Review of International Economics, 8(3), 436–447, 2000

Marginal Intraindustry Trade and Labor Adjustment

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Abstract

In the context of Ethier's model of the division of labor, this paper accomplishes three tasks. First, it complements existing literature on the algebraic properties of marginal intraindustry trade (MIIT) measures by embedding one of these measures in a general equilibrium model. Consistent with the existing literature, it is found that change in the Grubel–Lloyd index provides systematically different economic information from change in the MIIT index. Second, it examines the connection between intraindustry trade and intraindustry adjustment. Here it is found that the informal assumption that intraindustry trade generates only intraindustry adjustment cannot be sustained. That is, intraindustry trade will generally induce interindustry adjustment. Finally, because intraindustry trade generates interindustry adjustment, increased intraindustry trade will generally induce long-run changes in relative factor prices. This suggests, given the prominence of intraindustry trade in OECD countries, that there may be problems with inference on the link between trade and wages undertaken in a strict Heckscher–Ohlin framework.

1. Introduction

In recent years there has been a boom in research measuring intraindustry trade (IIT) with the goal of studying the relationship between that trade and labor-market adjustment (Brülhart, 1998). This research proceeds from the widely held presumption that IIT is associated with lower adjustment cost in factor markets than interindustry, or "net", trade (NT). This revival of interest follows an important paper in which Hamilton and Kneist (1991) argued that using the simple change in the Grubel–Lloyd index of IIT to identify low adjustment-cost trade can lead to potentially serious measurement error. In addition to a number of empirical applications, an interesting body of papers has developed examining the algebraic properties of various measures of *marginal* intraindustry trade (MIIT) to determine their relative suitability as measures of the low-adjustment-cost component of increased trade (Azhar et al., 1998). Because this work focuses on measures of IIT for a given sector, without incorporating adjustments of the overall equilibrium, the algebraic analysis of these measures is equivalent to a partial equilibrium analysis. The purpose of this paper is to extend the analysis of MIIT to an explicitly general equilibrium environment.

The next section provides a very brief review of research on the relationship between IIT and adjustment to put the current paper in context. Section 3 develops a general equilibrium framework based on Ethier's (1982) well-known division-of-labor model. Section 4 derives measures of change in IIT in the context of this model. Section 5 is the core of the paper, developing our analysis of MIIT and its economic consequences. The final section discusses the special properties of the model used and the

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extent to which our findings can be expected to carry over to alternative economic environments.

We find that the connection between MIIT and interindustry adjustment is not as direct in the general equilibrium context as presumed in partial equilibrium treatments. In particular, we show that a tariff reduction that influences only intraindustry trade causes interindustry adjustment. This result implies that increased IIT will generally be associated with some high-cost adjustment and with long-run changes in relative factor prices.

2. Related Literature

At least since the classic work of Verdoorn (1960), Drèze (1960), Kojima (1964), Balassa (1966), and Grubel (1967), it has been clear that IIT is in some fundamental way associated with trade liberalization, at least among industrial countries. Balassa in particular has argued that the empirically prominent role of IIT, along with a presumption that IIT is associated with lower adjustment cost than NT, helps to account for the unexpected sustainability of trade liberalization among industrial countries. In fact, Hufbauer and Chilas (1972), Lipson (1982), and Marvel and Ray (1987) invert Balassa's logic as the basis of a political economic account of both intra-European and multilateral liberalization. Specifically, this line of research argues that, taking it as axiomatic that IIT is associated with lower adjustment cost than NT, not only will liberalization (either preferential or multilateral) be easier between countries whose trade can be expected to be characterized by a large share of IIT in total trade, but the intersectoral pattern of liberalization will be skewed toward sectors characterized by IIT. A survey of related research by Brülhart et al. (1998) strongly suggests widespread acceptance of the hypothesis that IIT induces lower adjustment cost than NT.[1]

If we accept that IIT really is intra-*industry* (i.e., not the result of problems with categorical aggregation) and, as we shall see, more importantly, that adjustment to changes in IIT is intraindustry, we can take advantage of substantial direct evidence from research by labor economists on the question of the relative costs of inter- versus intraindustry adjustment. Specifically, a substantial body of research uniformly finds that the cost of being displaced in terms of lower wages is substantially higher under interindustry adjustment (Jacobson, 1998). The modal explanation is quite clear: workers accumulate human capital which is portable between firms in the same sector, but is not portable between sectors; when a sector contracts (as the importable sector does under liberalization in the H–O–S model), labor is forced to move to the expanding (exportable-producing) sector (e.g., Topel, 1990; Neal, 1995; Kletzer, 1996). Because human capital is sector-specific, workers lose the value of their investment and, because accumulation is related to time in an industry, they may never fully recover from the move. Intraindustry adjustment is thought to be different: firms may go out of business, but liberalization does not generate (high-cost) interindustry adjustment. As with the other trade literature on this subject, we take these empirical findings as given. On the other hand, we do not assume an identity between intraindustry trade and intraindustry adjustment. Section 5 focuses on the relationship between these two magnitudes.

3. A Two-Country Model with Intraindustry Trade

Because we are interested in intersectoral adjustment, our analysis requires a model with at least two sectors; and because we are interested in the effects of intraindustry trade, the model requires that at least one of those sectors be characterized by IIT. While there are several models that meet these requirements, in this paper we will be working with Ethier's (1982) model of trade in differentiated intermediate goods.[2] The model posits two factors of production, labor (l) and capital (k); and two final consumption goods, wheat (w) and manufactures (m). Wheat is taken to be produced with a standard neoclassical technology represented by a production function $f(k_w, l_w)$ which is twice-differentiable, linearly homogeneous, and concave. Both factors are costlessly mobile between sectors, and the markets for k, l, w, and m are perfectly competitive. Demand is taken to be generated by a representative agent with Mill–Graham preferences such that a share γ of income is spent on the manufactured final good. We will be considering a two-country world in which both countries are large, share the same technology sets, tastes, and endowments of capital and labor.[3] Importantly, we assume that countries share the same trade policies (i.e., we will assume that they levy the same *ad valorem* tariff on imports of intermediate goods, $t = T$).[4] Finally, we will focus only on international equilibria in which both countries produce both wheat and manufactures.

The Ethier model diverges from standard trade models in the technology of manufactures production: m is produced by costless assembly of components (x) which are, themselves, produced with internal increasing returns. Following the development in Ethier (1982), we suppose that in the relevant equilibrium there are n home firms and N foreign firms producing intermediates. Finished manufactures are costlessly assembled from intermediate components according to

$$m = \left[\sum_{j=1}^{n} x_j^{\beta} + \sum_{i=1}^{N} X_i^{\beta}\right]^{\frac{1}{\beta}}, \quad M = \left[\sum_{j=1}^{n} x_j^{\beta} + \sum_{i=1}^{N} X_i^{\beta}\right]^{\frac{1}{\beta}}, \tag{1}$$

where x_j is the input of intermediate component j, which is produced by the home country, and X_i is the input of intermediate component i, which is produced by the foreign country. Finished manufactures are produced in a similar way in the foreign country. Two features of this production technology are important. The first is the imperfect substitutability of differentiated components. The elasticity of substitution between any pair of component is $1/(1 - \beta)$ $(0 < \beta < 1)$. The second feature to note is that output is increasing in n and N, the number of distinct home and foreign varieties. The elasticity of output with respect to n or N is $1/\beta$, indicating increasing returns to variety.

To produce x_j units of intermediate variety j, a firm must purchase $b_j = ax_j + A$ bundles of k and l. The internal increasing returns to scale implies that a finite number of intermediates are produced, and each variety is produced by a different firm. These firms engage in large group monopolistic competition. Note that both the fixed (A) and marginal (a) costs are paid in bundles and are constant across firms in the component-producing sector. We assume all components have identical cost functions, which coupled with the symmetric form of (1) implies that all x_j and X_i are produced in the same quantity. If we let $b = \Sigma b_j$, and $x_j = x \ \forall \ j \in n$, and similarly for foreign producers of intermediates, then $b = n(ax + A)$ and $B = N(aX + A)$. With positive production of intermediates in both countries, producers of final manufactures will use all varieties of intermediates, so positive quantities of intermediates from both sources will be used by both home firms (x_h, X_h) and foreign firms (x_f, X_f). The total quantity of each input variety produced is the sum of sales to home and foreign firms: $x = x_h + x_f$ and $X = X_h + X_f$.

With a fixed endowment of factors of production, $(\bar{k}, \bar{l})$ and $(\bar{K}, \bar{L})$, we can summarize the resource constraint of the economy in terms of a transformation function between bundles and wheat: $w = s(b)$ and $W = S(B)$. We assume that bundles used in the production of components are produced using capital and labor according to a standard neoclassical production function, which is linearly homogeneous, twice-differentiable, and concave. Along with the equivalent assumptions on the production of wheat, and assuming no factor-intensity reversals, the function $w = s(b)$ is the concave transformation function of the H–O–S model. In particular, we know that $s'(b) < 0$ and $s''(b) \leq 0$.

Furthermore, given perfect competition in wheat and bundles, and taking wheat as the *numéraire*, the relative price of factor bundles for component production is $p_b = -s'(b)$. Since component producers purchase bundles under competitive conditions, total cost for a representative component-producing firm is $-s'(b)[ax_j + A]$. Total revenue is $q_j x_j$, so the condition that marginal revenue equals marginal cost can be rearranged to get an expression for q, the common price of intermediates:

$$q = \frac{-s'(b)a}{\beta}; \quad Q = \frac{-S'(B)a}{\beta}. \tag{2}$$

The profit of each component-producing firm is $\pi_j = q_j x_j + s'(b)[ax_j + A]$ which will be driven to zero by free entry and exit (abstracting from integer problems). Thus, setting $\pi_j = 0$ and substituting for q_j from equation (2), we get $x = X = A\beta/a(1 - \beta)$. Since this is made up entirely of parameters that are constant across component producing firms, scale is identical across firms.[5] Note also that these parameters are globally common, so all intermediate firms, regardless of location, produce the same quantity of the intermediate good.

It is important to note that while a representative home producer of intermediates produces exactly the same quantity as a representative foreign producer, it will not generally be the case that $x_h = X_h$ or $x_f = X_f$. In particular, the presence of tariffs creates a distortion in the choice of final manufacturers between home and foreign produced intermediates. Since this fact is essential to our analysis, we note that:

$$\frac{x_h}{X_h} = \left[\frac{Q(1+t)}{q}\right]^{1/(1-\beta)}; \quad \frac{X_f}{x_f} = \left[\frac{q(1+T)}{Q}\right]^{1/(1-\beta)}. \tag{3}$$

Ceteris paribus, a tariff shifts the input mix toward domestically produced intermediates. The elasticity of substitution between home and foreign inputs is $1/(1 - \beta)$.

Because the market for final manufactures is perfectly competitive, equilibrium is characterized by zero profits:

$$pm = qnx_h + Q(1+t)NX_h; \quad PM = QNX_f + q(1+T)nx_f, \tag{4}$$

which says that total revenue in manufactures is the sum of domestic and foreign input costs. Finally, our assumption of Mill–Graham demands ensures that a constant share, γ, of national income, inclusive of tariff revenue, will be spent on manufactured goods. Thus:

$$pm = \gamma(w + qnx + QtNX_h); \quad PM = \gamma(W + QNX + qTnx_f). \tag{5}$$

This system describes the two-country economy we use to examine the relationship between MIIT and resource allocation.

4. MIIT in a Two-Country Ethier Model

As we noted above, there is a widely held presumption that the larger the contribution of IIT to the change in total trade, the larger the contribution of intraindustry adjustment to total adjustment. This has led to a number of studies that use measures of the change in IIT more-or-less explicitly as a proxy for low-adjustment-cost trade. Most of this work measures IIT by the Grubel–Lloyd index, or one of its variants.[6] The Grubel–Lloyd index of IIT in sector j, G_j, gives IIT as a share of total trade in commodity j and, thus, takes values between 0 (no IIT, all trade is NT) and 1 (all IIT). The earlier research on liberalization–IIT–adjustment links, implicitly or explicitly, takes the change in the Grubel–Lloyd index to indicate the magnitude of that part of trade that does not generate high adjustment cost. That is, for the case of IIT in sector j, this research uses the measure

$$\Delta G_j := G_{j,t+1} - G_{j,t}. \tag{6}$$

To derive an expression for the Grubel–Lloyd index in terms of the framework developed in section 3, suppose the home country is (weakly) a net exporter of components. Because of the symmetry assumptions, there is no trade in wheat.[7] Thus, home exports are nx_f, and home imports are NX_h. In this context:

$$IIT = 2\min[nx_f, NX_h] = 2NX_h. \tag{7}$$

Using (7), the Grubel–Lloyd index, G, is

$$G = \frac{2NX_h}{nx_f + NX_h}. \tag{8}$$

Using circumflexes to denote proportional changes (i.e., $\hat{x} = dx/x$), we can express the change in the Grubel–Lloyd index as

$$\hat{G} = \frac{nx_f}{nx_f + NX_h}[\hat{N} + \hat{X}_h - \hat{n} - \hat{x}_f]. \tag{9}$$

By this measure, intraindustry trade increases when the number of foreign varieties or the quantity of each foreign variety used by home producers expands. In contrast, intraindustry trade is lower when the number of home varieties or the quantity of each home variety used by foreign producers expands. Note that the weight on the expansion of varieties in either country is the same—home exports as a share of total components trade.

As we noted in the introduction, Hamilton and Kniest (1991) argue, following Caves (1981, p. 213), that what is relevant to the analysis of factor market adjustment is not whether the amount of IIT has increased, but whether the share of IIT in trade has increased. That is, if one is interested in the effect of changed trading conditions on adjustment, it is necessary to identify the contributions of IIT and net trade (NT) to the change in total trade. In this paper we will focus on a set of indexes due to Dixon and Menon (1997) which, like the Grubel–Lloyd index, have the attractive property that they can be derived from an identity with an intuitive relationship to both the theory and the data.[8] Specifically, Dixon and Menon's (1997) basic measure of the contribution of the change in IIT to the percentage change in total trade is

$$C_j := \frac{\Delta IIT_j}{TT_j} = \hat{IIT}_j G_j. \tag{10}$$

The second equality follows from the definition of the Grubel–Lloyd index, $G := IIT/TT$, and simple manipulation. Menon and Dixon prefer C_j to ΔG_j because the latter can lead to quite misleading inferences about the significance of MIIT in changing trade. Specifically, an increase in G_j is generally taken to imply an increase in the significance of IIT relative to NT. However, as Menon and Dixon (1996, pp. 7–8) show analytically, it is possible for $\Delta G_j > 0$ to be associated with a smaller increase in IIT than the increase in net trade.[9]

In terms of the model developed above, we can use (7) and (8) to write the C index as

$$C = \frac{2NX_h}{nx_f + NX_h}[\hat{N} + \hat{X}_h]. \tag{11}$$

This measure involves only expansion of foreign varieties and home usage of foreign varieties. Provided the home country remains the net exporter of components, changes in the number of home varieties and foreign usage of each home variety do not contribute to the measured change in intraindustry trade. Another distinction between this MIIT measure and the change in the Grubel–Lloyd index is that the weight used here is twice foreign intermediate exports as a share of total intermediates trade. If foreign production of components is small, changes in foreign exports of components lead to a small measured change in MIIT.

Thus, a first useful result from this analysis is that we confirm, in the context of a standard general equilibrium model, a result well known from the algebraic analysis of the Grubel–Lloyd index and the Menon–Dixon indices: these are measures of economically different things.

5. MIIT and Adjustment in a Two-Country Ethier Model

We now apply the analysis from sections 3 and 4 to our central question: What is the relationship between IIT and intraindustry adjustment? We proceed by totally differentiating the system given in section 3. Following Ethier (1979), we can express the international equilibrium in terms of national allocation curves. The home-country equilibrium requires that the market for finished manufactures clears. Because we assume the same import tariff that is levied on components is also levied on imports of finished manufactures, there is no trade in finished manufactures. Consequently, domestic equilibrium requires that the domestic demand price of finished manufactures equals the domestic supply price. This condition implies that the value of consumption of finished manufactures (given by equation (5)) equals the total cost of inputs to domestic manufactures (given by equation (4)).

As shown in an Appendix (available from the authors on request), the system reduces to two simultaneous equations that may be depicted as allocation curves. Letting $\tau = (1 + t)$ and $T = (1 + T)$, these equations take the form

$$\begin{aligned} &\phi_n\hat{n} + \phi_N\hat{N} + \phi_t\hat{\tau} + \phi_T\hat{T} = 0, \\ &\Gamma_n\hat{n} + \Gamma_N\hat{N} + \Gamma_t\hat{\tau} + \Gamma_T\hat{T} = 0. \end{aligned} \tag{12}$$

The home allocation curve is depicted in Figure 1 as the curve HH′ and the foreign allocation curve is depicted as FF′. We have assumed that the international equilibrium is stable and occurs at point A in the presence of identical tariffs on intermediates imports in each country. To understand the effect of liberalization, we note that a tariff reduction by the home country alone shifts both allocation curves. (The foreign

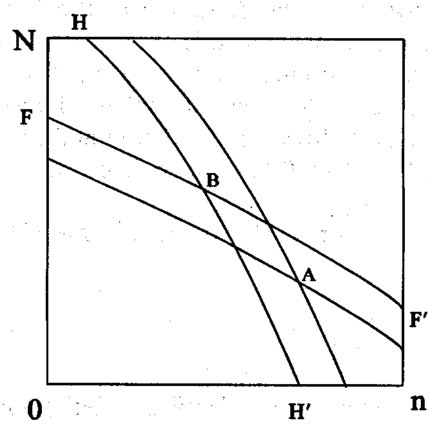

Figure 1. National Allocation Curves: Effect of a Decrease in the Home Tariff

curve is affected because the tariff reduction reduces home bias toward home intermediates, raising home demand for foreign intermediates.) The horizontal shift in HH′ is given by

$$\left.\frac{\hat{n}}{\hat{\tau}}\right|_{HH'} = -\frac{\phi_t}{\phi_n}. \tag{13}$$

Domestic stability requires that ϕ_n be negative. ϕ_t may take either sign and we assume that $\phi_t > 0$. Thus, a decrease in the home tariff shifts HH′ to the left. The foreign allocation curve also shifts, however, and its horizontal shift is given by

$$\left.\frac{\hat{n}}{\hat{\tau}}\right|_{FF'} = -\frac{\Gamma_t}{\Gamma_n}. \tag{14}$$

As discussed in the Appendix, Γ_t is negative and Γ_n is negative. The sign of this derivative is therefore negative and FF′ shifts right when the home tariff is reduced. Because HH′ shifts left and FF′ shifts right, the number of home input varieties falls while the number of foreign varieties rises when the home country reduces its tariff. The new equilibrium occurs at point B in Figure 1.

When both the home and foreign countries liberalize simultaneously, with the same percentage reduction in their tariffs, both countries influence the position of the two allocation curves. The net effect on the number of varieties depends on whether the effect of a tariff cut on one's own allocation curve induces a shift of the same, larger, or smaller magnitude (in absolute value) in the allocation curve of one's partner. Clearly, since the two countries cut tariffs by the same proportion, the net effect of the two policy changes will be the same for each country's total number of varieties. Whether the total number of varieties in each country rises or falls, these changes will be identical.

We can solve for the change in home varieties (the change in foreign varieties will be the same) as

$$\hat{n} = \frac{1}{D}[(\phi_N - \phi_n)(\phi_t + \phi_T)]\hat{\tau}, \tag{15}$$

where we have used the symmetry assumptions, as shown in the Appendix. Because the equilibrium is stable, the determinant, D, is positive. As in Ethier (1979), we also assume that an increase in either country's finished manufactures output reduces the demand price both absolutely and relative to that country's supply price and lowers the supply price of the other country. These assumptions imply that both ϕ_N and ϕ_n are negative but that $\phi_N > \phi_n$. Therefore, the sign of (15) depends on the sign of $\phi_t + \phi_T$. This sign will be positive if the rightward shift in the home allocation curve induced by an increase in the home tariff exceeds the leftward shift induced by an increase in the foreign tariff. If we assume this to be the case, the number of home varieties must fall when the home and foreign tariffs are reduced. Because the identical responses occur in the foreign country, liberalization reduces the total number of intermediates varieties.[10]

Now we turn to the measures of marginal intraindustry trade used in the empirical trade literature. These indices require measurement of changes in the amount of each variety that enters trade as well as their number. Using equations (3), we can derive expressions for changes in the amount of each imported intermediate. The change in home imports of each foreign variety is

$$\hat{X}_h = \frac{1}{1-\beta}\frac{X_f}{\Lambda}\left[x\varepsilon_h(\hat{n}-\hat{N})+(x_f-x_h)\hat{\tau}\right], \tag{16}$$

where Λ is a measure of the home bias in input choices induced by the tariff and is positive, and ε_h is the elasticity of the supply price of factor bundles. We have also used symmetry of the two economies and of the policy changes. Similarly, the change in foreign imports of each home variety is

$$\hat{x}_f = -\frac{1}{1-\beta}\frac{x_h}{\Lambda}\left[X\varepsilon_h(\hat{n}-\hat{N})+(X_f-X_h)\hat{\tau}\right]. \tag{17}$$

Because $\hat{n} = \hat{N}$, and $X_f > X_h$ while $x_f < x_h$ (home bias in input usage), it can be seen by inspection that the tariff reductions must increase both X_h and x_f.

Because symmetry ensures that $X_f = x_h$ and $X_h = x_f$, it can easily be confirmed that the change in the Grubel–Lloyd index, G, and in net trade, F, is zero. These results follow from the symmetry assumption: all trade is intraindustry. The liberalization by both countries does alter trade, however, in that fewer varieties are traded but each variety is now traded in larger quantities—the home bias in input use is reduced by the tariff reductions. Therefore, liberalization will induce changes in IIT.

The measure that captures the intraindustry trade induced by the mutual liberalization is the Menon–Dixon C index. For the present model, this expression is

$$C = \frac{2NX_h}{nx_f + NX_h}\left[\hat{N}+\hat{X}_h\right]. \tag{18}$$

The number of varieties falls while the amount of each variety traded rises, but the net effect on intraindustry trade in indeterminate. While we are unable to sign the MIIT measure, there is no presumption that it is zero.

Although the change in the volume of trade is indeterminate, the direction of adjustment is determinate. Because the number of varieties falls in each country, the total amount of domestic resources devoted to the manufacturing sector must fall. Trade generated or reduced is intraindustry, but the adjustment is interindustry. This observation leads us to the following propositions.

PROPOSITION 1. *For identical countries and interior equilibria before and after liberalization, mutual reductions in tariffs on imported intermediates can reduce the amount of resources employed in the manufacturing sector.*

PROOF. If $\hat{n} < 0$, then $\hat{b} < 0$. This follows from the positive (linear) relationship between n and b (see note 5). Resources are reallocated from the manufacturing sector to the wheat sector. All marginal trade is intraindustry but all adjustment is interindustry. □

This proposition suggests that MIIT measures may be poor guides to the share of adjustment that is low-cost adjustment. The link breaks down in that observations about changes in trade patterns do not map directly into changes in industry resource allocations. Moreover, as shown by the next proposition, observations about changes in trade patterns may be poor guides to the effect of trade on factor prices.

PROPOSITION 2. *For identical countries and interior equilibria before and after liberalization, mutual reductions in tariffs on imported intermediates alter the distribution of income. Assuming that the manufacturing sector is capital-intensive, liberalization reduces the return to capital and raises the wage.*

PROOF. Because n and N fall with liberalization, q and Q fall with liberalization. As shown by Ethier (1982, Proposition 4), a fall in the price of intermediates reduces the return to the factor used intensively in manufacturing and raises the return to the other factor. □

6. Conclusions

The two main results of this paper have interesting implications for research on trade and labor-market adjustment. With respect to research on measuring MIIT with the goal of linking MIIT to factor-market adjustment costs, we conclude that the algebraic/partial equilibrium approach characterizing the earlier literature may be misleading. Our analysis shows that in a general equilibrium environment a change in net trade is not a necessary condition for high-cost (i.e., intersectoral) factor-market adjustment. The model we have used is a special case in that the extent of IIT is independent of scale parameters and is instead determined entirely by those parameters that determine the intersectoral allocation of resources. However, while the effect is shown in high relief here, as long as the change in IIT requires intersectoral reallocation, as it will if sectors shrink or expand in response to liberalization, changes in IIT will induce high-cost adjustment. This observation from our analysis holds true in alternative economic environments.[11]

In models in which liberalization induces scale effects as well as intersectoral reallocation, the relationship between MIIT and factor market adjustment will be more complex.[12] Liberalization may then alter the scale, as well as the number, of firms. Changes in trade patterns, then, may reflect both types of adjustment. It remains to be seen if, in the general equilibrium context, the contribution of MIIT to changes in total trade is a useful guide to the share of low-cost adjustment in total factor-market adjustment.

The second proposition takes us from the focus on short-run costs of adjustment to the long-run consequences of trade liberalization which has been the focus of so much recent empirical research (Gaston and Nelson, forthcoming). Specifically, the implication of Proposition 2 is that, not only may increases in IIT be associated with high-cost intersectoral adjustment, but as a result it may also be associated with long-run changes in relative factor returns. This suggests that worries about North–South trade, exemplified by rhetoric about a "giant sucking sound," as a culprit in the deterioration of the wages of unskilled workers may be missing the point in a way very different from the current stress on technological change. The culprit could conceivably be trade with other industrial nations.[13] It follows from the analysis leading to Ethier's (1982) fifth proposition that, even with pure intraindustry trade, the intersectoral adjustment will induce a change in the relative price of manufactures. This change in P_m/P_w can take, in general, either sign for a given change in P_b/P_w, though the change in the relative price of manufactures will be smaller than the change in the relative price of bundles. Given the prominence of IIT among OECD economies, this suggests the possibility that both informal and econometric inference on the relationship between the relative prices of final goods and factors based on the H–O–S model may be faulty. At the very least, by using a model that incorporates IIT, which is such a prominent feature of trade data, we are alerted to aspects of the relationship between trade and wages that have been ignored in the focus on the Heckscher–Ohlin model.

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Notes

1. Brülhart et al. (1998) refer to this as the "smooth adjustment hypothesis." This usage differs from the common use of the term "smooth adjustment," which refers to nondiscontinuous adjustment along a transformation function.
2. See Francois and Nelson (1998) for an expository development of the Ethier model and a variety of its applications.
3. Following Dixit and Norman (1980), we will denote home country magnitudes with lower-case letters and foreign country magnitudes with upper-case letters.
4. As in Markusen's (1990) analysis of derationalizing tariffs, we assume that each country levies the same tariff on imports of finished manufactures. Because final manufactures are costlessly assembled from intermediate goods, a tariff on finished manufactures eliminates the incentive to "jump" the tariff on intermediates through final goods imports.
5. Thus, from the fact that $b = n(ax + A)$, we can solve for the number of firms as a function of aggregate output of bundles: $n = (1 - \beta)b/A$. Note the implication that b and n are linearly related.
6. See Grubel and Lloyd (1975) for the original presentation of this index. The main variants attempt to correct for problems related to categorical aggregation or unbalanced trade, neither of which will concern us in our theoretical development, so we will focus on the Grubel–Lloyd index. For details on other measures, see ch. 5 of Greenaway and Milner (1986).
7. Note that wheat may be traded freely. However, because the two countries are identical, there is no neoclassical comparative advantage. Consequently, all trade is the exchange of component varieties.

8. The Grubel–Lloyd index follows straightforwardly from the fact that $IIT_j := 2\min[EX_j, IM_j] = EX_j + IM_j - |EX_j - IM_j|$, and normalization by total trade (TT). It is also quite natural to interpret G_j by noting that, since $NT_j := |EX_j - IM_j|$, we can rearrange the identity $TT \equiv IIT + NT$, and divide by TT to get an index that takes values in [0,1].

9. Perhaps more importantly, they develop extensive empirical evidence of precisely such an implication. For example, Dixon and Menon (1997) use Australian data at the 3-digit SITC level to illustrate the empirical significance of the measure one chooses to use in analyzing the effect of IIT in changing aggregate trade. They find that, of the 133 manufacturing industries that make up their dataset, about 14% in 1981–86 and 31% in 1986–91 were characterized by increases in G_j but larger contributions of marginal net trade than marginal *IIT*.

10. That protection raises the number of home varieties is the standard case, underlying arguments for optimal tariffs, as in Francois (1992). Markusen (1990) highlights the opposite case when he derives conditions under which protection makes the number of domestic and foreign input varieties fall. He shows that a necessary condition for tariffs to be "derationalizing" is that the price elasticity of demand for finished manufactures exceeds the elasticity of substitution between home and foreign intermediate inputs. In the present model, this condition does not hold. Following Ethier (1982), we assume that the price elasticity of demand is unity, while the elasticity of substitution exceeds unity. Thus, in the present case, a liberalization may be derationalizing, in the precise sense that the liberalization reduces the total number of input varieties. See Markusen for references and further detail.

11. In any event, one implication of Proposition 1 would appear to be that, if we are interested in the link between trade and intersectoral adjustment, we will need measures of both intersectoral movement and trade. See Brülhart et al. (1998) for a first attempt in this direction.

12. Similarly, in the context of the current model, liberalization that reduces a firm's fixed costs will also produce a more complex relationship between MIIT and adjustment.

13. It is important to note, along with this theoretical possibility, that this is not a Stolper–Samuelson result. We have not shown that any factor experiences a *real* decline. As Ethier (1982, Proposition 6) makes clear, to make such a statement requires explicit attention to the interaction between intersectoral effects, of the usual Stolper–Samuelson sort, and scale effects.