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TRADE LIBERALIZATION AND INTRA-INDUSTRY TRADE: THE CASE OF THE UNITED STATES AND MEXICO

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This article investigates how U.S.-Mexican intra-industry trade (IIT) has evolved since the creation of the NAFTA beginning in 1994. These empirical findings are of value not only for the study of the U.S.-Mexican trading relationship, but they also contain several important conclusions applicable more generally to the study of the theoretical basis for intra-industry trade and its empirical estimation. The basic conclusions of this study are: 1) Unlike the European experience after the creation of the European Common Market, and most other regional trade arrangements, trade between the U.S. and Mexico has remained mostly inter-industry trade, and the growth of trade has been largely inter-industry as measured by both IIT indexes and marginal intra-industry trade (MIIT) indexes. 2) Also, unlike most studies of IIT using European countries, the IIT and the MIIT indexes are highly correlated across sectors. 3) The fall in the IIT indexes since NAFTA is due significantly to Mexico's trade surplus with the U.S. 4) The IIT and MIIT indexes at a sectoral level are significantly related to the duty treatment of U.S. imports; the higher the percentage of imports entering duty-free, the higher the IIT and MIIT indexes, and the higher the actual ad valorem duty rate, the lower the IIT and MIIT indexes. 5) There is significant "smoking gun" evidence that the U.S.- Mexico IIT that does exist is not typical IIT but is significantly composed of the U.S. re-import of U.S. components within the same sector; the percentage of

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[1] The views are those of the author and do not represent the official position of the U.S. Labor Department.

U.S. components in the value of U.S. imports by product, is significantly related to the IIT and MIIT indexes even at the most extensive level of product disaggregation. In addition, a new graphical measure for IIT is proposed which is better able to describe the level of IIT.

I. INTRODUCTION

One of the most important conclusions coming out of the early empirical studies of European integration after the formation of the European Community was that trade liberalization increased primarily intra-industry trade (IIT) (Verdoorn, 1960; and Balassa, 1966). Succeeding studies of regional integration arrangements amongst the developing countries, such as the Central American Common Market and the Latin American Free Trade Area (Balassa,1979; and Balassa and Bauwens,1987), also concluded that preferential trade agreements significantly increased IIT.

Prior to 1994, most of those who expressed an opinion about NAFTA's likely effects on IIT, including Gonzalez and Velez (1993), Shelburne (1993a), and Globerman (1992), speculated that the free trade between the U.S. and Mexico would primarily increase IIT.[2] Many NAFTA supporters who argued that NAFTA would benefit U.S. workers, although not addressing the issue of IIT explicitly, probably implicitly viewed that trade growth would follow the European pattern and be primarily intra-industry trade. In the only post-NAFTA study to examine U.S.-Mexico IIT, Ruffin (1999) concluded that NAFTA had largely resulted in increased IIT. The implications of these analyses were that adjustment costs and Stolper-Samuelson effects from trade liberalizations were minimal and therefore unskilled workers in the developed nations had little to fear from trade liberalization even with developing nations. In this study, however, it is found that the increase in U.S. - Mexican trade since the creation of NAFTA has been largely inter-industry trade. The results presented here for U.S.-Mexico are therefore somewhat unique and opposite the conventional view of how liberalization affects trade.

[2] However, Shelburne (1993b) pointed out that many of the NAFTA studies based upon computer general equilibrium models suggested that NAFTA would create primarily inter-industry trade.

II. CALCULATING THE INTRA-INDUSTRY TRADE INDEX

The standard Grubel-Lloyd formula for calculating the IIT index (for trade between countries j and k) is used where:

$$IIT_{jk} = 1 - \frac{\sum_i |X_{ijk} - M_{ijk}|}{\sum_i (X_{ijk} + M_{ijk})} \qquad (1)$$

and X_{ijk} is country j's exports to country k in sector i, and M_{ijk} is that country's imports from country k in sector i. In order to examine the effect that the classification system has on the IIT index, indexes are calculated using four different classification systems for a number of different years.

It has never been theoretically clear which type of classification system (i.e., how items should be aggregated into sectors i) is most appropriate for the calculation of IIT indexes. This ambiguity stems from the fact that the theoretical basis of IIT is usually based upon trade in differentiated but similar products, from a demand perspective, which are also assumed to be produced using similar factor endowments and technology. This is the basic assumption of most theoretical models which attempt to model IIT such as the general equilibrium monopolistic competition model of Helpman and Krugman (1985). In the real world, however, many similar goods from a demand perspective are produced using quite different technologies and factor intensities; and many unrelated goods, from a demand perspective, are produced using similar technologies and endowments. Exactly how these items should be treated in calculating IIT indexes has never been fully resolved either theoretically or empirically. How these cases are handled in the actual calculation of an IIT index depends to some degree on whether a commodity-based system such as the Standard International Trade Classification (SITC) system or the Harmonized Tariff System (HTS) is used, or whether a production-based system such as the Standard Industrial Classification (SIC) system or the North American Industrial Classification System (NAICS) is used. The question as to which classification system is best would appear to be dependent on the ultimate question one wishes to address.

If the nature of the study is more oriented to the issue of product differentiation with a focus on consumer preferences for different varieties with different product characteristics, a product classification scheme that focuses on the product characteristics may be most desirable. If the focus of the study is whether IIT is inconsistent with the Heckscher-Ohlin model, or on the possibility of trade adjustment problems or Stolper-Samuelson effects, a production-based classification system may be most appropriate. For example, two products, such as Women's Leg Warmers (SITC 8519 or SIC 2252) and Women's Socks (SITC 8462 or SIC 2252), are two distinct commodities from a consumption perspective since neither is really a substitute for the other; however, from a production perspective these two items may be made using similar equipment and by workers with similar skills, and therefore the import of one and the export of other would be inconsistent with the H-O model. Even in the more commodity-based systems, factor inputs are still a significant criteria in the classification scheme. For example, silver teapots (SITC 897) and ceramic teapots (SITC 666) are not even in the same group at the one-digit SITC level, nor are gas stoves (SITC 697) and electric stoves (SITC 775). Likewise, washing machines and clothes dryers, two products few would consider to be differentiated substitutes, are in the same 4-digit industry (SITC 7751). Thus current classification systems do a poor job of aggregating items in a manner consistent with the theoretical models of IIT. Given the ambiguity of which type of classification system to use, in the next section, IIT indexes for U.S.-Mexico trade are calculated for four different classification schemes to determine the degree to which the classification system affects the value of the index.

III. U.S. - MEXICO IIT INDEXES

IIT indexes for U.S.-Mexico trade covering the 1983-99 period using four different classification schemes are presented in Table 1. Data availability varied depending on the classification system. Firstly, note that before 1993, the year prior to the beginning of the NAFTA, the IIT index (using the SITC) had been increasing consistently each year; thus if there was a pre-NAFTA trend it was towards more IIT. However, since 1993, the IIT index has been on a decreasing trend. It would appear that the NAFTA has reversed the trend towards greater IIT trade.[3] Thus these results are at variance with the conventional view of IIT that has asserted that trade liberalization generally increases IIT. These results are also at variance with

[3] Note that the 1983-87 IIT indexes are from Gonzalez and Velez (1993) and are considerably lower than the indexes calculated by the author for 1989-99; since they are so significantly different there may be a tendency to view them with suspicion. However, their 1989 indexes exactly matched those of this author for 1989; therefore their indexes would appear to be correct and were calculated using the same methodology as in this article.

the previously published results of Ruffin (1999) who concluded that U.S.— Mexico trade since NAFTA was largely IIT; Ruffin appears to have based his results on a limited sample of highly aggregated manufactured goods.

Note that before NAFTA, the pattern of the U.S.-Mexico IIT index was more consistent with the conventional view. There was a significant unilateral " re-liberalization" on Mexico's part during the mid-1980s after the large duty increases imposed after the 1982 crisis, and a further liberalization in 1986 when Mexico joined the GATT; during this period the IIT index increased significantly. Average Mexican tariffs were generally fixed between 1988 and 1993, and thus the 1989-93 period can not be characterized as a period of increased liberalizations (Hinojosa-Ojeda, et al., 1997, Figure 3.5); therefore it is not surprising that the IIT index was relatively stable during this period.

Table 1

U.S. - Mexico IIT Indexes by Classification System 1983-99

Class.	3-Digit	4-Digit	5-Digit	6-Digit
HTS	99-(177)=.576	99-(1,239)=.417	99-3,514=.350	99-4,978=.326
	98-(177)=.599	98-(1,239)=.436	98-3,498=.361	98-4,953=.335
	97-(177)=.614	97-(1,239)=.441	97-3,502=.361	97-4,958=.335
	93-(177)=.619	93-(1,237)=.456	93-3,447=.368	93-4,798=.326
SIC	99-(170)=.518	1999-(446)=.466		
	98-(170)=.550	1998-(445)=.486	------------	---------
	97-(169)=.558	1997-(445)=.498		
SITC	99-(262)=.488	99-(1,020)=.420	99-2,999=.353	
	98-(262)=.508	98-(1,023)=.436	98-2,998=.365	
	97-(262)=.512	97-(1,020)=.439	97-2,995=.367	--------------
	95-(262)=.487	95-(1,020)=.398	95-3,023=.320	
	93-(262)=.525	93-(1,023)=.440	93-3,010=.359	
	91-(261)=.507	91-(1,016)=.423	91-3,011=.331	
	89-(262)=.523	89-(1,023)=.426	89-3,018=.339	
	87-(*)=.401	87 (*)=.276		
	85-(*)=.317	85 (*)=.214		
	83-(*)=.261	83 (*)=.181		
NAICS		99-(107)=.544	99-(215)=.510	99-(455)=.457

Note: The number in parentheses ( ) is the number of sectors; except (*) SITC IIT indexes for 1983-87 are from Gonzalez and Velez (1993).

Of course, as pointed out by Greenaway (1989), there is no overwhelming theoretical reason as to why integration should increase IIT relative to inter-industry trade, but the belief that it does has prompted a large number of theoretical arguments as to why it might. What this evidence presented here suggests is that liberalization increases trade of the type one might expect from standard trade theory. If countries have similar endowments, as the European countries did, trade growth is likely to be intra-industry; if countries have dissimilar endowments (and/or technology), their trade growth is likely to be inter-industry. The belief that liberalization increases IIT was based on limited evidence since most previous free trade agreements (or customs unions) were amongst countries which were similar in terms of endowments.

Table 1 also reveals how similar the IIT indexes are regardless of which classification system is used. Obviously, as the number of divisions within a classification system increases, the level of IIT falls; however, these data show that after controlling for the number of divisions, which classification system is used is of only minor significance in affecting the IIT index. There are several "internationally standardized" classification systems including the commodity-based Harmonized System (HTS), and Standard Industrial Trade Classification system (SITC), and the production-based International Standard Industrial Classification system (ISIC). Even when these are used, researchers often use different levels of aggregation and it is often difficult to make comparisons between studies. However, it is much more difficult to make comparisons amongst the national production-based classification systems such as the Canadian 1980 SIC, the European NACE, the U.S. 1987 SIC, and the new North American NAICS. Therefore it would be desirable to have an IIT measure that is independent of which classification system is used so that the indexes could be more readily compared across countries which use different classification systems, as well as across time periods where specific classification systems have been revised or even eliminated.

There is one important qualification to the preceding analysis, and that is that the IIT index is not adjusted for trade's overall level of imbalance. During the 1989-93 period, U.S.-Mexico bilateral trade was essentially balanced; however since the peso crisis in 1994-95, the U.S. has had a deficit of 10-16 percent of the total bilateral trade flow. There is a large body of literature on the need and procedures for adjusting the IIT index for a trade imbalance. Unfortunately there is no consensus that an adjustment is needed; for example, see Vona (1991). Given that a primary reason for calculating an IIT index is to reveal if there may be potential adjustment problems, imbalanced trade is likely to have a similar effect as purely inter-sectoral trade, and there would appear to be little logic in adjusting the IIT measure to what it would be under the hypothetical condition that trade was balanced. It is, therefore, this author's assessment that any adjustment creates more distortions than it corrects, and for that reason the analysis should focus on the unadjusted index. However, in order to show how the imbalance contributes to the changing IIT index, adjusted IIT indexes are presented using the procedure of Aquino (1978) which is the most cited adjusted index used in the trade literature. The Aquino adjusted IIT index (IITADJ) is defined as:

$$IITADJ_{jk} = 1 - \frac{\sum_i |aX_{ijk} - bM_{ijk}|}{\sum_i (aX_{ijk} + bM_{ijk})} \qquad (2)$$

where

$$a = \frac{\sum_i (X_{ijk} + M_{ijk})}{2\sum_i X_{ijk}} \quad \textit{and} \quad b = \frac{\sum_i (X_{ijk} + M_{ijk})}{2\sum_i M_{ijk}}$$

The IIT and IITADJ indexes for 1989-99 using the SITC 3 and SITC 4 are presented in Table 2. When the IIT index is adjusted for the trade imbalance, the trend toward lower IIT is less noticeable at the 3-digit level and the IITADJ actually increases through time at the 4-digit level.

Trade in manufactured goods accounts for 84% (1999) of U.S.-Mexico trade; therefore the IIT index for only manufactures is relatively close to the calculated indexes for all trade. However, as is usually the case, when only manufactures are included, the IIT index is slightly higher. Table 3 provides U.S.-Mexico IIT indexes using only manufactured trade for several years and for several degrees of aggregation using the SITC classification system. As with total trade, the IIT index appears to be on a slightly decreasing trend since the creation of the NAFTA. The indexes are all lower over the last several years (1997-99) compared to their level in 1993. Unlike the result with total trade, the trend towards lower IIT for manufactures began slightly before the beginning of NAFTA for the 3 and 4-digit indexes since these 1993 IIT indexes are below the 1989 IIT indexes. However, the manufactures IIT index at the 5-digit level peaked in 1993, the year before NAFTA.

Table 2
U.S. Mexico IIT Indexes and Adjusted IIT Indexes

Year	SITC 3		SITC 4	
	IIT	IITADJ	IIT	IITADJ
1999	.488	.503	.420	.436
1998	.508	.514	.436	.447
1997	.512	.518	.439	.452
1995	.487	.500	.398	.413
1993	.525	.527 .	440	.441
1991	.507	.510	.423	.425
1989	.523	.521	.426	.425

Table 3
U.S. Mexico IIT Indexes for Manufactures

Classification	3-Digit	4-Digit	5-Digit
SITC Manufactures	99-(166)=.548	99-(712)=.476	99-(2314)=.400
(SITC 5-8)	98-(166)=.570	98-(715)=.495	98-(2319)=.415
	97-(166)=.587	97-(713)=.509	97-(2315)=.426
	95-(166)=.575	95-(714)=.476	95-(2348)=.383
	93-(166)=.616	93-(715)=.530	93-(2343)=.434
	91-(166)=.618	91-(715)=.523	91-(2351)=.410
	89-(166)=.652	89-(717)=.538	89-(2348)=.426
	87-(*)=.498	87-(*)=.344	
	85-(*)=.469	85-(*)=.318	
	83- (*)=.468	83-(*)=.326	

Note: (*) SITC IIT indexes for 1983-87 are from Gonzalez and Velez (1993).

IV. A PROPOSAL FOR A NEW GRAPHICAL IIT MEASURE

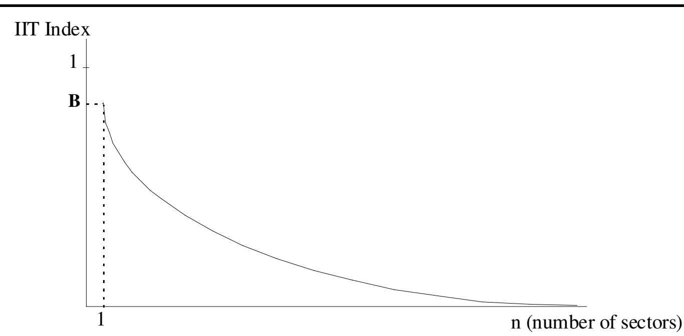
In the previous section, two shortcoming of conventional IIT indexes were presented. These were: 1) the need for a "standardized" IIT measure that is comparable across classification systems and levels of aggregation, and 2) a better method of dealing with overall trade imbalances. In this section it is proposed that instead of describing IIT by one number, that IIT should be defined by a simple function that has a simple graphical counterpart. For the U.S.-Mexico data, there is an equation that fits the relationship between the IIT indexes and the number of observations quite closely. Using the calculated IIT indexes as the dependent variable and the number of divisions (n) (regardless of classification system) as the dependent variable, the following equation is estimated:

$$IIT = \beta - \alpha \ln(n) \quad (3)$$

$$= .85 - .061 \ln(n)$$

Using 1999 data, this equation has an R-square of 98.5 and a t-statistic for the α coefficient of 26.69; thus the number of divisions can estimate the IIT index quite accurately. Note that the intercept coefficient β gives the estimated IIT index when n=1, i.e., only one division which is total trade aggregation. In the case where trade is balanced (imports equaling exports), the IIT index at this level of aggregation is equal to one; however, when trade is not balanced, the IIT index will be less than one. The β coefficient therefore provides a measure as to the degree that the overall trade flow is unbalanced. The β coefficient could be estimated along with the rest of the equation or could be restricted to the level calculated from the unbalanced aggregate trade flows. In the case given here, it makes no difference since the freely estimated β coefficient turned out to equal the proposed restricted intercept term; i.e., the aggregate balance suggests a value of .85. The estimated function provides a more "standardized" measure of IIT than a simple IIT index since it controls for both the number of divisions as well as the level of the unbalanced trade. The smaller the α coefficient, the more prevalent IIT. The α coefficient is undesirable, however, in that it certainly has less intuitive appeal than the simple IIT index which can be readily interpreted as the simple percentage of trade that is IIT trade. This IIT function also has the undesirable property of theoretically becoming negative as the number of sectors approaches infinity; ideally one would prefer a function that approached zero as n approached infinity.[4] Nevertheless, given the problems with interpreting the IIT or the adjusted IIT index, this new function may provide a more useful measure of IIT.

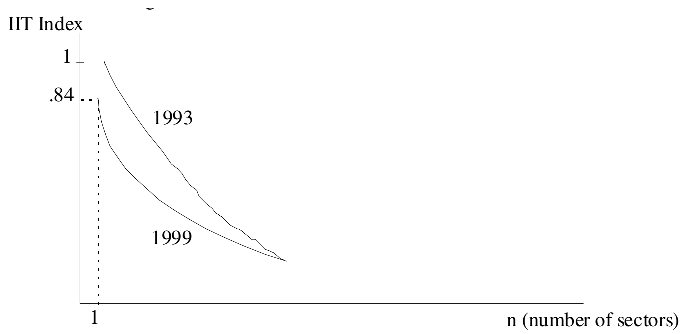
Figure 1
The IIT Index and the Number of Sectors



[4] The functional form of IIT= β / (1+Ln(n)) has the desirable property of being equal to β when n=1 and goes to zero as n approaches infinity. However, this functional form does not estimate the data as closely (an R^2 of only .85) as the simple log function estimated above.

This new function of the IIT can now be used to provide a better picture of how U.S.-Mexico intra-industry trade has evolved. The IIT function is plotted in Figure 2 for years 1993 and 1999.

Figure 2
U.S. - IIT Indexes



V. IIT'S RELATIONSHIP WITH DUTY TREATMENT AND U.S. COMPONENTS

A major focus of IIT research has been on how trade liberalization and trade in components are likely to affect the IIT index. Therefore, several correlations are performed between the IIT index for a sector and either the degree to which that sector is liberalized or the degree to which U.S. components are being traded in that sector. The duty treatment of U.S. imports from Mexico is available in U.S. import statistics. For each sector, an ad valorem duty rate is calculated based upon reported duties paid; this variable is defined as the dutyrate (DR). In addition, the percentage of items within a sector that enter duty free is calculated and defined as the free-percentage (FP).[5] Unfortunately, data on the duty treatment of U.S. exports to Mexico is not published. Although Mexico's tariff schedule is published, the actual duty treatment of a given item can not be ascertained from this since information about whether the item received the NAFTA rate or the MFN rate is dependent on whether the item satisfied all the requirements (i.e., rules of origin, etc.) for NAFTA treatment. The duty treatment variable therefore is based unfortunately only on the U.S. import side of the trade flows since the Mexican information is not available.

[5] Ideally, it would be desirable to use the 8-digit HTS system for this analysis since dutyrates are defined at the 8-digit level; however, the U.S. import and export classification systems are not compatible at the 8-digit level (although they are at the 6-digit level).

Gonzalez and Velez (1994) have argued that U.S. - Mexico IIT trade is significantly the result of trade in components and not trade in differentiated final goods. These authors found, using yearly time series data from 1961 to 1991, that the level of value added in the maquiladora industry was a significant factor in explaining the aggregate IIT index of U.S.-Mexico trade. Although suggestive, this is less than persuasive evidence since the value of value-added in the maquiladora industry generally increased throughout this time period as did the IIT index; thus the maquiladora variable could simply be capturing the effects of other factors (likely to affect the IIT index) that increased throughout this time period. Likewise, since 1993, maquiladora value-added has continued to expand, but the IIT index has declined; thus their explanation is inconsistent with this trend. The effects of components in explaining the IIT index is investigated more fully in this article by examining how components affect the IIT index across sectors.

Data on the value of U.S. components (re-imported) in Mexican exports to the United States can also be obtained from data provided on the U.S. import declaration form. The U. S. Customs requires firms to pay an import processing user fee, even if the item is eligible for dutyfree treatment; however, no fee is required on any U.S. components being re-imported.[6] Therefore, there is an incentive for importers to declare any U.S. content included in their products even if the item qualifies for either MFN (most favored nation) or NAFTA duty-free treatment. Obviously, U.S. components are declared on items imported into the U.S. under the U.S. 9802 program (the U.S. offshore assembly program); however, during 1999, of the $13.9 billion of U.S. components declared on the import declaration, only $4.2 billion entered duty-free under the 9802 program ($1.5 billion under the regular 9802 program and $2.7 billion under the special 9802.00.90 textile and apparel program). Although not absolutely inclusive, this data on U.S. components provides a reasonably close calculation of the value of U.S. components being re-imported from Mexico and provides a much more comprehensive variable than the 9802 data on maquila imports. Using this data, a variable is created based on the percentage of U.S. components in an import category and is named the component- percentage (CP).

[6] Beginning July 1, 1999 the user fee was waived for items imported from Mexico that met the rules of origin requirement under NAFTA.

In order to determine if the duty-rate (DR), the free-percentage (FP), and the component-percentage (CP) are related to the IIT index, correlations are presented in Table 4 of these variables using four different classification systems at several levels of aggregation. If the variable is correlated to IIT index at the 95% level or above, it is included in the box in Table 4; an asterisk represents significance of at least 99% and a negative sign represents a negative correlation.

The correlation between the components percentage (CP) and the level of IIT is positive and robust, being significant at the 99% level for every classification system at every level of aggregation (except one where the level of significance is 95%). Although there is no way to determine if the components being re-imported are in the same product category as when they were exported, these results are certainly suggestive that many of them are. What is somewhat surprising is that the correlation between the components percentage and the level of IIT becomes weaker as the level of aggregation increases; one would think that the correlation would increase with the level of aggregation since there would be an increasing likelihood that components would be in the same category as the final product.

Table 4

Correlations Between IIT, Duty Treatment and Components Percentage

Classif. System	**3-Digit**	**4-Digit**	**5-Digit**	**6-Digit**
HTS	99=CP* 93=CP*	99=FP*,CP* 93=FP*,CP*	99=FP*,CP* 93=DR-*, FP*,CP*	99=FP*,CP* 93=DR-*, FP*,CP*
SIC	99=FP,CP*	99=CP*	-----	-----
SITC	99=CP	99=FP,CP*	99=FP*,CP*	-----
NAICS	-----	99=CP*	99=FP,CP*	99=DR-,FP,CP*

CP-Components Percentage, FP-Dutyfree Percentage, DR-Dutyrate.

The relationship between the level of IIT and the duty treatment variable is more robust as the level of aggregation decreases. Generally, the free percentage (FP) is positively related to the IIT index; thus the higher the percent of a product that enters dutyfree, the higher the level of IIT. This provides some product level evidence that liberalized trade is associated with a higher level of IIT. Of course, the direction of causality is not clear, since a high level of IIT in a sector might encourage trade liberalization in that sector while one-way trade might encourage continued protection. The actual duty rate is negatively correlated with the IIT index at only the lowest levels (5 and 6-digit level) of aggregation. The data in Table 4 cover 1999 except for the Harmonized System which has data for both 1993 and 1999; the correlations change little between these two points in time and suggest that the NAFTA did little to change any relationship that existed between these variables.

In addition, regressions were performed with the IIT index as the dependent variable, and the components percentage, the free percentage and a dummy variable for manufactured goods as the independent variables. Generally, the lower the level of aggregation the better the results. The results for 1999 using the lowest level of aggregation are presented below. The t-statistics are in the parentheses; an asterisk represents significance at the 99% level. These results are similar to the correlation results presented above. The components percentage, the free percentage, and being a manufactured good are all positively related to the IIT index. Note that the R-squares are all quite small; thus this analysis shows how these factors are related to the IIT index, but they are not intended to replace, rather only to make a small additional contribution to, the well established body of research examining the industry characteristics explaining IIT.

Table 5

Regression Explaining IIT Index

Classification System	**Significance of Variables, (t-statistic), * represents significance at the 99 percent level**	**R-square**
HTS -6 digit	FP (5.85)*, CP (9.10)*, MANF (.83)	.03
SIC - 4 digit	FP (1.83), CP (3.83)*, MANF (2.82)*	.04
SITC - 5 digit	FP (4.93)*, CP (7.11)*, MANF (3.24)*	.07
NAICS - 6 digit	FP (2.34), CP (3.62)*, MANF (3.17)*	.08

FP-Dutyfree Percentage, CP-Components Percentage, MANF-Manufactures dummy.

The relationship between these variables and the IIT index is examined further by putting each item (6 digit HTS) in an aggregated grouping based upon the following characteristics. These groups are: MF – for 6-digit items in which at least 90% enter MFN duty free, NAF – items where at least 75% enter NAFTA dutyfree, ATP – items where at least 40% enter dutyfree as U.S. components, OFR- items where at least 50% enter dutyfree under any program but do not satisfy any of the previous criteria, MED – items where only 25 to 50% enter duty free, LOW – items where less than 25% enter duty free, and EXO – items that are exported by the U.S. but not imported. Table 6 provides the trade weighted IIT index for each of these groupings, as well as the level of net exports (NX) and net imports (NM).[7]

Table 6
IIT Index by Groups Based Upon U.S. Duty Treatment (1999)

Group	IIT Index	Net Exports (NX)	Net Import (NM)	Total Trade ($billions)
MFN	.397	.213	.390	$43.4
NAF	.351	.257	.393	$93.1
ATF	.367	.037	.597	$10.4
OFR	.397	.319	.285	$14.5
MED	.128	.194	.678	$14.5
LOW	.124	.128	.747	$5.7
EXP	.000	1.00	.000	$8.7

Table 6 reveals that the IIT index appears rather similar (about .35) for groups for which a large percentage of the items enter duty free regardless of whether the dutyfree status is due to MFN, NAFTA, the HTS 9802 program, or other special programs. Items for which the United States is primarily an importer (i.e., a high NM value) are items which don't generally enter duty free. Overall the results are similar to those found in the previous section, i.e., liberalized sectors have a higher level of IIT.

VI. U.S. - MEXICO MARGINAL IIT

As first recognized by Hamilton and Kniest (1991), changes in the IIT index through time do not provide information as to whether the corresponding trade changes were largely intra-industry or inter-industry trade. Thus even when all of the "new" trade is inter-industry trade, the IIT index can still increase over time. For this reason the change in the trade flows is best analyzed using a marginal intra-industry (MIIT) trade index. The MIIT index is of interest for determining whether "new" trade has 1) created an adjustment problem by requiring a reallocation of production factors, especially labor, or 2) has altered "long-run" factor prices through Stolper-Samuelson channels. Recently, the theoretical usefulness of the

[7] If export (X)>imports (M) then NX=(X-M)/(X+M), if X<M then NM=(M-X)/(X+M). Note that IIT+NX+NM=1 for every item.

MIIT concept for analyzing adjustment issues has been questioned by Lovely and Nelson (2000) using Ethier's fixed-capital sector model with differentiated intermediate goods; a model with fixed sector capital would appear to be the most reasonable framework for analyzing short-run labor adjustment problems. However, in a more empirical vein, Brulhart (2000) has provided some evidence of a statistical relationship between adjustment pressures and a one-year lagged MIIT index which had been calculated using short (1 year) time periods. For Stolper-Samuelson factor price effects, a longer time frame for calculating the MIIT would appear to be appropriate, although there is no theoretical or empirical literature which specifically addresses this issue.[8]

For the analysis of MIIT in this article, the Shelburne MIIT index[9] is used:

$$MIIT_{jk} = 1 - \frac{\sum_i |\Delta X_{ijk} - \Delta M_{ijk}|}{\sum_i |\Delta X_{ijk}| + |\Delta M_{ijk}|} \quad (4)$$

where ΔX_{ijk} = the change in exports from country *j* to country *k* in sector *i*, and ΔM_i = the change in imports of country *j* from country *k* in sector *i* between two points in time. Calculated MIIT indexes for U.S. – Mexico are presented in Table 7 using several different classification systems with several different levels of aggregation for several time periods. First, notice that the MIIT indexes covering the first four years after the creation of the NAFTA (1993 to 1997) are rather low and are quite similar to the indexes covering the four years prior to the NAFTA (1989 to 1993). Therefore, the results of the MIIT indexes support the conclusion using the IIT indexes, which is that the integration created by the NAFTA has not been generally described by IIT. The MIIT index based upon yearly changes is surprisingly low, averaging only about .2 to .25 for intermediate levels of aggregation. Also in each of the last several years (from 1996 to 1999), the yearly MIIT index has declined; for example, the yearly MIIT index using the 6-digit HTS declined from .26 for 1996/97 to .18 for 1997/98 and to .16 for

[8] Also, when using a longer time horizon for calculating MIIT indexes, it must be remembered that the MIIT index for the whole period need not equal the aggregation of the MIIT indexes for the sub-periods (Oliveras and Terra, 1997).

[9] This index has been referred to as the A-Index or the Brulhart A-Index; however, Shelburne (1993b) was the first to propose and use this index.

1998/99. This result is consistent across classification systems regardless of the level of aggregation. Thus the tendency for U.S.–Mexico trade growth to be characterized by largely inter-industry trade has increased the longer NAFTA has been in operation.

Table 7
Marginal Intra-Industry Trade Indexes for U.S. Mexico

Years	HTS 4	HTS5	HTS6	SITC3	SITC4	SITC5	SIC4
98 to 99	.228 F, C*	.199 F*,C*	.165 F*,C*	.309	.224 C*	.205 F*,C*	.209 C*
97 to 99	.246 F,C*	.224 F*,C*	.197 F*,C*	.313	.246 F*,C*	.237 F*,C*	.248 C*
96 to 99	.334 F,C*	.278 F*,C*	.262 F*,C*	----	----	----	.384 C*
97 to 98	.236 C*	.189 F*,C*	.183 F*,C*,D-*	.285	.243 C*	.212 F*,C*	.240 C*
96 to 98	.340 F,C*	.286 F*,C*,D-*	.269 F*,C*,D-	----	----	----	.386 C
96 to 97	.385 C*	.284 F*,C*,D-	.263 F*,C*,D-*	----	----	----	.425
95 to 97	----	----	----	.477 C*	.386 C*	.318 F*,C*	----
93 to 97	.338 C	.284 F*,C*,D-*	.277 F*,C*,D-*	.407 C	.346 C*	.282 F*,C*,D-	----
89 to 93	----			.425	.343		----

F-Free Percentage, C-Component Percentage, D-Applied Dutyrate (- means negative correlation).

The MIIT, like the IIT index, is biased downward whenever the trade changes are not balanced; the changes in exports and imports were generally not equal during any year and varied by 15% or more. However, during the 1995 to 1997 period, the change in exports was approximately equal (within one percent) to the change in imports. Thus the MIIT indexes for 1995-97 are not "distorted" by unbalanced trade which has complicated the interpretation of how the NAFTA affected U.S.-Mexico IIT . As expected, the MIIT indexes for 1995-97 appear to be higher than MIIT indexes for other similar time periods. The MIIT indexes calculated using a longer time period are generally higher the longer the time period used; this result is likely due to the declining time trend of yearly MIIT indexes instead of reflecting some more general principle of MIIT indexes. Although Oliveras and Terra (1997) have demonstrated that there is no mathematical necessity that the MIIT index will become smaller as the level of disaggregation increases (as is the case with the Grubel-Lloyd index), as an empirical matter the MIIT index, without exception, becomes smaller the more disaggregated the trade.

As with the IIT analysis presented in the previous section, correlations were performed between the MIIT index and measures of the degree of trade liberalization within a sector and measures of the likely amount of U.S. components being re-imported under the maquila program. It is not clear whether the liberalization and components variables should be calculated as end-of-period values, beginning-of-period values, average (of the two dates) values, or a change in the values. For example with the argument that trade liberalization results in a high level of MIIT (and/or IIT), it is not clear if this should be due to the fact that the sectors are currently liberalized, or if it is due to the fact that the sectors have just been liberalized. In Table 7 above, for each year and classification system/level, those end-of-period variables that are correlated with the MIIT at the 95% level are listed (those significant at the 99% level have an asterisk); a negative sign represents a negative correlation. A similar pattern exists for the correlations between the MIIT index and the free-percentage (F) and component-percentage (C) variables that was found for the IIT index. At a high level of aggregation (3 or 4-digit level), only the component-percentage is significantly correlated with the MIIT index. As the level of aggregation decreases (5 or 6-digits) both the free percentage and the component percentage variables are found to be highly correlated with the MIIT index. Also at low levels of aggregation (5 or 6-digits) there is often a significant negative correlation between the duty rate and the MIIT index.

Previous studies have generally concluded that the IIT and MIIT indexes by sector are not correlated; however, for U.S. - Mexico trade these indexes are highly correlated across sectors at the 99.9% level (using 6-digit HTS or 5-digit SITC data for 1998-99). In addition, when the sectors are aggregated into the groupings in Table 6, the MIIT index is found to be much higher in those groupings which had largely liberalized trade and had the highest IIT indexes, i.e., the MFN, NAF, ATF, and OFR groupings. Even within each of these groupings, the MIIT and IIT indexes are correlated at the 99% level.

VII. CONCLUSIONS

As the U.S. and Mexico have liberalized their trade as part of NAFTA, the IIT index has fallen slightly and the calculated MIIT indexes reveal a low and decreasing level of IIT trade; this clearly suggests that the NAFTA liberalization has reduced IIT. This result is counter to the well established findings from European integration where liberalization increased IIT. To some degree the fall in U.S.-Mexico IIT is due to the trade imbalance that has developed since 1994. At the cross-sectional sectoral level, however. there is evidence that liberalized sectors have a higher level of IIT and MIIT. Although the direction of causality is not clear, one interpretation of these findings is that as liberalization proceeds, formally protected sectors which have a low level of IIT are liberalized and the growth of trade is concentrated in these sectors and they continue to exhibit little IIT; therefore the aggregate level of IIT falls. Therefore it does not appear that liberalization increases IIT unless trade is largely IIT initially. A more comprehensive understanding of why the U.S.-Mexico liberalization has evolved differently than the European liberalization will require a more detailed look at how IIT was related to duty treatment in the European case. In addition, it is found that U.S. - Mexico IIT is composed significantly of trade in intermediate components instead of differentiated final products.

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