U.S. and Canadian propensity to import from each other. The strong correlation indicates that liberalization had potentially large effects on North American manufacturing through its effect on import penetration. Gaston and Trefler show that employment changes are positively related to changes in Canadian tariffs (hence, the lowering of Canadian trade barriers reduces output), while Hazledine does not find statistically significant relations between tariff changes and Canadian shipments.

In this paper, we take an alternative route of attempting to link our examination of the change in the relative size of each Canadian industry to the predictions of a specific trade model. We match Census of Manufactures data from the United States and Canada to examine industry changes occurring at the four-digit SIC level. This allows us to examine a large number of relatively disaggregated industries with greater variation in tariffs and other characteristics than those analyzed in the other studies. Before developing the formal model, it seems worth considering several possible accounts of what might be expected to happen to a small country when it liberalizes manufacturing trade with a larger neighbor.

Simple notions of Ricardian comparative advantage would predict that free trade would cause Canada's relative output share to expand in industries where Canadian workers are relatively productive. The problem with applying this theory is that it predicts one-way trade, whereas most North American manufacturing industries exhibit two-way trade. For instance, Canada's largest export industry, automobile-related products, is also its largest import industry.

Table 12.1 depicts several aspects of North American manufacturing trade by major industry group (according to the Canadian two-digit classification system) prior to the FTA. The first data column shows each industry's Grubel-Lloyd (1975) intraindustry trade index. The second column lists the share of each industry's trade in total manufacturing trade between Canada and the United States. The final column shows Canadian exports divided by imports. The table reveals a large amount of two-way trade within industries. Transport equipment, the industry with by far the largest trade share, realizes almost balanced trade. The trade data suggest that we move in the direction of a model that is consistent with intraindustry trade.

Some proponents of freer trade argued that Canada could reduce its trade barriers, obtain efficiency gains, and maintain its North American production shares. The reasoning was that, under protection, Canadian plants produce multiple product lines in order to serve the local market's demand for variety. With free trade, these plants would specialize in particular lines, achieving

Table 12.1 North American Trade in Manufactures, 1985–87

Industry	IIT (%)	Share (%)	X_C/X_{US}
All manufacturing	96.0	100.0	1.08
Food	99.7	2.4	.99
Beverages	28.0	.5	6.15
Tobacco	92.9	.0	.87
Rubber products	89.1	.9	1.24
Plastic products	74.9	1.1	.60
Leather products	91.1	.1	1.19
Primary textiles	36.6	.5	.22
Textile products	56.4	.3	.39
Clothing	47.8	.3	3.19
Wood	23.0	3.8	7.70
Furniture & fixtures	29.1	1.0	5.86
Paper products	22.3	6.5	7.96
Printing & publishing	57.0	1.2	.40
Primary metals	58.7	7.0	2.41
Fabricated metal products	98.6	3.0	1.03
Machinery	55.9	7.1	.39
Transport equipment	98.8	43.5	1.02
Electrical	64.6	8.7	.48
Nonmetallic mineral products	90.4	1.3	1.21
Refined petroleum & coal products	49.4	2.6	3.05
Chemicals	76.6	5.0	.62
Other manufacturing	53.1	3.2	.36

Source: Authors' calculations based on data from Statistics Canada (1993).
Note: IIT is the Grubel and Lloyd (1975) intraindustry trade index, 2 min $(X_C, X_{US})/(X_C + X_{US})$, where X_C are Canada's exports to the United States and X_{US} are U.S. exports to Canada. "Share" is the portion of total manufacturing trade between Canada and the United States in each industry group.

lower costs through larger production runs. Meanwhile, plants south of the border would specialize as well. Increased trade flows would maintain the level of product variety in both markets. The end result would be less duplication without net shrinkage or loss of product diversity.

Adherents to this sanguine view of the likely effects of free trade pointed to the experience of the automobile industry as a prototype for an across-the-board free trade agreement. In 1965, the United States and Canada eliminated tariffs in automotive-related products. "Safeguards" requiring that Canadian production not drop below 75 percent of Canadian sales for any vehicle producer never posed a binding constraint on the manufacturers. Instead, even as the Big Three rationalized production, Canada's share of North American vehicle assembly rose from 7 percent in 1965 to 15 percent in the early 1980s (U.S.-Canada Automotive Agreement Policy Research Project 1985).

The theory sketched above makes no reference to the market-size asymmetry between the United States and Canada. When trade impediments impose additional costs on exports, firms prefer to locate in the larger country in order to avoid incurring these costs. This incentive gives the large country an inherent advantage attracting firms. Trade liberalization that achieves a truly integrated market would eliminate large countries' size advantage. However, even in the absence of tariffs, impediments to trade will remain. At the very least, there will be transportation costs; moreover, frontier controls, cabotage restrictions, and exchange rate risk may pose significant barriers to trade. This implies that, even after trade liberalization, the small country will have incomplete access to consumers in the larger country. Formal modeling is required to predict the precise effect of tariff reductions in these circumstances, but adjustments certainly involve more than the simple shift in the composition of product lines suggested above.

In section 12.1, we develop a model in which the market-size asymmetry between the United States and Canada tends to promote concentration of production in the larger country. The model predicts that Canada's production share in differentiated product industries will be smaller than Canada's expenditures share unless there are substantial offsetting asymmetries in trade barriers or costs. While bilateral trade liberalization offers firms in the small country greater access to the large market, it will nevertheless tend to reduce the relative size of the small country's differentiated-product industries. Section 12.2 matches industry data from Canadian and U.S. sources and examines whether initial relative size and the changes between 1987 and 1992 conform to the predictions of the monopolistic-competition model. Our main results are the following: (1) Canada's relative shipments declined between 1987 and 1992 in 83 percent of the matched industries. (2) The industries that were large in Canada relative to the United States in 1987 tended to decline the most over the subsequent five years. (3) Regression analysis of the changes in relative size finds significant negative effects of Canadian tariff reductions after including controls for industry sensitivity to the business cycle and exchange rate movements.

12.1 The Monopolistic-Competition Trade Model

We examine the effects of the FTA in the context of the monopolistic-competition trade model developed in Helpman and Krugman (1985). Their model has three main components: constant elasticity preferences over differentiated products, zero-profit entry equilibrium, and trade barriers. We generalize the model in two ways. First, as in Krugman and Hanson (1993), we decompose trade barriers into tariffs and other border costs (all trade impediments that remain after a free trade agreement is implemented). Second, we allow for industry-specific marginal cost differences. This last assumption makes our model a hybrid in which trade arises from both product differentiation and standard comparative advantage.

Total utility is given by $U(u_1, u_2, u_3, \ldots)$ in the home country and $U^*(u_1, u_2,$

$u_3, \ldots$) in the foreign country.[1] Each industry comprises either differentiated products or homogenous goods. The form of each subutility function u_i depends on whether i is a differentiated-products industry or a homogeneous product. Let C_{ij} denote consumption of industry i goods produced by firm j. For homogeneous goods, $u_i = \sum_j C_{ij}$, that is, the consumer cares only about total consumption, not the identity of the manufacturer. In contrast, demand for the output of firm j in differentiated-products industry i is derived from a subutility function with a constant elasticity of substitution between varieties equal to σ_i. We now suppress the i subscript and focus on the determination of equilibrium in a particular differentiated-products industry.

In the monopolistic-competition model, firms specialize in the production of a single good in a single location.[2] Costs consist of a fixed cost, F, and constant marginal costs, c. It is customary to assume that the firm maximizes its profits with respect to a perceived elasticity of demand equal to σ, the elasticity of substitution between varieties, yielding

$$p = \frac{\sigma c}{\sigma - 1}. \tag{1}$$

Entry occurs until price is driven to average cost. This implies that each firm will produce

$$q = \frac{(\sigma - 1)F}{c}. \tag{2}$$

Consider representative domestic and foreign firms with costs c and c^*. Relative prices (at the factory door) will be $p/p^* = c/c^*$, whereas relative per-firm outputs will be $q/q^* = c^*/c$. Note that these relations imply that relative industry shipments, $S/S^* \equiv pqn/p^*q^*n^*$, equal the relative number of varieties produced at home and abroad (n/n^*). When labor is the only input and used in fixed proportions (the usual assumption in models of this type), relative employment (L/L^*) will also equal n/n^*.

Trade barriers create wedges between the price paid for locally produced and imported products. Consumers in the home country pay p for home-produced goods and $p^*\tau$ for imports. Similarly, consumers in the foreign country pay p^* for foreign-made goods and $p\tau^*$ for goods they import from the home

1. We focus on bilateral trade between the United States and Canada and, therefore, ignore third-country competition and markets. The small country, Canada, will be referred to as the *home country*. Third countries tend to have small shares of the North American market. Across twenty-two two-digit industries, the U.S. and Canadian share of the combined market is over 90 percent in fifteen cases, over 80 percent in nineteen cases, and over 70 percent in twenty-one cases, with this share being relatively low (48 percent) only in the case of leather.

2. This is a very restrictive assumption since it rules out both multiproduct and multinational enterprises. The investigation of how the effect of trade liberalizations depends on whether firms have multiple plants or products will be left for future research.

country. We decompose total trade impediments into the intrinsic costs of transborder shipments, κ, and ad valorem tariffs, t and t^*:

$$\tau = (1 + \kappa)(1 + t),$$

$$\tau^* = (1 + \kappa)(1 + t^*),$$

where κ includes transborder transaction costs such as freight, insurance, exchange rate hedges, customs documentation, and the threat of antidumping or countervailing duties.[3]

We now turn back to consumer demand to derive the equilibrium distribution of production. Let E and E^* denote the total expenditures at home and in the foreign country on the products in a particular industry. Let x equal the share of home expenditures devoted to home-produced varieties and x^* the share of foreign expenditures on foreign-produced varieties. Total shipments from each country, S and S^*, comprise production for the national market and exports. Using the notation defined above, we obtain

$$S = xE + (1 - x^*)E^*, \tag{3}$$

$$S^* = x^*E^* + (1 - x)E. \tag{4}$$

In the basic monopolistic-competition model, the allocation of expenditures between domestic and imported varieties depends solely on the prices that consumers face. We generalize the model to allow for an asymmetry between domestic and imported varieties in the utility function. Specifically, denoting H and F as the sets of home- and foreign-produced varieties, the subutility function for any industry is

$$u = \left[\sum_{j \in H} (\beta C_j)^{(\sigma-1)/\sigma} + \sum_{j \in F} C_j^{(\sigma-1)/\sigma}\right]^{\sigma/(\sigma-1)},$$

where β measures the degree to which, on average, consumers prefer home-produced varieties ($\beta > 1$) or foreign varieties ($\beta < 1$). A value of β larger than one need not represent nationalistic preferences; rather, it could be viewed as a shortcut for getting at the idea that domestic firms choose to produce product varieties that match domestic tastes.

Utility maximization subject to prices p and p^* yields

$$x = \frac{np^{1-\sigma}}{np^{1-\sigma} + n^*(p^*\tau\beta)^{1-\sigma}}, \tag{5}$$

$$x^* = \frac{n^*p^{*1-\sigma}}{n(p\tau^*\beta)^{1-\sigma} + n^*p^{*1-\sigma}}. \tag{6}$$

3. McCallum (1995) and Helliwell (1995) have found evidence of very strong effects of national borders on trade volumes. After controlling for distance and economy size, the volume of trade between two Canadian provinces is twenty times larger than the volume of trade between a province and an American state.

Note that any observed domestic expenditure share, x, for given factory prices, p and p^*, can arise either because of high trade impediments, τ, or home bias in preferences, β. Since $\beta\tau$ and $\beta\tau^*$ always appear raised to the power of $1 - \sigma$, results are streamlined somewhat by defining

$$\rho \equiv [\beta(1 + \kappa)(1 + t)]^{1-\sigma}$$

and

$$\rho^* \equiv [\beta(1 + \kappa)(1 + t^*)]^{1-\sigma}.$$

These variables can be interpreted as indicators of "openness" to international trade.

Division by p^* in the numerators and denominators of equations (5) and (6) expresses x and x^* in terms of $(p/p^*)^{\sigma-1}$. Recall that relative prices equal relative marginal costs. Hence, substitution yields $\theta \equiv (c/c^*)^{\sigma-1}$ as an additional determinant of expenditure allocation. Thus, we have reduced x and x^* to functions of ρ, ρ^*, and θ. Substituting these expressions into equations (3) and (4), and solving for relative shipments, we obtain

$$S/S^* = \frac{\theta[(E/E^*)(1 - \theta\rho) - \rho(\theta - \rho^*)]}{(\theta - \rho^*) - (E/E^*)\rho^*(1 - \theta\rho)}. \tag{7}$$

This equation forms the theoretical basis for our empirical analysis of the relative size of Canadian manufacturing industries and the changes brought about by trade liberalization. Since it is highly nonlinear, we will examine its implications using graphs. We will consider first the case of symmetric costs, preferences, and trade barriers. Thus, the only difference between the two countries is size. By assuming that $c = c^*$, we focus on trade driven entirely by product differentiation. Let α_i and α_i^* equal the share of GDP spent on industry i at home and in the foreign country. Assuming these shares to be constants, $E_i/E_i^* = (\alpha_i/\alpha_i^*)(\text{GDP}/\text{GDP}^*)$. Hence, if preferences are identical, that is, $\alpha_i = \alpha_i^*$, relative expenditures will equal relative GDP. The assumptions of symmetric costs and preferences allow us to obtain two stark predictions, which are illustrated in figure 12.1.

Figure 12.1 plots relative shipments of the small country as a function of symmetric trade barriers for three different values for the elasticity of substitution. The horizontal line at 0.1 represents relative expenditures since that is the approximate ratio of Canadian to U.S. GDP. Two results stand out. First, relative shipments for the small country lie strictly below its relative GDP. Second, relative size falls as trade impediments decline. The intuition for these results is that, from the point of view of minimizing trade costs, firms want to locate in the large market and pay border costs only on the small share of goods they export to the small market. However, the trade-cost-inflated prices in the small market give at least a few firms the incentive to locate there. A symmetric reduction in trade costs tilts the balance somewhat in favor of the large country.

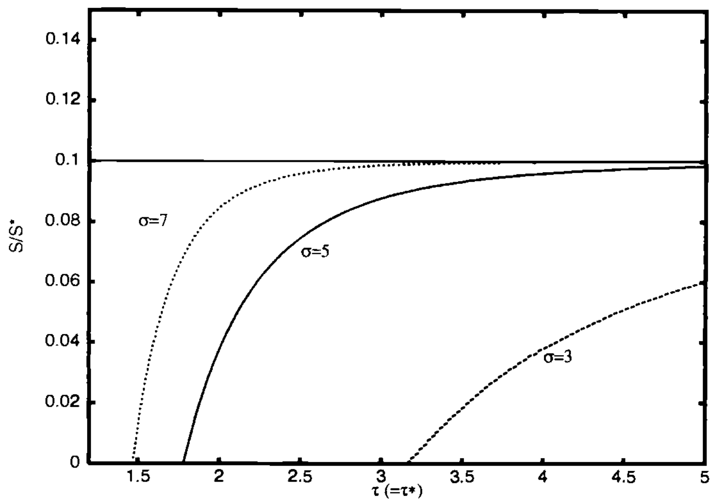

Fig. 12.1 Relative industry size, trade barriers, and the elasticity of substitution

The model predicts that the industry in the small country will disappear altogether if trade costs (including home bias in preferences) become sufficiently small. The figure also shows how the responsiveness of industry output to trade is a function of the elasticity of substitution. Small values of σ correspond to industries where, in equilibrium, economies of scale are more important. The lower the value of σ, the greater is the pressure for the industry to concentrate in the large country.

Figure 12.2 shows the effect of a cost advantage on relative industry size of the small country. Notably, cost advantages possessed by firms in the small country are not always sufficient to offset the market size disadvantage and result in relative output exceeding relative expenditures. When relative costs are 0.70, the small country will enjoy a relatively high industry share, which is magnified by liberalization. However, when the cost advantage is smaller, for a large range of trade impediments, relative size is less than relative expenditures. Moreover, trade liberalization does not necessarily raise relative industry size.[4] However, one clear prediction emerges—when cost advantages yield higher Canadian industry shares than expenditure shares, liberalization causes a relative expansion of the Canadian industry.

The cases discussed thus far consider bilateral reductions of symmetric trade barriers. Since Canada generally had higher levels of protection than the United States in 1987, we need to discuss the effect of liberalization under asymmetric protection. The contour plot in figure 12.3 adds a dimension to the

4. The U shape apparent in the curve is noted in Krugman and Hanson (1993).

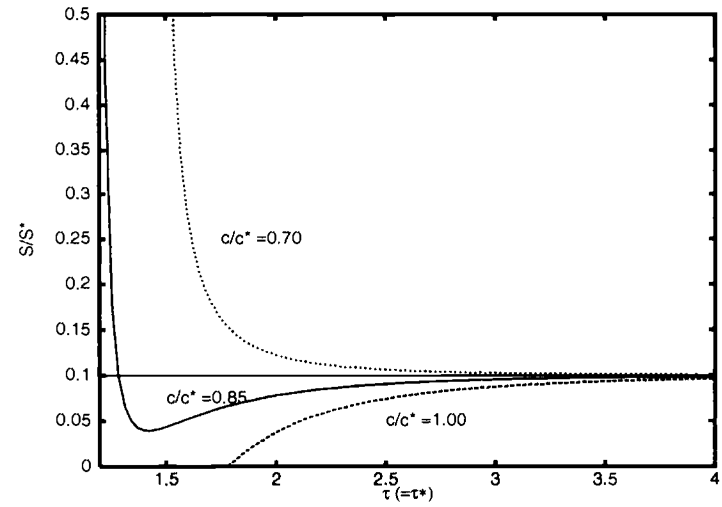

Fig. 12.2 Relative industry size, trade barriers, and relative marginal costs

previous graphic analysis by showing relative industry size as a function of trade barriers in each country. (Here, we revert to the assumption of equal marginal costs.) The contour where relative industry size equals 0.1 represents combinations of τ and τ^* that yield relative industry sizes equal to relative expenditures in the two countries. Combinations below this contour correspond to industry shares for the small country that exceed relative expenditures. This indicates that relatively high small-country industry shares are possible even without a cost advantage. However, levels of protection in the small country must be quite large relative to protection in the big country. In this figure, bilateral liberalization corresponds to movements toward the origin. As the arrow indicates, it is possible for liberalization to increase the relative size of the small country's industry. However, if both countries have the same remaining trade impediments, that is, if free trade corresponds to a position along the diagonal where $\tau = \tau^*$, then tariff reductions are certain to lower small-country industry shares.

To summarize, the model allows for a variety of possible results, but it also offers some general predictions. First, if Canada does not have a cost advantage, a symmetric trade liberalization will reduce Canadian relative industry size. Second, two effects are possible when Canadian industries start out with higher industry shares than relative expenditures. If the high share is a consequence of relatively high Canadian trade barriers, then the removal of the protection will lower the relative size of the Canadian industry. When it is the outcome of a cost advantage, Canada's share should rise. In the next section, we examine the changes that occurred in North American manufacturing to see whether actual changes are consistent with the predictions of the model.

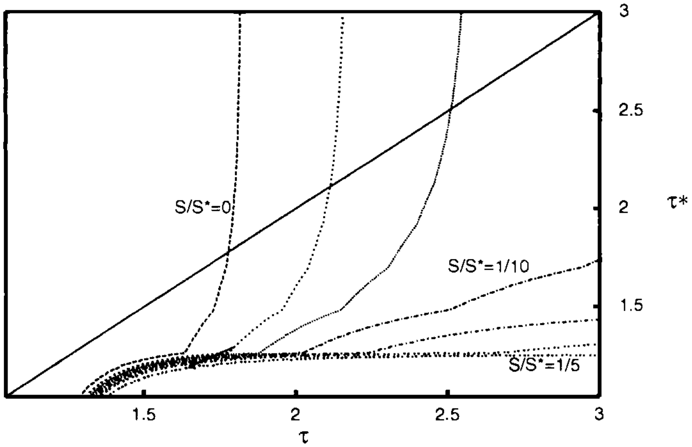

Fig. 12.3 Relative industry size with asymmetric trade costs

12.2 Relative Industry Size before and after the FTA

Canada and the United States use different industry classification systems. In 1991, the two countries developed a correspondence, but, unfortunately, there are many cases where part of a U.S. industry is assigned to one Canadian industry and part to another. In most cases, we were able to use seven-digit product-class data from the U.S. census to apportion U.S. SICs into our constructed industries. For instance, we were able to create a balanced "wine" industry by subtracting the brandy proportion of the U.S. "wine and brandy" industry. In addition, missing Canadian data for certain industries poses a problem. Ultimately, we obtained data and a satisfactory correspondence for 128 industries accounting for 77 percent of Canadian manufacturing shipments and 72 percent of U.S. shipments. Canadian industries are often more aggregated than their U.S. counterparts. Hence, many of our composite industries are similar to three-digit U.S. industries. Complete documentation for the correspondence is available from the authors (Head, Ries, and Zhang 1995).

Table 12.2 lists the ratio of Canadian industry size to U.S. industry size for three measures of size—the value of shipments, employment, and the number of establishments. Close to half the 128 industries we constructed had Canadian relative shipments in excess of Canada's relative GDP in 1987 (0.1004 at the PPP [purchasing power parity] exchange rate).[5] Moreover, contradictory

5. Ideally, we would compare relative shipments to industry-level relative expenditures. However, to calculate relative expenditures requires information on production, imports, and exports. It is quite difficult to match trade flows to domestic production for disaggregated industries. However, Statistics Canada information for two-digit SIC industries is available and shows that relative Canadian expenditures range from a low of 0.056 (other manufacturing) to a high of 0.114 (leather and allied products) with the larger machinery, transport equipment, and electrical and electronic productions taking values of 0.095, 0.082, and 0.058.

Table 12.2 Relative Canadian-U.S. Manufacturing Performance

	1987			1992		
	Q1	Median	Q3	Q1	Median	Q3
Shipments	.065	.094	.124	.052	.073	.105
Employment	.084	.125	.162	.074	.103	.147
Establishments	.091	.116	.170	.078	.110	.164
Shipments per establishment	.526	.749	1.027	.484	.684	.888
Value added per hour	.520	.664	.850	.533	.694	.825

Source: Authors' calculations based on data from the Canadian and U.S. censuses of manufacturing.

Note: Q1 and Q3 are the upper bounds of the first and third quartiles of the sample consisting of 128 constructed manufacturing industries. We convert to a common currency using the PPP exchange rate of 0.827 in 1987 and 0.845 in 1992.

to the theory, the relative number of establishments does not equal relative shipments. On the contrary, Canadian establishments appear to be systematically smaller than U.S. establishments in the same industry. This fact is inconsistent with the simple monopolistic-competition model.

Relative employment also frequently exceeds Canada's GDP share and generally lies above the shipments share.[6] The median Canadian establishment appears to have about the same number of workers as its U.S. counterpart, but these workers produce substantially less per hour.[7] Workers in Canada appear to generate only two-thirds the value added per hour of U.S. workers in the same industry. Although value added per hour is a crude measure of productivity in that it fails to control for price differences or the levels of other factors of production, these results conform with Baldwin, Gorecki, and McVey's (1986) finding that total factor productivity in Canadian manufacturing industries averaged 0.7 of the productivity in the same U.S. industries. Using PPP exchange rates, median relative productivity increased only a small amount between 1987 and 1992.

While Canada enjoyed 10 percent lower manufacturing wages in 1987, this was not sufficient to offset lower value added per worker. By 1992, owing largely to the stronger Canadian dollar, this wage advantage had disappeared. It seems clear that, if cost advantages are to explain the prevalence of Canadian industries that are larger than one-tenth the size of their American counterparts, input costs other than labor must be responsible. Unfortunately, we lack information about the unit costs of other factors and intermediate goods.

An inspection of table 12.2 reveals that the relative size of Canadian industry

6. The two are highly correlated, however: 0.98 in 1987 and 1992.

7. Using the same data set, John Helliwell found that, in both Canada and the United States, worker value added per employee tended to be lower in high-tariff industries. Helliwell's regression analysis also revealed that industries with more employees per establishment generated more value added per employee, although this result did not extend to relative productivity.

fell from 1987 to 1992. It is well documented that employment in both Canadian and U.S. manufacturing declined over this period (see, e.g., Gaston and Trefler 1994). The fact that the decline was relatively greater in Canada is consistent with a main tenet of the theory—the larger country starts out with an advantage that tends to be reenforced by trade liberalization. We now turn to an examination of whether the theory can explain the outcomes in individual industries.

Consider a scatter diagram that charts changes in industry relative size against initial relative size, with the diagram divided into quadrants by lines corresponding to relative change equal to zero and relative size equal to 0.1 (the relative GDP of Canada). The basic monopolistic-competition theory predicts that, with symmetric costs and trade barriers and expenditure shares equal to GDP shares, all points should lie in the lower-left-hand quadrant; that is, Canadian manufacturing industries should start out small, and then trade liberalization should further reduce their size relative to the corresponding U.S. industries. If Canadian firms enjoy large cost advantages, then we would also expect observations in the upper-right-hand quadrant. That is, if a Canadian industry has a large-enough cost advantage so that its production share exceeds its GDP share, liberalization may cause it to grow larger. The upper-left-hand quadrant is a possibility if the Canadian industry has an intermediate cost advantage and its trajectory corresponds to the U shape depicted in figure 12.2 above. Thus, only a quite specific combination of parameters will put an industry into the upper-left-hand quadrant. Relative size may also exceed 0.1 if Canada has much higher levels of import protection (either from tariffs or asymmetric transport costs). In that case, we expect trade liberalization to reduce Canada's relative size. Hence, the lower-right-hand quadrant is also possible if there are large asymmetries in trade barriers.

Figure 12.4 plots Canadian and U.S. tariffs for each industry in 1987. Tariffs levels are generally small but range as high as 22.7 percent. Since the majority of the points are below the diagonal line, it is clear that Canadian tariffs are generally higher than U.S. tariffs. These tariff asymmetries provide an avenue for the relative size of Canadian industry to exceed relative expenditures. Once protection is removed, then the relative size of these industries should fall, and we could obtain observations in the lower-right-hand quadrant of the hypothetical scatter diagram.

We employ a simulation to investigate more fully our model's predictions of the effect that tariff reductions under the FTA had on relative industry size. The theory tells us that changes in industry size depend on key parameters such as relative production costs and relative trade costs as well as the elasticity of substitution. Unfortunately, while we know tariff reductions, we do not observe other important industry characteristics. The simulation randomly assigns parameter values to industries. In the case of Canadian and U.S. tariffs, the simulation generates t and t^* with the means, standard deviations, and covariance of the actual data (see fig. 12.4). The distributions for the other param-

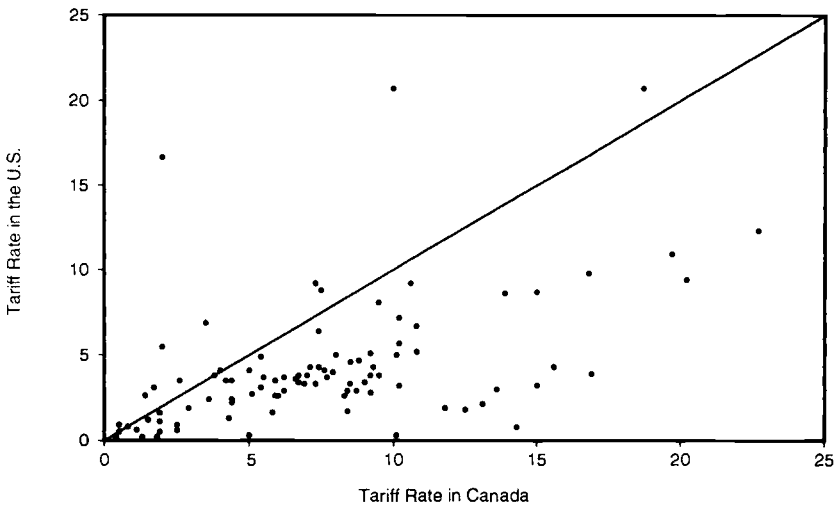

Fig. 12.4 Import tariffs in Canada and the United States in 1987

eters in the model—border costs, home bias, the elasticity of substitution between varieties, and relative marginal costs—are set so as to be reasonable and also to yield an initial distribution of relative size that approximates the 1987 distribution.[8] This assignment allows us to generate relative size before and after the removal of tariffs. Relative size is measured as Canadian shipments divided by U.S. shipments.

The results of the simulation are presented in figure 12.5, which is a scatter diagram divided into the quadrants defined above. Virtually all the points are in either the lower-left- or the upper-right-hand quadrants. The lower-left-hand quandrant corresponds to industries that start out with shipments ratios below 0.1 and decline with the removal of the tariff. These are Canadian industries that do not have a cost advantage vis-à-vis U.S. industries, and liberalization therefore shifts production to the larger country. Points in the upper-right-hand quandrant are industries where Canada has a comparative advantage, and improved access to the U.S. therefore increases Canada's relative production. Interestingly, the simulation shows that tariff asymmetries are not large enough to generate points in the lower-right-hand quandrant. Thus, while in principle Canadian industries can initially be large owing to asymmetric protection and then decline with liberalization, in practice it appears that these asymmetries are not sufficiently high. Overall, the simulations exhibit a positively sloped scattered diagram where relatively large Canadian industries grow and small Canadian industries decline with tariff reductions.

8. Specifically, σ is uniformly distributed between 3 and 7 (the implied markups over marginal costs vary from 14 to 33 percent), c/c^* is uniform between 0.5 and 1.5, and the combined home bias and border cost, $\beta(1 + \kappa)$, varies uniformly between 1.5 and 4.

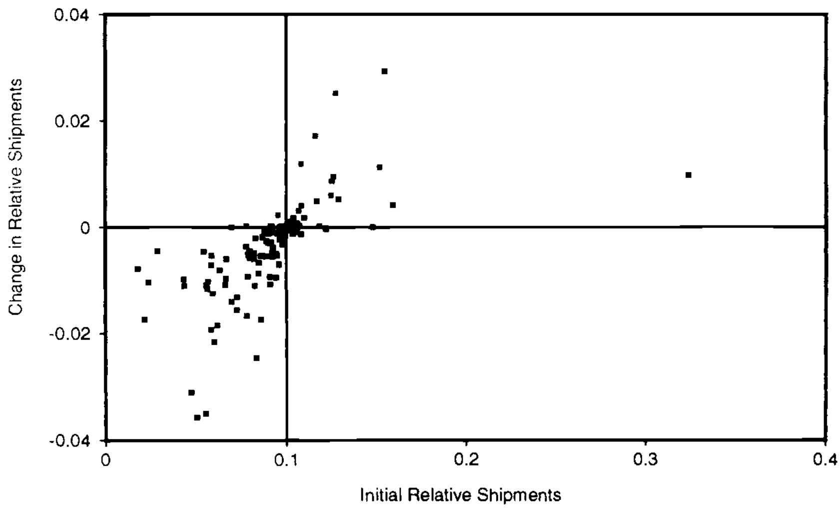

Fig. 12.5 Simulated changes in relative shipments

Figure 12.6 plots the actual data and presents a very different pattern than anticipated. Only industries with initial relative shipments less than 0.5 are included in the diagram. This eliminates just three industries: fur goods, pulp, and newsprint. The last two industries were actually larger than their U.S. counterparts (with relative shipments of 1.1 and 2.3). All three declined sharply in relative size between 1987 and 1992. An examination of the quadrant figure reveals that most of the points lie in the lower two quadrants (106 of 128). Moreover, contrary to our expectations, the diagram suggests that, the larger a Canadian industry was in 1987, the more it tended to shrink relative to its U.S. counterpart.

We may rule out some potential explanations for these features of the data. First, by construction, common business-cycle effects or trends away from manufacturing into services will not affect relative shipments. Similarly, if all North American consumers begin to avoid products made from asbestos or animal furs (two industries in our sample), relative shipments would be unaffected. Second, while Canada's relatively large pre-FTA tariffs seem consistent with the idea that the high-protection industries would start out largest relative to the United States and decline the most, the simulations show that the tariff asymmetries were too small to generate the negative correlation between changes and initial levels. Furthermore, most of the large industries that declined were resource-intensive industries with low Canadian tariffs (newsprint, pulp, nonferrous refining, fish products).

The negative correlation that appears in figure 12.6 does not necessarily imply that relative industry size is converging. As formalized in Quah (1993), even if there is no underlying change in the distribution of some cross section

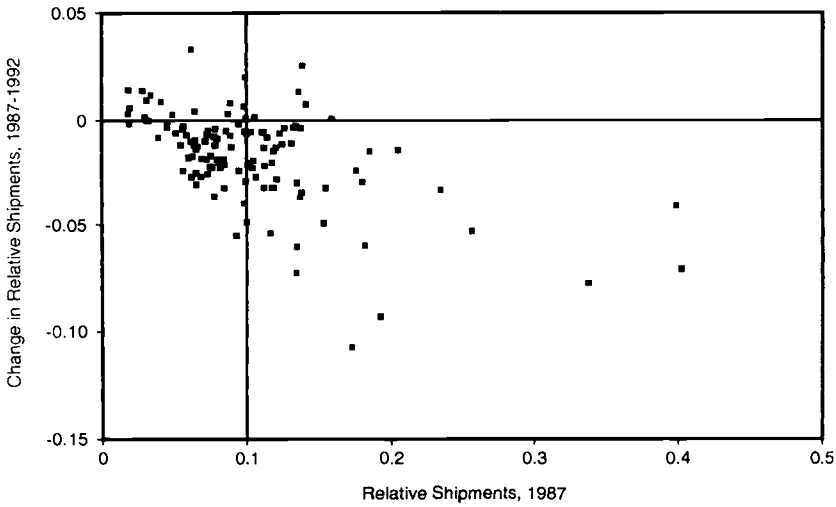

Fig.12.6 Actual changes in relative shipments

of data, we would expect changes to be negatively related to initial levels. The intuition is that, if the parameters that determine relative size are not fixed over time, then the industries that are particularly large at any moment are likely to be ones that were "lucky" that period. Five years later, those favorable circumstances are likely to have receded somewhat. Quah considers the case where each cross-sectional unit has its own distribution from which each time period is a random, independent draw. Under those assumptions, the regression of changes on initial conditions will yield a negative coefficient. An alternative procedure (suggested by our discussant, John Helliwell) consists of regressing changes on the average of initial and final levels, which results in a zero coefficient under the Quah scenario. A positive or negative estimate of the coefficient indicates a rise or fall of the cross-sectional variance.[9] The regression of changes in relative shipments on initial (1987) relative shipments yields a coefficient of −0.20 with standard errors of 0.03. The coefficient declines but remains significantly negative at −0.16 when we replace the 1987 value with the average of 1987 and 1992 relative shipments. Thus, there has been a reduction in the dispersion of relative industry size during the period we study.

Changes in the macroeconomic environment serve as potential explanations for the pattern of changes in relative shipments. First, the Canadian dollar ap-

9. To see why, define y_0^i and y_1^i as the initial and final data for some industry. Each y^i may be drawn from a different distribution as long as draws at different time periods are independent. Let $\Delta y^i = y_1^i - y_0^i$ and $\bar{y}^i = (y_0^i + y_1^i)/2$. A regression of Δy on $\bar{y}$ will yield a coefficient equal to the cross-sectional covariance of Δy and $\bar{y}$ divided by the cross-sectional variance of $\bar{y}$. The covariance term will equal $(V_1 - V_0)/2$, where V_1 and V_0 are the final and initial cross-sectional variances of y_1 and y_0. Thus, an expansion in the cross-sectional variance, $V_1 > V_0$, implies a positive coefficient in the regression.

preciated 11 percent against the U.S. dollar during the period 1987–92 (and by 21 percent from 1986 to 1991), raising the relative cost of production in Canada. In addition, the sample period was characterized by a decline into recession that appears to have been more severe in Canada than in the United States. An interest rate differential emerged in the late 1980s, peaking at 4 percentage points in 1990. In the context of the model, exchange rate appreciation would raise relative marginal costs, c/c^*, whereas a deeper recession or higher interest rates in Canada would tend to lower relative expenditures, E/E^*. While these factors could easily explain relative shipments declines in certain industries, it is not obvious why the largest Canadian industries would experience the biggest declines. It could be the case that industries sensitive to macroeconomic changes simply happened to be relatively large in Canada. It is also possible that the conditions that made Canadian industries large also led to large reductions under adverse macroeconomic conditions.

Exchange rate appreciation raising c/c^* will have the greatest negative effect on industries that have low trade costs or home bias. A cost advantage for Canada translates into high exports and relatively large shipments when import barriers are low. When currency appreciation undermines this cost advantage, exports and relative size decline. Thus, low trade costs may account for observations in the lower-right-hand quadrant. This same logic, however, argues that, when trade costs are low, comparatively disadvantaged Canadian industries would start out small and lose significantly with the appreciation. Thus, rather than a downward slope, differences in trade sensitivity imply an inverted-U pattern in which trade-insensitive industries have shipment ratios roughly equivalent to relative expenditures and are largely unaffected by the appreciation.

Relative expenditures in Canada could be lowered by deeper recession or higher interest rates. If the Canadian and U.S. economies were fully integrated, Canadian producers would be no more affected by declines in Canadian demand than U.S. producers. Thus, the geographic distribution of demand would not affect the distribution of production. Since the North American economy is only partially integrated, declines in E/E^* may account for the reductions in the relative size of Canadian manufacturing industries. There seems to be little a priori reason for the declines in relative expenditure to be largest in the industries with high Canadian relative shipments.[10] Hence, we do not expect the inclusion of macroeconomic sensitivity variables to eliminate the negative size effect. Nevertheless, in assessing the effects of tariffs on relative shipments, we want to control for characteristics of industries that make them likely to be more affected by the business downturn in 1990–92 and the accompanying high Canadian interest rates.

10. Differences between the Canadian and the U.S. share of GDP expended on goods of a particular industry could, however, generate such a result. The industries on which Canadians spend a disproportionate amount would tend to be relatively large and also be the most affected by a decline in Canada's GDP relative to the United States.

Table 12.3 **Changes in Relative Manufacturing Size after the FTA**

	Dependent Variable: $\Delta(S/S^*)$				
	(1)	(2)	(3)	(4)	(5)
Constant	.007	.008	.008	.011[b]	.015[b]
	(.005)	(.005)	(.005)	(.005)	(.006)
Size (S/S^*)	−.174[a]	−.176[a]	−.172[a]	−.177[a]	−.191[a]
	(.032)	(.032)	(.037)	(.036)	(.037)
Canadian tariffs $(\lvert \Delta t_C \rvert)$	−.151[b]	−.12[c]	−.123[c]	−.085	−.122[c]
	(.060)	(.069)	(.071)	(.073)	(.070)
U.S. tariffs $(\lvert \Delta t_{US} \rvert)$		−.095	−.097	−.147	−.165
		(.107)	(.108)	(.110)	(.111)
Openness			−.012	.025	.036
			(.055)	(.059)	(.059)
Cyclical sensitivity				−.07[c]	
				(.039)	
Durable goods					−.009[b]
					(.004)
R^2	.207	.212	.212	.234	.242
Root MSE	.020	.020	.020	.020	.020
No. of observations	125	125	125	125	125

Note: Ordinary least squares regressions with standard errors in parentheses. The superscripts a, b, and c indicate significance in a two-tailed test at the 1, 5, and 10 percent levels. Size is the average of 1987 and 1992 relative shipments.

We now turn to statistical analysis to estimate the strength of the link between trade liberalization and relative manufacturing performance while including controls for changes in macroeconomic conditions. Table 12.3 reports regression estimates of the effects of changes in tariffs and the macroeconomy on changes in the relative size of manufacturing industries.[11] In each specification, we include the average of the industry's 1987 and 1992 relative shipments as a covariate. Its coefficient reflects the tendency of the industry cross-sectional variance to expand or decline after conditioning on other observed characteristics of the industry.

The first two columns show that the removal of both Canadian and U.S. tariffs is associated with lower Canadian relative shipments. When we enter Canadian tariff levels alone, the effect is highly significant. Thus, the elimination of Canadian tariff protection appeared to have led to the relative contraction of Canadian industry. When we include both tariff levels, the Canadian tariff remains significant at the 10 percent confidence level, while the U.S. tariff variable enters with a perverse sign but is not statistically significant.

11. The regression sample excludes three extreme observations: fur goods, pulp, and newsprint. These industries were the three largest relative to the United States in 1987 (with relative shipments of 0.76, 1.1, 2.3). They also experienced declines that were an order of magnitude larger than the average for other industries (−0.37, −0.44, and −0.74, compared to −0.02).

The following three columns display results when we add controls for industry sensitivity to exchange rate appreciation and the deeper Canadian recession. "Openness" is calculated as the 1987–92 average of bilateral trade divided by the sum of Canadian and U.S. production in North America. We use it as a proxy for each industry's trade impediments. Open industries are more vulnerable to exchange rate appreciation. Column 3 shows that the variable obtains the expected negative sign, but the estimate is insignificantly different from zero. Thus, we find little evidence that exchange rate appreciation affected the pattern of changes across industries.

Columns 4 and 5 present results incorporating variables representing business-cycle sensitivity. The "cyclical sensitivity" variable employed in the column 4 regression is based on Bloskie's (1991) study of the performance of two-digit industries during the last eight recessions preceeding the one in 1991–92. Bloskie calculated the average percentage drop in output from the last quarter prior to the recession to the last quarter of the recession. The negative coefficient estimate supports the hypothesis that cyclically sensitive industries declined disproportionately in Canada. Somewhat stronger results obtain for an alternative measure of business-cycle sensitivity, "durable goods," which is an indicator variable based on the Statistics Canada classification.[12] Given the relatively high interest rates that prevailed in Canada from 1989 to 1991, it seems likely that durable-goods industries would decline disproportionately in Canada. Column 2 results bear this expectation out; the durable-goods effect is significant at the 5 percent confidence level.

The results appearing in table 12.3 suggest that both Canadian tariff reductions and a deeper Canadian recession share responsibility for the tendency of Canadian industries to decline relative to their U.S. counterparts. The purported gains from opening U.S. markets to Canadian producers receive no support from the regression analysis. U.S. tariffs were generally small, and they also tended to be positively correlated (Spearman rank correlation of 0.6) with Canadian tariffs. Thus, industries that benefited from more access to U.S. markets tended to be industries that experienced even larger reductions in the protection afforded them by Canadian tariffs. Industries that are consistently more cyclical or that produce durable goods declined more during the period 1987–92. Interestingly, the strong negative effect of average relative size remains across all specifications. Thus, the data suggest that the FTA and adverse macroeconomic factors produced a negative shift in the distribution of relative industry size. Meanwhile, the variance of that distribution declined.

12.3 Conclusions

This paper extends a two-country model of intraindustry trade to allow for asymmetries in country size, rates of protection, and production costs. While

12. Machinery, electronics, transportation equipment, furniture, metals, and miscellaneous manufactures are all classified as durable goods. Nondurables include paper, textiles, chemicals, food, and beverages.

trade liberalization may generate a large variety of outcomes for the relative size of industries in the two countries, the primary prediction of the model is that market-access considerations encourage production of differentiated products to concentrate in the larger of two trading partners. Using data for 128 matched industries in the United States and Canada for the years 1987 and 1992, we examine what happened over the period that the FTA was implemented.

The data reveal that most Canadian industries experienced relative shipments reductions from 1987 to 1992, a result consistent with the model. Our examination of the distribution of these reductions across industries indicates that they are related to Canadian tariff reductions and the business cycle. Thus, the elimination of Canadian protection and a deeper recession in Canada partly explain the relative decline of Canadian manufacturing over this period. We could not, however, provide evidence that Canadian dollar appreciation harmed specific industries. Moreover, U.S. tariff reductions do not appear to have increased relative output in Canada. Indeed, our regressions consistently yield the wrong sign for U.S. tariffs, although the estimates lack statistical significance.

A striking feature of the data is that Canadian industries that were relatively strong in 1987 did not expand after trade liberalization; rather, they were the ones that suffered the greatest relative declines. Our statistical evidence indicates a convergence in relative size even when we include controls for the tariff changes and sensitivity to macroeconomic influences. The observed tendency of the industry cross section to converge during the period 1987–92 suggests that some underlying source of variation in relative size has become less important. Some possible mechanisms would include convergence in North American factor prices or production technologies. Overall, it appears that trade liberalization explains only a small part of the changes in U.S. and Canadian manufacturing from 1987 to 1992.

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