INTRA-INDUSTRY TRADE AS AN INDICATOR OF LABOR MARKET ADJUSTMENT

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Abstract:

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A growing body of recent empirical research uses measures of change in intra-industry trade as indicators of labor market adjustment. In this paper, we argue that the theoretical foundations for this work are problematic. To make this argument we develop a simple model with both inter- and intra-industry trade and adjustment. We define measures of IIT and of labor reallocation and, in the context of the model, compare and contrast them. We find that changes in domestic absorption, which influence trade flows but which are distinct from production changes, make changes in IIT an unreliable guide to labor market pressure.

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The relationship between international trade and labor markets has been a central concern of pamphleteers, politicians, and academics for virtually as long as "international trade" has been a coherent concept.[1] While much of the current concern is motivated by the apparent deterioration in the returns to unskilled labor (both absolutely and relative to skilled labor), issues of adjustment cost have figured prominently in both theoretical and empirical research for some time. In the 1990s, a sizable body of work developed attempting to use intra-industry trade (IIT) as an indicator of "non-disruptive trade growth" (Dixon and Menon, 1997, pg. 234). This work extends from Balassa's (1966) observation that adjustment to IIT might involve lower costs than adjustment to inter-industry trade.

Balassa's observation explains the powerful attraction of the IIT approach: it promises to isolate the role of trade changes on labor reallocations. Many factors influence labor markets, and, as the "trade and wages debate" shows, parceling responsibility for labor market outcomes to trade, technological change, labor supply shifts, etc., is fraught with difficulty. The IIT approach offers a way around these difficulties in that it promises readily available information about trade's ability to generate disruptive structural change. Its importance to trade policymaking is obvious; predictions about the structure of trade changes flowing from any particular agreement can be viewed as predictions about

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[1]Viner (1937, pp. 52-57) discusses the mercantilist's "stress on employment" and Irwin (1996) illustrates the continuing importance of labor-related issues in the evaluation of international trade from Graeco-Roman times down to our own.

the political costs of the agreement.

Measurement issues are at the heart of the recent literature on IIT and adjustment. Hamilton and Kneist (1991) argue that using the change in the Grubel-Lloyd index of IIT to identify low-adjustment-cost trade can lead to potentially serious measurement error. In response, a growing body of papers examines the algebraic properties of various measures of *marginal intra-industry trade* (MIIT), seeking to determine their relative suitability as measures of the low-adjustment-cost component of increased trade (Azhar, Elliott, and Milner 1998). These measures, which disaggregate the change in total trade in various ways, are claimed to be superior to simply measuring the change in the Grubel-Lloyd index, based on arguments that a particular calculation better represents the structure of the *change* in trade flows and, thus, better represents the effects of innovations in trade on labor allocation. Table 1 summarizes the recent literature and indicates the data used to calculate the authors' preferred IIT and/or MIIT measures.

Despite the obvious importance of this empirical work for general assessment of the desirability of trade agreements, the theoretical foundations for MIIT measures have been examined in only a rudimentary way.[2] The purpose of this paper is to extend the theoretical analysis of MIIT, and in particular to embed it in an explicitly general-equilibrium environment. Working within a general-

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[2]Much of this work focuses on measures of IIT for a given sector, without incorporating adjustments of the overall equilibrium, making algebraic analysis of these measures equivalent to a partial equilibrium analysis. Brülhart's (1999) approach is ostensibly general equilibrium, but he makes extreme assumptions that render the treatment of questionable value. One such assumption is that the structure of demand remains unaltered by changes in trade and domestic production. As we shall argue, MIIT measures fail to measure labor adjustment pressures, even under the best of production circumstances, precisely because of concomitant demand changes.

equilibrium context is essential because these measures are used to gauge an essentially general-equilibrium phenomenon: how labor is reallocated in response to broad trade agreements. We posit a model that reflects the literature's concern with short-run labor adjustment, and we use it to derive analytical expressions for MIIT and labor reallocation. We then compare these expressions to identify the conditions under which popular measures of (marginal) intra-industry trade are informative with respect to intra- versus inter-industry labor adjustment. Our results indicate the need to control for trade-induced changes in domestic demands, a feature that is absent from the existing literature. Controlling for such changes offer a way to improve the current MIIT program, and the lack of such controls may explain the inability of researchers to find a systematic relationship between MIIT and direct measures of labor adjustment.

We begin by tracing the development of IIT as a measure of low-adjustment-cost trade and by describing the measures commonly used in the literature. In Section II we present our analytical framework, while section III provides a comparative static analysis of liberalization in that framework. In section IV we use this analysis to assess MIIT measures as indicators of labor reallocation. We conclude in section V by placing our formal analysis in the context of the ongoing research program.

I. Adjustment Costs under Inter-Industry *versus* Intra-Industry Trade

Analysis of IIT has developed in close relationship with both the analysis of trade liberalization and the analysis of adjustment to international trade. In their now classic analyses of the trade effects of early European efforts at economic integration, Verdoorn (1960), Drèze (1960, 1961), and Balassa (1966), all emphasized the empirical importance of IIT. Balassa's work, in particular, laid the foundation for what has become an enormous empirical literature on the measurement of IIT.[3] It was also Balassa (1966) who suggested that adjustment to IIT might be expected to involve lower costs than inter-industry trade:

> It would appear that the difficulties of adjustment to freer trade have been generally overestimated. It is apparent that the increased exchange of consumer goods is compatible with unchanged production in every country while changes in product composition can be accomplished relatively easily in the case of machine building, precision instruments and various intermediate products. These considerations may explain why the fears expressed in various member countries about the demise of particular industries have not been realized. (pg. 472)

This theme, which has figured prominently in the literature on IIT, is also central to this paper. Thus, we first review the literature on IIT and industrial adjustment, which proceeds under the assumption that intra-industry adjustment is less costly than inter-industry adjustment, and then we review some recent research in labor economics that provides evidence of this assumption.

We need to consider two key causal connections: the link between liberalization and IIT, and the relative adjustment costs of intra- *versus* inter-industry trade.[4] Following early studies that appeared to show that IIT grew rapidly relative to total intra-EEC trade and relative to IIT growth outside the EEC, the question of whether there was an association between liberalization, and especially preferential liberalization, and growth in IIT was addressed in a large proportion of the research on

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[3]Grubel and Lloyd (1975) is an essential landmark. See Greenaway and Milner (1986) for an extremely useful survey of the state of the art on all aspects of research on IIT. Greenaway and Torstensson (1997) provides an update.

[4]Our review of this early literature will be brief. For more detail with a particular focus on the adjustment implications of IIT in the EC context, see: White (1984); Greenaway and Milner (1986, chapter 11); Greenaway and Tharakan (1986); Greenaway (1987); and Greenaway and Hine (1991).

IIT.[5] There seems to be fairly widespread acceptance of the existence of such an empirical relationship, even though empirical research has provided only mixed support.[6] The difficulty with this result is that there is no particular reason for there to be such a relationship based on economic fundamentals. Even in a world characterized by IIT, there is no particular reason for general liberalization, whether preferential or multilateral, to generate more IIT than would be present in the general evolution of trading patterns.[7]

The peculiarity of the apparent connection between liberalization and IIT has led a number of

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[5]In addition to the papers by Verdoorn, Drèze, and Balassa that we have already mentioned, important early papers by Kojima (1964) and Grubel (1967) also showed an apparently strong connnection between liberalization and IIT. Similar results are recorded by Menon (1994) for the case of the Australia-New Zealand Closer Economic Relations Pact (CER).

[6]Key papers supporting the presence of a link between IIT and preferential liberalization are: Loertscher and Wolter (1980); Havrylyshyn and Civan (1983); Balassa and Bauwens (1987); and Globerman and Dean (1990). Pagoulatos and Sorenson (1975) and Caves (1981) consider measures of tariff level and tariff similarity between countries to test the hypothesis that multilateral liberalization induces IIT–i.e. tariff levels should be negatively associated and tariff similarity positively associated with IIT. Pagoulatos and Sorenson interpret their findings as supportive of this relationship. Caves, for whom levels had the wrong sign, found the relationship unconvincing on *a priori* grounds and took his results as insufficiently strong to change his priors. More recent research on protection levels or openness measures continues to generate mixed results, with Balassa and Bauwens (1987, 1988), Lee (1989), Clark (1993), and Stone and Lee (1995) providing support for some relationship, but Toh (1982) agreeing with Caves, and Torstensson (1996) arguing that protection variables are not robust in sensitivity analyses.

[7]This is particularly true given that the relationship between liberalization and IIT seems to be present in both south-south (Balassa, 1979; Havrylyshyn and Civan, 1983, 1985) and north-south (Tharakan, 1984, 1986) trade. As Havrylyshyn and Civan (1983) make clear, while the trade of LDCs contains significant IIT, it is important to note that the volume of intra-industry trade declines as GNP per capita declines for any country, and also declines with the difference in GNP per capita between trading partners. The existence of substantial north-south IIT has led to a sizable literature on vertical IIT (see Hine, Greenaway, and Milner, 1999). An essential point is that vertical IIT may be endowment-based and generate adjustment pressure more like that of inter-industry trade than intra-industry trade.

investigators to conjecture that the causation actually runs from IIT (or, rather, potential for IIT) to liberalization. The argument proceeds from the claim, already present in the quotation above from Balassa (1966), that adjustment to IIT is less costly than adjustment to inter-industry trade, to the claim that countries negotiating liberalization will be predisposed to agree to liberalize sectors characterized by significant IIT, via a straightforward political economy argument. This suggestion was first studied in detail by Hufbauer and Chilas (1974), in the context of an analysis of trade among industrial countries, arguing:[8]

> GATT negotiations very much favor intra-industry over inter-industry specialization. ... It is easier to secure one industry's consent for lower trade barriers if that *same* industry stands to gain from reciprocal concessions. ... Thus, GATT concessions typically foster intra-industry specialization. (pg. 6)

The authors then compare inter-industry specialization within the European Community to that between states in the United States, finding substantially higher inter-industry specialization within the US. That is, in an environment where local (i.e. national in the EC context) governments are able to resist market reallocation, we observe the same pattern of IIT-dominated trade that we observe under GATT liberalization.

The suggestion that political economy forces help account for the prominence of IIT is widely

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[8]One might note that this is also the basis of the common claim that free trade areas/customs unions are easier to create among countries between which IIT might be expected to be intense–i.e. relatively developed countries with similar factor endowments. Thus, whether preferential or multilateral, the liberalization process is expected to be most successful when it begins with partners and goods that are expected to involve relatively low adjustment costs and builds on that base. This would seem to be the model of the EU, NAFTA (which began not just with the US and Canada, but with autos), and the GATT/WTO. Difficulties developed in all three cases in extending the logic of liberalisation to both new products and new members. Thus, it is probably not surprising that such expansions have led to a boom in research on adjustment.

cited and has received additional systematic study in the U.S. case by Finger and DeRosa (1979), Marvel and Ray (1987), and Ray (1991). Finger and DeRosa estimate a cross-industry regression of nominal or effective (post-Kennedy round) tariff rates on capital, labor, and human capital inputs as well as measures of intra-industry trade, finding a highly significant positive effect of labor use, and highly significant negative effects of human capital use and IIT for the case of nominal tariffs. That is, independently of the commonly noted tendency of industrial countries to protect labor, and controlling for factors generating export success, Finger and DeRosa find evidence of an independent effect of IIT on protection. Marvel and Ray (1987) regress measures of nominal or effective tariffs on instruments for import share, export share, and an interaction of the two, finding support for the claim that "as imports rise, additional exports limit significantly the protectionist impulse that the imports engender" (pg. 1288).[9] Lundberg and Hansson (1986) examine the relationship between protection and IIT for the case of Sweden finding only a weak and insignificant correlation (1959) or a positive and significant correlation (1972). However, when Lundberg and Hansson consider changes, they find a strong positive correlation between the initial level of IIT in 1959 and the reduction in tariffs from 1959 to 1972.[10] They take this as evidence in favor of the claim that adjustment costs are lower for IIT than inter-industry adjustment.

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[9]Nelson (1990) and Ray (1991) provide discussions of the implications of this intersectoral pattern of protection on the prospects for LDC exports.

[10]This can be compared with Finger and DeRosa who find no cross-sectional relationship between their factor-input and IIT measures and changes. In the Finger-DeRosa case, because they were looking at effects generated by the Kennedy Round, which, as Jan Tumlir points out in a comment on the paper, was the first round to use a linear cut, this was to be expected. Similarly, since Lundberg and Hansson examine only correlation and not a regression, their cross-section results on levels of protection are not strictly comparable with those of Finger and DeRosa.

If we accept that IIT really is intra-*industry* (i.e. not the result of problems with categorical aggregation), we can take advantage of substantial direct evidence from research by labor economists on the question of the relative costs of inter- versus intra-industry adjustment. Specifically, a substantial body of research uniformly finds that the cost of being unemployed in terms of lower wages is higher under inter-industry adjustment (Neal, 1995; Kletzer, 1996; Kim, 1998; Greenaway, *et al.*, 1999). 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 HOS model), labor is forced to move to the expanding exportable producing sector. The IIT case is thought to be different: firms may go out of business, but liberalization does not generate (high cost) inter-industry adjustment.

An interesting body of recent research, however, has questioned whether evidence of increases in IIT, as measured in conventional ways, provides a sufficient basis for accurate inferences about adjustment. This research accepts, as do we, the causal connection, based on findings by labor economists that intra-industry adjustment is associated with lower adjustment cost than inter-industry adjustment, but suggests alternative measures of the trade forces inducing the adjustment.

Virtually all of the work we have considered to this point measures IIT by the Grubel-Lloyd index, or one of its variants.[11] If we let X_j and M_j denote exports and imports of commodity j, the

[11]The 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 Chapter 5 of Greenaway and Milner (1986).

Grubel-Lloyd index of IIT in sector j is given by:[12]

$$G_j := \frac{IIT_j}{TT_j} = \frac{X_j + M_j - \left|X_j - M_j\right|}{X_j + M_j} \equiv 1 - \frac{\left|X_j - M_j\right|}{X_j + M_j}. \quad \textbf{(1)}$$

G_j gives IIT as a share of total trade in commodity j, TT_j, and, thus, takes values between 0 (no IIT) and 1 (all trade is IIT). These indices can be studied directly or aggregated to study broad sectoral or economy-wide trends in IIT. To do the latter, it is common to use an average of the form:

$$G_J := \sum_{j \in J} w_j G_j,$$

where J is a subset of industries (often manufacturing), at some level of aggregation (commonly 3-digit SITC), and where the w_j are aggregation weights such that $\sum_{j \in J} w_j = 1.$ The research we reviewed above, implicitly or explicitly, takes change in the (sectoral or aggregate) Grubel-Lloyd index to indicate the magnitude of that part of new trade that does not generate high cost adjustment. That is, for the case of IIT in sector j, this research considers:

$$\Delta G_j := G_{j,t+1} - G_{j,t}. \quad \textbf{(2)}$$

Starting with a paper by Hamilton and Kniest (1991), however, it has been argued that equation (2) cannot provide accurate information on adjustment pressure.[13] Hamilton and Kniest

[12]The Grubel-Lloyd index follows straightforwardly from the fact that $IIT_j := 2\min[X_j, M_j] = X_j + M_j - *X_j - M_j*$, and normalization by TT. One interprets G_j by noting that since net trade, $NT_j := *X_j - M_j*$, we can use the identity TT / $IIT + NT$ and divide by TT to get an index that takes values in [0,1].

[13]See Azhar, Elliott, and Milner (1998) for a very useful geometric comparison of the empirical properties of the various marginal IIT indices, and Brülhart (1999) for a detailed review of measures and empirical results, with particular reference to adjustment issues.

emphasize, following Caves (1981, pg. 213), that what is relevant is not whether the share of IIT has increased, but whether the share of IIT in *new* 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 change in IIT and change in net trade (NT) to change in total trade. Thus, they propose a measure of *marginal* IIT (MIIT). Following a critical evaluation by Greenaway, Hine, Milner, and Elliott (1994), which identified some serious shortcomings in Hamilton and Kniest's indices, the bulk of empirical research on IIT and adjustment has focused on two, closely related, sets of measures of MIIT–one set due to Jayant Menon and Peter Dixon, the other due to Marius Brülhart.[14] Because Menon and Dixon are fundamentally concerned with measurement of MIIT and its contribution to change in total trade, where Brülhart is ultimately interested in issues of adjustment, we will start with Menon and Dixon's analysis and then take up Brülhart's.

In a useful series of papers, Menon and Dixon develop the theory of MIIT measurement in considerable detail.[15] Menon and Dixon's basic measure of the contribution of the change in IIT to the percent change in total trade is:

$$MD1_j := \frac{\Delta IIT_j}{TT_j} = I\hat{I}T_j\, G_j, \tag{3}$$

[14]We follow the literature in this attribution, but it should be noted that Shelburne (1993) first presented what is essentially Brülhart's *A* index, while Greenaway, Hine, Milner, and Elliott (1994) give the first use of what we will call Menon and Dixon's first index (*MD*1).

[15]Dixon and Menon (1997) lays out the basic theory, Menon and Dixon (1996a) develops the application to regional trade arrangements, and Menon and Dixon (1996b) develops a framework within which the contributions of exports and imports of a commodity are separately considered.

where the "^" denotes a proportional change and G_j is the Grubel-Lloyd index for commodity j. Menon and Dixon prefer $MD1_j$ 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 (1996a, pp. 7-8) show analytically, it is possible for $\Delta G_j > 0$ to be associated with a smaller marginal increase in intra-industry trade than in net trade. Perhaps more importantly, they develop extensive empirical evidence of precisely such an implication. 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. Specifically, they find that, of the 133 manufacturing industries that make up their data set, about 14% in 1981-1986, and 31% in 1986-1991, were characterized by increases in G_j but larger contributions of marginal net trade than marginal IIT.

Dixon and Menon (1997) point out that $MD1_j$ may itself lead to faulty inference if the goal of the analysis is to identify that share of trade growth characterized by low adjustment costs. As an alternative, they propose:

$$MD2_j := \frac{2\min\left[\Delta X_j, \Delta M_j\right]}{TT}. \qquad \textbf{(4)}$$

Since $2\min\left[\Delta X_j, \Delta M_j\right] \neq \Delta IIT$, it is clear that the indices in (3) and (4) are distinct.[16] $MD2_j$ is a measure of the part of trade change accounted for by matched changes in imports and exports, which is

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[16]It is straightforward to show that $\Delta \mathrm{IIT} = \Delta X_j + \Delta M_j + |X_j - M_j| - |X_j + \Delta X_j - M_j - \Delta M_j|$ and that $2\min[\Delta X_j, \Delta M_j] = \Delta X_j + \Delta M_j - |\Delta X_j - \Delta M_j|$.

a measure of the share of trade change that creates low adjustment costs. Specifically, Dixon and Menon (1997, at equations 17-20) show that $MD1_j$ will overestimate the "non-disruptive" part of change in trade (i.e. $MD1_j$ \$ $MD2_j$).[17] As they argue, since $MD2_j$ is a direct measure of matched changes in imports and exports, relative to total trade, it is precisely a measure of that part of the change in trade which has been widely seen as non-disruptive. With reference to the same Australian data used to evaluate the inferential implications of)G_j relative to $MD1_j$, Dixon and Menon find that the strict inequality applies in 21% and 34% of the 133 industries. Perhaps more damaging from this perspective, in many of the cases, the signs are even different, with $MD2_j$ taking negative signs.

Brülhart is particularly interested in generating a measure with properties like those of the Grubel-Lloyd index. Specifically, Brülhart proposes an index of MIIT:

$$A_j := 1 - \frac{\left|\Delta X_j - \Delta M_j\right|}{\left|\Delta X_j\right| + \left|\Delta M_j\right|}. \qquad \textbf{(5)}$$

Like G_j, A_j takes values in [0,1], with a 0 indicating that the entire change in trade is inter-industry and a 1 indicating that the entire change is intra-industry. Also, like G_j, A_j can be aggregated to give a measure of broad sectoral or economy-wide MIIT.[18] On the other hand, A_j seems to lack a clear

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[17]Specifically, $MD1_j > MD2_j$ if sgn[X_j - M_j] ... sgn[)X_j -)M_j].

[18]We note, however, that Oliveras and Terra (1997) show that Brülhart's *A* index does not fully share the aggregation properties of G_j. They argue that where G_j can be consistently aggregated across time, and has systematic (and thus known) aggregation bias across sectors, A_j does not have these properties. Rather, A_j is sensitive to both the temporal and sectoral levels of aggregation, but not in generally predictable directions.

derivation of the sort Dixon and Menon give for *MD*1 and $MD2_j$.[19]

In addition to considerable discussion of the algebraic properties of these indices, recent years has seen a considerable amount of application to data as well, as summarized in Table 1. There are two distinct types of research using MIIT measures. The first is primarily interested in pointing out that ΔG is a poor measure of "non-disruptive trade growth". While the research is always motivated by an interest in adjustment issues, the empirical work in these papers is generally undertaken to illustrate that ΔG and the author's preferred measure are not empirically related to one another. This permits a conclusion to the effect that ΔG is a poor measure of "non-disruptive trade growth". These papers can be identified by the "N.A." ("Not Applicable") in the column listing measures of structural adjustment and method.

The second group of papers, also summarized in Table 1, are considerably more ambitious. These papers seek to evaluate the claim that IIT is "non-disruptive". Most of these papers seek simple correlations between some measure of MIIT (usually ΔGL and either the *A* index or *MD*1) and some measure of adjustment. A few attempt to control for a small set of other factors in an OLS framework. The most sophisticated of these studies creates parallel measures of labor adjustment from firm level data in a panel method (Brülhart, Murphy and Strobl, 1998). Regardless of the measures or the method, the usual result is that there is little evidence of a systematic relationship between MIIT and adjustment.

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[19]The problem is that, since $|\Delta X_j| + |\Delta M_j| \geq \Delta X_j + \Delta M_j$, with strict inequality if ΔX_j or ΔM_j or both are negative, the A_j index does not follow from an obvious operation on the identity $\Delta TT_j = \Delta IIT + \Delta NT$ or $\Delta TT = 2\min[\Delta X_j, \Delta M_j] + |\Delta X_j - \Delta M_j|$.

We argue here, and in Lovely and Nelson (2000), that there is a fundamental problem in the economics underlying the asserted link between the measures of MIIT in use and any plausible measure of labor adjustment. The problem stems from the fact that changes in labor allocation reflect changes in production structure while changes in trade patterns reflect changes in production and demand. Brülhart, Murphy and Strobl (1998) note that, while the Grubel-Lloyd index has been systematically incorporated in theoretical frameworks that generate IIT, there has been no similar development with respect to MIIT.[20] Given the importance of MIIT measures for inference on the link between trade and adjustment, Brülhart *et al*. argue that this is a serious shortcoming in the theoretical literature. We agree and now turn to a first attempt to fill this gap.

II. A Specific-Factors Model with IIT

As noted above, we use a general-equilibrium model to explore analytically the relationship between measures of MIIT and measures of labor adjustment. An implicit assumption of the MIIT literature is that labor reallocation is positively correlated with production changes -- expanding industries employ more labor, contracting industries employ less.[21] To assess MIIT as a metric for labor adjustment, we choose to use a model that has this characteristic – a model with sector-specific

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[20]For derivation of the Grubel-Lloyd index in well-specified general equilibrium models, see Helpman (1981, at eqs. 42 and 43) and Helpman and Krugman (1985, Chapter 8) for the case of trade in differentiated final goods, or Ethier (1982, at eq. 24) for the case of trade in differentiated intermediate goods. Lovely and Nelson (2000) develop various MIIT measures in the context of Ethier's division-of-labor model.

[21]This relationship is made explicit in Brülhart's (1999) theoretical treatment, where he "formalizes the intuition behind the proposed measures of MIIT". Our goal here is to stay as close to the spirit of this intuition as possible, while emphasizing the relationships imposed by general equilibrium conditions.

capital.[22] The resulting measures of labor reallocation may be viewed, in this context, as measures of short-run pressure for labor adjustment.

Labor is treated as a mobile factor, moving freely among subsectors of the economy. Like the rest of the literature, we do not explicitly model adjustment costs, relying instead on the assertion that movement across industries is more "costly" to labor than movement between subsectors. We associate movements of labor between subsectors of a given industry with intra-industry, and thus low-cost, labor adjustment.

Part of the intuition underlying MIIT analysis is that expanding subsectors may absorb some of the labor freed from contracting subsectors in the same industry. To permit such adjustment patterns, we posit a production structure in which distinct groups of intermediate inputs are used in production of each of two final goods. We capture the possibility for substitution among inputs by positing a pair of intermediates in each industry. To close the model, we assume that the economy is small, taking trading prices as given. This simple structure allows us to highlight the neglected role of demand in discussions of the theoretical foundation for MIIT measures while maintaining the literature's focus on short-run labor adjustment.

Final goods are costlessly assembled from intermediate inputs. Denoting final good output as Y_1

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[22]This model treats intra-industry trade in the simplest way possible, by positing distinct intermediates that form an "industry." Models that introduce intra-industry trade through increasing returns and imperfect competition offer a more satisfying basis for such trade, but are unlikely to add additional clarity to our understanding of how MIIT measures and labor adjustment are related. For the present purposes, we chose not to introduce the additional complexity associated with these models. For an exploration of the link between MIIT and labor adjustment in a model of international increasing returns, see Lovely and Nelson (2000).

and Y_2, the production functions for final goods are:

$$Y_j = F^j\left(A_{1j}, A_{2j}\right), \quad j = \{1,2\}. \tag{6}$$

where F^j is assumed to be a linearly homogeneous and twice-differentiable function, and A_{ij} is domestic absorption of intermediate ij. Final goods producers take input and output prices as given, so equilibrium requires zero profits in final goods assembly.

The economy trades intermediate inputs and places an *ad valorem* tax on imports of intermediates in each industry. We assume that the inputs labeled 21 and 22 are imported while the inputs labeled 11 and 12 are exported. Thus, within each industry there is an import-competing subsector as well as an exporting subsector. Because the economy is small, a change in home tariffs results in a proportional change in the price of imported intermediates. To avoid tariff jumping through final-goods trade, we assume a tariff is levied on final-goods imports at the same rate as is levied on imported inputs. This tariff implies that there is no trade in final goods. Consequently, the economy produces all the final goods it consumes through assembly from domestically produced and imported intermediates.

Production of intermediate inputs requires labor and subsector specific capital. Production functions for the four intermediate inputs are:

$$X_{ij} = f^{ij}\left(L_{ij}, \bar{K}_{ij}\right), \tag{7}$$

where $i = \{1,2\}$ denotes the input type and $j = \{1,2\}$ denotes the output sector. Total labor supply is fixed, fully mobile, and fully employed among the four subsectors of the economy:

$$\overline{L} = L_{11} + L_{12} + L_{21} + L_{22}. \qquad \textbf{(8)}$$

Demand for final goods is assumed to be a function of the domestic relative price, p ($p = P_2 / P_1$), and domestic aggregate income, inclusive of tariff revenue, Γ. That is, domestic demand functions are:

$$Z_j = D^j\left(p, \Gamma\right). \qquad \textbf{(9)}$$

Because no final goods are traded, equilibrium requires domestic final goods markets to clear:

$$Y_j = Z_j, \quad j = \{1,2\}. \qquad \textbf{(10)}$$

In contrast with final goods, intermediate goods are traded. Net exports of intermediate good ij are $N_{ij} = X_{ij} - A_{ij}$. Balanced trade requires the value of net exports to sum to zero:

$$\sum_i \sum_j q_{ij}^* N_{ij} = 0, \qquad \textbf{(11)}$$

where q_{ij}^* is the world price of intermediate ij. The domestic price of exported intermediates is the same as the world price, i.e. $q_{1j} = q_{1j}^*$ (for j = 1,2). Imported intermediates may be taxed, so $q_{2j} = q_{2j}$ $(1 + \tau_{2j})$.

III. Effects of Liberalization

The liberalization we consider is an equiproportionate reduction in all tariffs on imported intermediates (thus, we can drop subscripts on the J_{2j}) . In this section we derive the effects of this tariff change on labor allocation and on net exports. In the next section, we use these results to form MIIT and labor adjustment measures.

Liberalization implies reductions in the price of the imported intermediates:

$$\hat{q}_{21} = \hat{q}_{22} = \hat{t} < 0. \tag{12}$$

Because the economy is small, q_{11} and q_{12} remain unchanged. Domestic final goods prices change to reflect the reduction in input costs. Using zero-profit conditions in final goods assembly, we have:

$$\begin{aligned} \hat{P}_1 &= q_{11}\hat{q}_{11} + q_{21}\hat{q}_{21}, \\ \hat{P}_2 &= q_{12}\hat{q}_{12} + q_{22}\hat{q}_{22}, \end{aligned} \tag{13}$$

here the 2_{ij} are distributive shares (i.e. $2_{ij} = [a_{ij}\ q_{ij}]/p_j$). Given the intermediate input price changes,

$$\hat{p} = \hat{P}_2 - \hat{P}_1 = (q_{22} - q_{21})\,\hat{t}. \tag{14}$$

Whether the relative price of good 2 rises or falls depends on the value shares of imported intermediates in production. Only if imported intermediates account for the same share of value in each assembly process does the relative final goods price remain unchanged.

Domestic demand may respond to this change in relative prices as well as to the income change caused by liberalization:

$$\hat{Z}_j = e_{jp}\,\hat{p} + e_{j\Gamma}\,\hat{\Gamma}, \quad j = \{1,2\}, \tag{15}$$

where g_{jp} is the price elasticity of demand for final good j and $g_{j'}$ is the income elasticity of demand for final good j. The income change $\hat{\Gamma}$ is itself a function of the tariff change, but for our purposes it is sufficient to note that such an income effect occurs and that it may influence domestic demand.

To derive measures of MIIT, we need to understand how liberalization affects net exports. Defining the value of net exports, V_{ij}, as net exports valued at domestic prices, total differentiation yields:

$$\hat{V}_{ij} = d_{ij}^{x} \hat{X}_{ij} - d_{ij}^{A} \hat{A}_{ij} + \hat{q}_{ij}, \tag{16}$$

where $*_{ij}^{x} = [q_{ij} X_{ij}]/V_{ij}$ and $*_{ij}^{A} = [q_{ij} A_{ij}]/V_{ij}$. That is, the change in V_{ij} depends on the change in domestic production, X_{ij}, the change in domestic absorption, A_{ij}, and the change in domestic prices, q_{ij}. The price changes are given in equation (12). Changes in domestic production depend entirely on labor reallocation caused by price decreases for import-competing intermediates.[23] With subsector-specific capital, this reallocation accords with partial-equilibrium reasoning; the quantity of labor used in both exporting subsectors rises, while labor used in the import-competing sectors is reduced. Consequently, production changes are:

$$\begin{aligned} \hat{X}_{11} &= j_{11}\hat{L}_{11} > 0 \\ \hat{X}_{21} &= j_{21}\hat{L}_{21} < 0 \\ \hat{X}_{12} &= j_{12}\hat{L}_{12} > 0 \\ \hat{X}_{22} &= j_{22}\hat{L}_{22} < 0, \end{aligned} \tag{17}$$

[23]The appendix provides the fully differentiated system of equations describing labor allocation.

where n_{ij} is the elasticity of output in intermediate sector *ij* with respect to labor input.[24]

Changes in domestic absorption are a bit more complicated as they involve both final demand response and changes in intermediate input usage by final goods assemblers. Note that $A_{ij} = a_{ij}Y_j$, where a_{ij} is the quantity of input *ij* used to produce one unit of final good *j*. Totally differentiating gives

$$\hat{A}_{ij} = \hat{a}_{ij} + \hat{Y}_j, \;\; i = \{1,2\},\; j = \{1,2\}. \tag{18}$$

Changes in input coefficients depend on input price changes and the elasticity of substitution. As in the Heckscher-Ohlin-Samuelson model (Jones, 1965, pg. 560):

$$\begin{aligned} \hat{a}_{1j} &= -s_j q_{2j}\left(\hat{q}_{1j} - \hat{q}_{2j}\right), \;\; j = \{1,2\} \\ \hat{a}_{2j} &= \;\; s_j q_{1j}\left(\hat{q}_{1j} - \hat{q}_{2j}\right), \;\; j = \{1,2\}. \end{aligned} \tag{19}$$

where F_j is the (positive) elasticity of substitution in final good *j* assembly. Final goods markets must clear, so $\hat{Y}_j = \hat{Z}_j$. Using (15) and (19) in (18), and recalling that $\hat{q}_{1j} = 0$ and $\hat{q}_{2j} = \hat{t}$, we have:

$$\begin{aligned} \hat{A}_{1j} &= \left[s_j q_{2j} + e_{jp}\left(q_{22} - q_{21}\right)\right]\hat{t} + e_{i\Gamma}\hat{\Gamma} \\ \hat{A}_{2j} &= \left[-s_j q_{1j} + e_{jp}\left(q_{22} - q_{21}\right)\right]\hat{t} + e_{i\Gamma}\hat{\Gamma}. \end{aligned} \tag{20}$$

These expressions show how changes in domestic absorption depend on production and demand elasticities, as well as on the pattern of tariff changes.

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[24]Solutions for the $\hat{L}_{ij}$ are given in the appendix.

IV. Measures of MIIT and Labor Adjustment

To illustrate the relationship between MIIT measures and labor adjustment, we use the measure referred to above as *MD*1, defined by equation (3). The heart of this measure, a disaggregation of the change in total trade into changes in IIT and NT, is the basis for several other measures. Therefore, the issues we identify as problematic for MD1 apply as well to other measures based on total trade disaggregation, regardless of how they are scaled.

When we consider changes in total trade, we must account for changes in quantity and price.[25] If we let $\hat{N}_{ij} = \hat{V}_{ij} - \hat{q}_{ij}$, then we can use (16) to get the change in real net exports:

$$\hat{N}_{ij} = d_{ij}^{X} \hat{X}_{ij} - d_{ij}^{A} \hat{A}_{ij}. \tag{21}$$

Noting that, by assumption, the $N_{1j} > 0$ and the $N_{2j} < 0$, the real value of total trade may be measured as

$$TT = \sum_i \sum_j \left| N_{ij} \right|. \tag{22}$$

In this context, MD1 may be expressed as

$$MD1 = \sum_i \sum_j \left| y_{ij} \hat{N}_{ij} \right| - \sum_j \left| y_{1j} \hat{N}_{1j} + y_{2j} \hat{N}_{2j} \right|, \tag{23}$$

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[25] As with most trade theory, all of our magnitudes are taken to be real. Following comments in Greenaway, *et al.* (1994) empirical applications on MIIT deflate the trade data so that the results are informative with respect to real changes.

where $y_{ij} = N_{ij} / \left(\sum_i \sum_j \left| N_{ij} \right| \right)$ – the share of total trade accounted for by net exports in subsector ij. We note that the $R_{1j} > 0$ and the $R_{2j} < 0$.

To illustrate the relationship of this measure to labor reallocation, we now assume that liberalization causes all trade volumes to expand, in a manner consistent with trade balance –every $\hat{N}_{ij} > 0$. We also assume that net exports in industry 1 fall (imports rise more than exports) while net exports in industry 2 rise.[26] These assumptions permit us to know the sign of each term in (23) and allow us to express our MIIT measure as:

$$MD1 = 2\left(y_{11}\hat{N}_{11} - y_{22}\hat{N}_{22}\right). \qquad \textbf{(24)}$$

Using the expressions in (21) for $\hat{N}_{ij}$, and the first and fourth expressions for output change in (17), we get

$$MD1 = 2\left[y_{11}\left(d_{11}^{X} j_{11}\hat{L}_{11} - d_{11}^{A}\hat{A}_{11}\right) - y_{11}\left(d_{22}^{X} j_{22}\hat{L}_{22} - d_{22}^{A}\hat{A}_{22}\right)\right]. \qquad \textbf{(25)}$$

Note that $y_{11}d_{11}^{X} = \frac{q_{11}X_{11}}{TT}$ and $y_{11}d_{11}^{A} = \frac{q_{11}A_{11}}{TT}$, and similarly for subsector 22. Using these expressions, we get

$$MD1 = \frac{2}{TT}\left[\left(q_{11}X_{11}j_{11}\hat{L}_{11} - q_{22}X_{22}j_{22}\hat{L}_{22}\right) - \left(q_{11}A_{11}\hat{A}_{11} - q_{22}A_{22}\hat{A}_{22}\right)\right]. \qquad \textbf{(26)}$$

[26]These assumptions allow us to illustrate the relationship between MIIT and a measure of labor reallocation for a particular pattern of trade changes. The lessons we draw from this case do not depend on the patterns used to illustrate them.

The first term of expression (26) reflects changes in domestic production while the second term reflects changes in domestic absorption of intermediates.

We begin our examination of (26) by considering only the first term of *MD*1. We show that this term represents labor reallocation, perhaps explaining why MIIT is such a tempting measure of adjustment. Let us define a measure of labor reallocation that is analogous to MD1 in that it disaggregates total labor reallocation into within and between industry shifts and scales these shares by total labor.[27] Letting $l_{ij} = L_{ij} / \overline{L}$, the share of total labor in sector ij, this measure of intra-industry labor shifts is:

$$\hat{L}^{II} = \sum_i \sum_j \left| l_{ij} \hat{L}_{ij} \right| - \sum_j \left| l_{1j} \hat{L}_{1j} + l_{2j} \hat{L}_{2j} \right|, \tag{27}$$

which is the weighted sum of all proportionate labor movements less inter-industry movements. In the context of our model, movement between subsectors of the same final goods industry is intra-industry labor reallocation.

To illustrate, we assume that there is net reallocation of labor from final sector 1 to final sector 2. Using this assumption,

$$\hat{L}^{II} = 2\left(l_{11} \hat{L}_{11} - l_{22} \hat{L}_{22} \right). \tag{28}$$

We may now compare $\hat{L}^{II}$ with the first term in our expression for MD1 (26). The weights on labor

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[27]Brülhart (1999) explicitly proposes a measure of intra-industry labor movement (IILM) that is analogous to his *A* index. In our illustrative case, this measure is the same disaggregation we use here, except that Brülhart scales by total labor movement rather than by total labor.

movements in (26) are $q_{11}X_{11}n_{11}$ and $q_{22}X_{22}n_{22}$. The elasticity n_{ij} is the ratio of labor's marginal product to its average product in subsector ij. Marginal product in each sector equals the real wage in that sector. Based on these relations, we have:

$$j_{ij} = \frac{wL_{ij}}{q_{ij}X_{ij}}, \tag{29}$$

the output elasticity equals labor's share of total product. The first term of *MD*1 can now be expressed as:

$$\frac{2}{TT}\left(q_{11}X_{11}j_{11}\hat{L}_{11} - q_{22}X_{22}j_{22}\hat{L}_{22}\right) = \frac{2w}{TT}\left(L_{11}\hat{L}_{11} - L_{22}\hat{L}_{22}\right). \tag{30}$$

In contrast, the intra-industry labor reallocation measure is:

$$\hat{L}^{II} = \frac{2}{L}\left(L_{11}\hat{L}_{11} - L_{22}\hat{L}_{22}\right). \tag{31}$$

Comparing (30) and (31) it can easily be seen that, if absorption changes are absent:

$$\frac{\text{MD1}}{\hat{L}^{II}} = \frac{w\bar{L}}{TT}, \tag{32}$$

so these measures differ by a scaling factor.

While this type of analysis exemplifies the intuition underlying the use of MIIT as a metric for labor reallocation (see Brülhart, 1999, for a formal statement of precisely this logic), the unfortunate fact remains that trade changes involve more than production patterns. The second term of (26), reflecting changes in domestic absorption, simply cannot be ignored. Because trade changes result from the endogenous response of production *and* domestic demand, it makes no sense to identify trade changes with production changes while, in *ceteris paribus* fashion, assuming demand is unaltered. The same liberalization that prompts labor reallocation induces changes in input usage and consumption. They are part and parcel of the same system.

Moreover, changes in domestic absorption do not depend directly on how labor shifts within the production sector and, thus, make *MD*1 and similar measures unreliable guides to economy-wide labor reallocation. As shown in equations (20), absorption changes depend on the elasticity of substitution in production as well as on price and income elasticities of domestic demands. These absorption terms "disappear" only under very extreme assumptions. The assumptions are:

(1) the elasticity of substitution in production is zero;

(2) there is no change in final goods relative prices (which in the present model requires that $2_{22} = 2_{21}$); and

(3) demands are quasi-linear or income effects of the liberalization are compensated.

In general, we would not expect these assumptions to hold. Consequently, the share of new trade that is new intra-industry trade generally will not indicate the share of labor reallocation that is intra-industry, even when the production sector works in a manner consistent with partial-equilibrium reasoning.

The observation that demand changes make MIIT an unreliable measure of labor reallocation may explain why attempts to find correlations between MIIT measures and indicators of production or labor adjustment have been largely unsuccessful. *A priori*, we would not expect any particular relationship to exist. For example, even if most of labor reallocation is intra-industry, most of the change in trade could be accounted for by change in net trade.[28] Such a situation could occur if final-good demand shifts were large.

Given the attraction of using trade data to gauge the effect of trade alone on labor markets, it may be possible to adjust trade-based measures to better reflect production shifts by themselves. Inspection of (26) suggests that such an empirical strategy requires information on changes in domestic final-goods demand and changes in input usage. Because MIIT analysis it typically performed at the 3-digit level of aggregation, it may be possible to find suitable elasticity estimates created for other purposes, such as applied general equilibrium analysis. Such a procedure also would require the analyst to specify the price changes induced by the liberalization under study. Because agreements like the EU, ANZCERTA, and NAFTA are such complex undertakings, such specification is difficult. The need to avoid an exact characterization of liberalization is, after all, one of the attraction of using MIIT measures alone. Amending MIIT measures to reflect absorption is admittedly burdensome, both in the data required and in the leaps of faith needed to represent demand changes. It is difficult, however, to see how such a burden is less troubling than assuming that trade liberalization has no effect on domestic absorption.

V. Conclusions

Paul Samuelson famously argued that one of the important roles of theory is to serve an auditing function with respect to empirical intuition. One of the most prominent applications of this insight has

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[28]Lovely and Nelson (2000) presents a model in which precisely the opposite occurs as a result of liberalization – the change in total trade is all intra-industry while labor reallocation is all inter-industry.

been the role of general equilibrium theory in auditing essentially partial equilibrium intuition. The idea that intra-industry trade induces relatively lower adjustment costs than inter-industry trade is *prima facie* extremely plausible. Furthermore, for the case of relatively small changes in a single sector, the analysis strikes us as unexceptionable as a rule of thumb. However, as the literature surveyed in section I indicates, this is not the purpose for which these measures are intended, nor for which they have been used. Rather, they have been applied to cases of large-scale, multi-sector liberalizations like the EU, ANZCERTA, and NAFTA; and their purpose is to provide guidance with respect to the likely adjustment consequences of future liberalizations. It has been the essential claim of this paper that a careful examination of the theoretical foundation for this work leads to doubt about the usefulness of MIIT as an indicator of labor market adjustment.

Because there are few general propositions of general-equilibrium theory, it is often the case that assertions of the form, “such-and-such claim cannot be sustained in general equilibrium,” are nihilistic with respect to attempts to quantify seemingly plausible economic relationships. We hope it is clear that this is not the purpose of this paper. We have shown that current measures lack solid economic foundations, and suspect that this may help explain the generally weak results in empirical work on the link between IIT and adjustment. We emphasize the essential difference between trade structure and production structure and we offer expression (26) as the basis for amendment of existing measures.

Appendix

This appendix provides solutions for the production changes induced by import liberalization.

Equations (12) and profit maximization imply that:

$$\hat{w} = h_{11}\hat{L}_{11} + \hat{q}_{11} \quad \textbf{(A1)}$$

$$h_{11}\hat{L}_{11} + q_{11} = h_{21}\hat{L}_{21} + q_{21} \quad \textbf{(A2)}$$

$$h_{21}\hat{L}_{21} + \hat{q}_{21} = h_{12}\hat{L}_{12} + \hat{q}_{12} \quad \textbf{(A3)}$$

$$h_{12}\hat{L}_{12} + \hat{q}_{12} = h_{22}\hat{L}_{22} + \hat{q}_{22} \quad \textbf{(A4)}$$

where 0_{ij} is the elasticity of the marginal product of labor with respect to labor input in the subsector *ij* ($0_{ij} < 0$). The labor constraint (13) can be totally differentiated to give:

$$l_{11}\hat{L}_{11} + l_{12}\hat{L}_{12} + l_{21}\hat{L}_{21} + l_{22}\hat{L}_{22} = 0. \quad \textbf{(A5)}$$

where the factor-shares are $l_{ij} = L_{ij} / \bar{L}$.

As discussed in the text, we assume that liberalization takes the form of an equiproportionate reduction in the tariffs on intermediate imports. Because the economy is assumed to be small and open, liberalization leads to the intermediate price changes given by (12).

Using these exogenous price changes and equations (A1)-(A5), it is straightforward to derive the following solutions for proportionate changes in labor allocations and the wage:

$$\hat{L}_{11} = \frac{1}{\Lambda}\left\{h_{12}h_{22}\,l_{12} + h_{21}h_{12}\,l_{22}\right\}\hat{t}$$

$$\hat{L}_{21} = -\frac{1}{\Lambda}\left\{h_{11}h_{22}\,l_{12} + h_{12}h_{22}\,l_{11}\right\}\hat{t}$$

$$\hat{L}_{12} = \frac{1}{\Lambda}\left\{h_{11}h_{22}\,l_{21} + h_{11}h_{21}\,l_{22}\right\}\hat{t}$$

$$\hat{L}_{22} = -\frac{1}{\Lambda}\left\{h_{12}h_{21}\,l_{12} + h_{21}h_{12}\,l_{11}\right\}\hat{t}$$

$$\hat{w} = \frac{1}{\Lambda}\left\{h_{11}h_{12}h_{22}\,l_{21} + h_{11}h_{21}h_{12}\,l_{22}\right\}\hat{t},$$

where $\Lambda := h_{11}h_{21}\left(h_{12}\,l_{22} + h_{22}\,l_{12}\right) + h_{12}h_{22}\left(h_{21}\,l_{11} + h_{11}\,l_{21}\right) < 0$. Because $0_{ij} < 0$ and $\hat{t} < 0$, L_{11} and L_{12} both increase as a result of liberalization while L_{21} and L_{22} both decrease. In accordance with partial-equilibrium intuition, liberalization reduces production in the import-competing sectors while raising output in the exporting sectors. We note also that the liberalization reduces the nominal wage.

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Table 1: Summary of Empirical Studies of MIIT[29]

Author(s)	SampleYr	SampleCountry	MIIT Measure	StructAdj Measure	Method	Result
Hamilton/Kniest (1991)	1981/82, 1986/87	ANZCERTA	) GL, HK	Nhat, Lhat, Yhat, (Y/N)hat	Comp. Avgs. by Lo and Hi IIT	Weak supporting evidence of a relationship between MIIT and adjustment
Shelburne (1993)	1980-1987	NAFTA	) GL, A	N.A.	N.A.	Trade pattern conclusons differ depending on measure of MIIT
Greenaway, Hine, Milner, and Elliott (1994)	1979-1985	UK (Chemicals)	) GL, HK, GHME, MD1	N.A.	N.A.	Trade pattern conclusions differ depending on measure of MIIT
Brülhart (1994)	1985-1990	Ireland (Chemicals)	) GL, HK, GHME, MD1, A, B, C	N.A.	N.A.	Trade pattern conclusions differ depending on measure of MIIT
Brülhart/McAleese (1995)	1985-1990	Ireland	) GL, A, B	Lhat, Yhat	Comp. Avgs. by MIIT Category, and Correlation	) GL misleading, MIIT correlated with measures of industrial performance
Menon/Dixon (1996a)	1981/86, 1986/91	ANZCERTA	) GL, MD1, MD1iu, MD1eu	N.A.	N.A.	) GL misleading, useful to consider independent contributions of inter-union and extra-union MIIT
Menon/Dixon (1996b)	1981/86, 1986/91	Australia	) GL, MD1, MD1x, MD1m	N.A.	N.A.	) GL misleading, useful to consider independent contributions of exports and imports to MIIT
Menon (1996)	1981/86, 1986/91	ASEAN	) GL, MD1	N.A.	N.A.	) GL misleading
Menon (1997)	1981/86, 1986/91	Japan-US	) GL, MD1, MD1x, MD1m	N.A.	N.A.	) GL misleading, useful to consider independent contributions of exports and imports to MIIT
Dixon/Menon (1997)	1981/86, 1986/91	Australia	) GL, MD1, MD2	N.A.	N.A.	Trade pattern conclusions differ depending on measure of MIIT
Menon/Dixon	1985-1990	Ireland	UMCIT	N.A.	N.A.	Trade pattern conclusions differ

[29] MIIT measures are as defined in the text, except that *MD*1*iu* and *MD*1*eu* refer to individual indexes for intra-union trade and extra-union trade, and *MD*1*x* and *MD*1*m* refer to individual indexes calculated on exports and imports. The structural adjustment measures are changes in: number of establishments in the sector (*N* hat), sectoral employment (*L* hat), sectoral output (*Y* hat); and output per establishment ([*Y*/*N*] hat).

(1997)		(Chemicals)				depending on measure of MIIT
Oliveras/Terra (1997)	1988/92, 1992/94	Uruguay	A	N.A.	N.A.	A index sensitive to temporal and sectoral aggregation
Brülhart/Elliott (1998)	1980-1990	Ireland	A	) L	OLS	Weak supporting evidence of a relationship between MIIT and adjustment
Brülhart (1998)	1961-1990	EU	) GL	Locational Concentration	Correlation	No evidence of a relationship between IIT and specialization
Thom/McDowell (1999)	1989-1995	EU-CSFR	A	N.A.	N.A.	A index works badly with vertical IIT
Tharakan/Calfat (1999)	1980-1990	Belgium	GHME, A, B	) L	OLS	No evidence of a relationship between MIIT and sectoral change, EU generated inter-sectoral adjustment
Harfi/Montet (1999)	1979-1990	France	) GL, A	) L	Correlation	Modest relationship between MIIT and sectoral adjustment
Smeets (1999)	1980-1987	Germany	) GL, A, B, GHME	) N,) L,) Y,) VA	Correlation	No evidence of a relationship between MIIT and sectoral change, EU generated inter-sectoral adjustment
Sarris, Papadimitriu, and Mavrogiannis. (1999)	1978-1978/7	Greece	) GL, A, B, GHME	) L	OLS	Evidence of a significant relationship between MIIT and sectoral employment change
Brülhart, McAleese, and O'Donnell (1999)	1961/67, 1978/87	Ireland	) GL, A, B, GHME, C	) L,) Y, specialization	Comp. Avgs. by MIIT Category, and Correlation	Evidence of a significant relationship between MIIT and sectoral employment/output change
Rossini/Burrattoni (1999)	1978-1987	Italy	) GL, A, B	) L,) Y	Correlation	No evidence of a relationship between MIIT and sectoral change, EU generated inter-sectoral adjustment
Kol/Kuijpers (1999)	1972-1990	Netherlands	) GL, A, B	) L, specialization	Comp. Avgs. by MIIT Category, and Correlation	Evidence of a significant relationship between MIIT and sectoral employment.
Porto/Costa (1999)	1986-1989	Portugal	) GL, A, B	) L,) Y, specialization	Comp. Avgs. by MIIT Category, and Correlation	Evidence of a significant relationship between MIIT and sectoral employment and output change.

Brülhart/Murphy/ Strobl (1998)	1980-1990	Ireland	) GL, A, C	Intra-Sectoral L reallocation	Panel	Weak supporting evidence of a relationship between MIIT and adjustment