Intra Industry Trade Measurement: Then and Now - Towards A New Measure of Marginal Intra Industry Trade

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Abstract

Intra industry trade (IIT) measures have been extensively used in international trade research as tools for examining the trade overlap dimension of trade flows. Since the earliest contributions many refinements and extensions have been made to IIT measures, most significantly though was the formulation of dynamic indicators. This paper summarizes the empirical measures of IIT and traces the evolution of these indicators over the last five decades. Furthermore, this paper examines and documents the relative strengths and shortcomings of each of these indices following which a new measure of dynamic IIT is proposed. This index stems from the widely accepted Brulhart A construct and represents a more refined measure of IIT. Data for two more developed Caribbean countries are employed and the results reveal a similar trend for both measures over time, though the proposed index is markedly higher for all periods.

Key Words: marginal intra industry trade, bilateral, intensity, Caribbean

JEL Classification: F10, F14

Introduction

Total trade can be decomposed into trade imbalance (inter industry trade) and trade overlap (intra industry trade). In the case of the former, trade flows are explained in large part by the traditional Heckscher Olin theorem and over time has emerged as being based on the theory of comparative advantage. New international economics (see Krugman's new trade theory) underlie trade flows of the latter (Krugman, 1980). Intra industry trade (IIT) refers to the exchange of commodities from the same industry. Alternatively said, it can be defined as the simultaneous exports and imports of commodities of similar factor intensity (Bhagwati and Davis, 1994).

IIT has evolved from being a mere curiosity in the 1960s to one of the newest branches of international trade theory today. Its recognition by academic scholars as an empirical anomaly (Finger, 1975; Grubel and Lloyd, 1975 and Falvey and Kierkowski, 1987); one that departed from the accepted theoretical arguments of the time sparked much debate that ultimately precluded the birth of empirical measures followed by a multitude of theoretical conjectures. The formal theoretical models that were subsequently developed in many ways legitimized the importance of IIT not just as an academic breakthrough but as a prominent practical tool with the potential to foster explanations and solutions for weak trade performances in mature and burgeoning markets (Spanu, 2003). Moreover, it was the rise of the dynamic school in the early 1990s that shaped the way forward for the intra industry strand and indeed added that element of empirical importance sought after by policy cohorts. Dynamic or marginal intra industry trade (MIIT) offered a new flexibility in which to analyze trade patterns in terms of the structure of the change in trade flows from period to period by focusing on the importance of changes in 'new trade' rather than that of Heckscher Olin trade (see Hamilton and Kniest, 1991 and Brulhart, 1994).

MIIT has since been accepted as an indispensible tool by policy makers in the developed world and although its importance has grown over time, there is a lack of urgency in the use of these measures within the Caribbean region (Lewis, 2008). The rest of this paper is outlined as follows: Sections 1 and 2 provide a concise summary of the existing static and dynamic measures of IIT. Section 3 reviews the structural properties of the Brulhart A index, develops the methodology for a proposed measure and compares both measures using hypothetical examples and live Caribbean data. The paper then concludes.

1. Static Intra Industry Trade

For several decades, scholars have been creating empirical measures of intra industry trade. These breakthroughs though laudable for the academic community at the time belonged to the 'static' school and in keeping with the custom of pioneering work these breakthroughs were shrouded with scepticism as they lacked flexibility and comparability when applied to different time periods. Prominent within this epoch of writing were Michaely (1962), Balassa (1966; 1979), Grubel and Lloyd (1975), Aquino (1978), Loertscher and Wolter (1980), Bergstrand (1983), Rajan (1996), Lloyd (1998), Nilsson (1999), Egger et al. (2004), Shen and Gu (2007), Mercan and Yergin (2012) and Boring (2012), (see Table 1 in appendix).

Many of these measures emerged as derivations of the Grubel and Lloyd (GL) index in the first instance and the Aquino index in the second instance (see Table 2 in appendix for evolution of these static measures). In particular, in the case of the former, an expression for measuring IIT overtime through the comparison of the GL measure for two time periods was proposed. This was followed by the redefinition of the GL index to incorporate international supply via different modes of international production as outlined by Lloyd (1998). The contribution of Mercan and Yergin (2012) followed which corrected for the standard GL's inability to account for sectoral competitiveness. Next came Boring (2012) who extended the GL construct by estimating an 'IIT intensity' measure for a particular commodity category when bilateral trade exists. The Aquino index was the object of three modifications. The first was developed by Balassa (1979) who was critical of the Aquino procedure noting that it considered the imbalance in all commodity trade without allowing for inter industry specialization between primary and manufactured commodities. Loertscher and Wolter (1980) then argued that the Aquino adjustment procedure can be used on a bilateral basis and sought to determine the IIT levels that would apply if trade was bilaterally balanced.

Lastly, the work of Bergstrand (1983) criticized the GL, Balassa and Aquino measures since they captured IIT as a proportion of a country's total trade with all other countries i.e. multilateral trade, when in his view, they should have really measured a country's bilateral trading patterns at the industry level. Outside of the GL-Aquino suite of indicators were the contributions of Rajan (1996) who established a reformulated index that captured the difference between the level and degree of IIT; Nilsson (1999) hereafter proposed the use of levels of IIT to yield a measure of the average level of IIT per product group and finally the measure proposed by Egger et al. (2004); the first to apply IIT in a multinational firm setting.

2. Marginal Intra Industry Trade

MIIT had its birth in the early 1990s when scholars found the GL index unsuitable for measuring changes in adjustment costs. Moreover, they envisioned measures which were structured to disaggregate changes in total trade, which better denoted the structure of the change in total trade and thus, could better represent the impact of trade shocks on the allocation of labour. Amongst the most notable contributors to the MIIT literature are Hamilton and Kniest (1991), Vona (1991), Shelburne (1993), Greenaway et al. (1994), Brulhart (1994), Oliveras and Terra (1997), Dixon and Menon (1997), Menon and Dixon (1997), Lloyd (1998), Brulhart and Hine (1999), Thom and Mc Dowell (1999), Annicchiarico and Quintieri (2000), Azhar and Elliott (2003), Thorpe and Zhang (2005) and Shen and Gu (2007), (see Table 3 in appendix).

The evolution of MIIT measurement indicators draws resemblance to that of the static school in that the majority of proposed indicators have stemmed from the Brulhart A index. Three years prior to the introduction of the A index in the literature, Hamilton and Kniest (1991) proposed an index which measured "the degree of IIT in new trade". Vona (1991) then produced a measure that emulated the characteristic that the simultaneous exchange of commodities that are very similar and are produced under very similar conditions justifies the classification of all trade as IIT regardless of whether there exists a trade imbalance.

Shelburne (1993) presented an index based on his argument that an assessment of the degree of IIT in a context of changing trade flows is not possible by simply looking at changes in the IIT index over time. Greenaway et al. (1994) then went on to suggest that the shortcomings of the Hamilton and Kniest (1991) index should give rise to an index that incorporates negative trade changes and also possesses scaling properties to factor in the initial level of trade or even each industry's initial production values before the change in IIT. Following this, Brulhart produced the A, B and C indices.

Several authors have produced modified versions of the Brulhart "A" index which are tailored to specific underlying assumptions of adjustment changes. Such authors include Brulhart and Hine (1999), Thom and McDowell (1999), Annicchiarico and Quintieri (2000), Thorpe and Zhang (2005), and Shen and Gu (2007). Brulhart and Hine (1999) argued that the A index does not take into account differing initial period trade flows between two trading partners and so proposed a measure that treated with this. Thom and McDowell (1999) contended that the A index is an adequate indicator of horizontal IIT but it cannot differentiate between inter industry trade and vertical IIT; thereby necessitating a modified measure which they proposed. Annicchiarico and Quintieri (2000) was responsible for the third modification of the A index. They proposed that when matched trade change is negative, the index should assume a negative sign. Thorpe and Zhang (2005) produced an industry measure of the A index while Shen and Gu (2007) applied the same logic for their commodity sub group index. Extensions to the Brulhart index was proffered by Lloyd (1998) who suggested that the relationship between imports and changes in employment may reveal a different pattern for imports from different countries. He further contended that this differing pattern can be explained by differences in the "mode of supply."

The Brulhart B index of sectoral trade patterns was modified by Brulhart and Hine (1999) to treat with initial trade levels. The Brulhart C index produced an absolute value of MIIT relating to matched trade changes and can take only positive values whilst its complementary Menon and Dixon (1997) indicator investigated the degree of marginal inter industry trade in absolute terms and its associated factor movements. Dixon and Menon (1997) developed a measure that captured trade expansion free from factor market disruption and Azhar and Elliott (2003) proposed an alternative index to the Brulhart B index; one that is superior and produces more data in the relevant data range. This measure is called the S index (see Table 4 in appendix for the evolution of MIIT measures).

3. The Brulhart A Index Revisited

The Brulhart A index and GL index share similar statistical characteristics. In particular, they both range between 0 and 1 with the A index corresponding to: 0 (marginal inter industry trade) ≤ A ≤ 1(marginal intra industry trade) and like the GL index, A can be summed across industries of the same level of statistical disaggregation (see equation 2), (Brulhart, 1994).

$$A = 1 - \frac{\left|(X_t - X_{t-n}) - (M_t - M_{t-n})\right|}{\left|X_t - X_{t-n}\right| + \left|M_t - M_{t-n}\right|} = 1 - \frac{\left|\Delta X - \Delta M\right|}{\left|\Delta X\right| + \left|\Delta M\right|} \tag{1}$$

$$A_w = \sum_{i=1}^{n} w_i A_i \quad \text{where } w_i = \frac{\left|\Delta X_i\right| + \left|\Delta M_i\right|}{\sum_{i=1}^{n}\left(\left|\Delta X_i\right| + \left|\Delta M_i\right|\right)} \tag{2}$$

A_w is the weighted average of MIIT over all industries of an economy or over all the sub industries of an industry, denoted by *i…n*.

According to Brulhart and Elliot (1998) the A index is a 'transposition' of the GL index to first differenced trade flows. Hamilton and Kniest (1991) was the first to consider a measure that was founded on the standard GL measure. Specifically, the researchers put forward a modified GL index (i.e. GL_{MIIT} =1- {|ΔX - ΔM|/ (ΔX - ΔM)}) but was quick to refute its usefulness. They noted that it "calculates the degree of IIT in total new trade rather than comparing new bilateral trade flows" such that the extent to which new trade flows i.e. imports (exports) are matched by trade flows i.e. exports (imports) of the same products are overestimated. Brulhart (1994), however, pointed out that it was indeed the degree of IIT in new trade that IIT researchers strive to measure and the index proposed above can be applied in the same way as the GL index for a single trade partner or several partners.

Nonetheless, by the omission of absolute values for the ΔX and ΔM in the denominator term renders this index meaningless where either ΔX or ΔM assumes negative values. It follows that the transposition of the GL index is only accurately represented in the context of MIIT if the latter criticism is considered.[1] Hamilton and Kniest (1991) argued that adjustment is a dynamic process that span a time period longer than one year and so the static field is deficient in this regard because they relate to trade flows in one year only. To address this issue, measures of MIIT have been developed to describe the dynamics of trade patterns (Brulhart and Elliott, 2002). It follows that the dynamic A index makes the link between adjustment costs and changes in trade patterns. This A index, however, draws a striking resemblance to Shelburne's index and in fact it was Shelburne (1993) who was the first to present what was essentially Brulhart's A index. Brulhart was, however, credited with its popularization (Lovely and Nelson 2002, Lewis 2008 and Ferto and Soos 2010). This paper proposes a modification to the Brulhart A index; hereafter for simplicity referred to as the Seecharan-Hosein (2013) A_{ij}^{*} index. This measure though similar to the Brulhart A index, it represents a more refined measure of IIT by accounting for trade flows that register bilateral flows only. An instrument for MIIT intensity is then drawn from this indicator.

3.1.The Brulhart A Index: A Modified Measure Proposed

The A_{ij}^{*} index draws on some of the complementary research regarding other IIT measurement indicators. In particular, Fontagne and Freudenberg (1997) argued that the empirical shortcomings of the GL index can be categorized under two headings: geographical bias and sectoral/product bias. The former, the authors contended occurs when various partner countries are grouped together for the computation of a group/regional GL measure and also when a particular country's trading relations with the rest of the world are investigated. They contended further that the sign of a commodity's trade balance may differ among partners, resulting in the amassing of inter industry trade flows for the same commodity for the aggregation level utilized. The ultimate effect is a "multilateral intra industry trade." To further clarify this point, Fontagne and Freudenberg provided an example. They noted that for a particular industry, country X's trade with partner countries Y and Z (both regarded as belonging to one trade bloc) may meet the criteria of IIT if 100 units are both exported and imported (perfect trade overlap) between the two trading partners i.e. X and trade bloc. However, under a 'strict bilateral' case, the outcome may reflect one way trade once the trade bloc is divided such that X's trade with Y alone and with Z alone can be reflected. It is possible that X exports to Y and imports from Z. They argued that this approach is superior in that it minimizes geographic and product biases and provides a clear and single explanation to each registered trade flow thereby ensuring that coherency is preserved between theoretical insights and empirical measurement. Fontagne and Freudenberg therefore maintained that "only a bilateral analysis is a methodologically robust way of defining two-way trade."

Sectoral/product bias arises from categorical aggregation on account of insufficient disaggregation in the trade classifications. Otherwise said, as more commodities are grouped together in a 'single industry', the greater the likelihood that trade will be characterized as intra industry in nature. Fontagne and Freudenberg also noted that another issue emerges when intermediate commodities e.g. car engines are exchanged for final commodities e.g. cars as this is considered by some as IIT due to the commodities belonging to the same industry. Most importantly, "apprehending IIT at the "industry" level may therefore blur, rather than clarify, two distinct, analytical notions: (1) the international splitting of the value-added chain, and (2) simultaneous exports and imports of "substitutable" product items ("two-way trade in similar products")."

Nilsson (1999) was severely critical of the GL index, arguing that it fails to reflect the actual level of IIT if total trade is small between two trading partners and if total trade between these two countries is the sum of only a few product groups. Specifically, if the GL index posits a high value in the presence of low absolute values (i.e. dollar values) for IIT then it provides a biased picture of both the extent and the importance of IIT. For example, the GL index between the UK and Mauritania is 0.47 whilst that between the UK and Hong Kong is 0.23 with IIT reported at US$4mn for the former and US$1.2bn for the latter. The number of products traded of an intra industry nature amounts to 62 and 396 for the first and second country pairs, respectively.

[1] By way of email correspondence, Professor Marius Brulhart stated "There is no sophisticated algebra behind the claim that my MIIT index is a "transposition" of the GL index to first differences. It's just that the MIIT index looks very similar to the GL index but instead of X and M we use dX and dM (plus apply absolute values). My MIIT index also resembles the GL index in that it ranges from zero to one and captures the share of two-way trade (change) within a sector."

It can therefore be inferred that IIT between Mauritania and the UK is more important and extensive than that for Hong Kong and UK. For comparative purposes, or for regression analysis, the use of the GL measure when comparing a cross section of countries can only occur if each country trades in the same product categories and this is not usually the case. Nilsson therefore proposed the use of levels of IIT where the volume of IIT between two countries i and j can be divided by the total number of products they trade with each other to yield a measure of the average level of IIT per product group. This measure is defined below:

$$\mathrm{IIT}_{\mathrm{pij}} = \frac{\text{Level of } \mathrm{IIT}_{\mathrm{ij}}}{\text{No. of products traded}} \tag{3}$$

Nilsson added that from the calculation of correlation coefficients between IIT_{pij} and the level of IIT and between IIT_{pij} and the GL index reveals high and low relationships, respectively implying that IIT per product is a suitable proxy for the level of IIT. He further noted that IIT_{pij} is reflective of the actual level of IIT between two trading partners and also allows for comparison of the extent of IIT between large and small partners, thereby presenting a less biased representation of the extent and importance of IIT as compared to the GL index. Even further, this index is transparent, easily computed, can be calculated at various aggregation levels and also corresponds better to the main determinants of IIT for example similarities in and average levels of economic size and factor endowments. Nilsson himself, however, noted that using the levels of IIT has a major drawback in that it becomes difficult to compare the extent of IIT specialization between countries especially since large countries trade in a greater number of commodities and usually display a higher volume of trade (and IIT by extension).

By applying elements[2] of the measurement design employed by Fontagne and Freudenberg (1997) and Nilsson (1999), Boring (2012) derived an index that can be regarded as an extension of the standard GL measure. Boring, like Fontagne and Freudenberg (1997) cited two main deficiencies of the GL index: a geographic bias and a product bias. She argued that for a given group of countries the former arises when unilateral trade i.e. exports only or imports only occurs among some partners, resulting in the GL index assigning an overall disproportionate weight to those partners in the group for which a country does conduct bilateral trade. A product bias arises when only a small proportion of trade with partner countries comprises the export and import of homogeneous commodity categories. To overcome these shortcomings, Boring applied the average GL index (a measure developed by Fontagne and Freudenberg (1997)) that produced greater detail when examining the nature of trade between a country and each of its partners for each commodity category at the highest level of disaggregation.

The average GL index is illustrated below.

$$GL_{kjt} = 1 - \left(\frac{\sum_{k \in n} \sum_{i \in j} \left| X_{kit} - M_{kit} \right|}{\sum_{k \in n} \sum_{i \in j} \left(X_{kit} + M_{kit} \right)} \right) \tag{4}$$

Where X_{kit} and M_{kit} are the value of a country's exports and imports, with its trading partner k among the country's n trading partners for commodity i from industry j during year t. Boring, however, noted that this technique is flawed in that firstly, the average GL index is correlated with a country's GDP level[3] such that the index tends to reveal that IIT is higher for larger countries. She further explains that it fails to estimate the 'intensity of IIT' for a particular commodity category when bilateral trade exists. In particular, a country may trade bilaterally only a few commodities or commodity groups such that IIT may be high or concentrated for these commodities whilst the average GL index may be low. She subsequently employed the denominator term from Nilsson's IIT_{pij} index as an instrument for IIT intensity (I_{kit}) in the presence of bilateral trade flows. I_{kit} is necessary according to Boring as it enables comparability of the extent of IIT between small and large trading partners, developing and developed countries. The overall adjustment as proposed by Boring is reflected in the following expression:

[2] These elements constitute Fontagne and Freudenberg's interpretation and treatment of IIT for the strict bilateral case and Nilsson's index (denominator) as an instrument for IIT intensity in the presence of bilateral trade flows.

[3] Boring's analysis also revealed a relatively high correlation between the average GL index and GDP per capita levels, though less prominent than the correlation between the average GL index and GDP.

$$GL^{*}_{kjt} = \frac{\sum_{i \in j} \left(1 - \frac{\left| X_{it} - M_{it} \right|}{\left(X_{it} + M_{it} \right)} \right)}{I_{kit}} \qquad (5)$$

Where I_{kit} refers to the number of commodities i that country k both import and export in year t. j is defined as the industry from which commodities i are derived. The argument proffered by Brulhart (1994) that the A index is a transposition of the GL index lends credence to the underlying claims of this paper and also provides a methodological basis for a similar treatment of the A index when strict bilateral trade flows are considered. Indeed, measuring MIIT for commodities that register bilateral trade only is comparable to the static bilateral case proposed by Boring above. This paper therefore applies a similar approach to Boring's bilateral IIT intensity index. In particular, this paper firstly redefines the Brulhart A index to measure only bilaterally traded commodities and secondly, extends the measure by applying Boring's denominator term. This approach therefore goes a few steps further than the Brulhart A index and in so doing it prevents overvaluation/undervaluation of MIIT, it is a more reasoned[4] comparator measure of MIIT between developed and developing countries, it is a more accurate measure of MIIT intensity and is theoretically valid because of its conformance to established IIT properties as outlined above. This approach is denoted below.

$$A^{*}_{ij} = \frac{\sum_{i \in j} \left(1 - \frac{\left| \Delta X_{i} - \Delta M_{i} \right|}{\left| \Delta X_{i} \right| + \left| \Delta M_{i} \right|} \right)}{I_{i}} \qquad (6)$$

I_i is the number of commodities traded bilaterally between trading partners. The numerator maintains the same statistical range as the standard Brulhart A index; $0 \leq A_i \leq 1$ and can be applied independently of I_i. A_{ij}^* is always positive and produces a percentage score. Further, like A_w, a weighted average of the bilateral A index can be scaled for structural variables (V)[5] in either the initial or last time period. Specifically,

$$A_{sc} = \sum_{i=1}^{N} v_i \ A_i \ \text{ where } \ v_i = \frac{V_i}{\sum_{i=1}^{N} V_i} \qquad (7)$$

3.2.The Brulhart A_j Index and Seecharan-Hosein A_{ij}^* Index Compared

Table 5 (see appendix) provides four hypothetical scenarios of the benefits of using the proposed Seecharan-Hosein A_{ij}^* index in relation to the marginal Brulhart A_j index. The underlying argument for the empirical disparity of the two measures is that at the industry level, both the A_j and A_{ij}^* indices are identical, however, the computation of an aggregate/country MIIT results in the A_j index subsuming all trade flows unilateral and bilateral while the A_{ij}^* index only sums those industries recording both export and import flows. It follows that a measurement bias is revealed for computations using the A_j index which gives rise to an undervaluation or overvaluation of its aggregate score. In the case of the A_{ij}^* the result is the same whether the value of unilateral flows is high or low per industry as it is unaffected by unilateral trade flows.

The scenarios illustrate these properties. In the four scenarios, the indices are computed at the aggregate level and at the industry level where the same six industries (i.e. industry 1, 2, 3, 4, 5 and 6) are considered in each case. Nominal trade flows are utilized in all cases. The analysis commences with scenario 1 which reveals that of the six industries, industry 4, 5 and 6 demonstrate strictly bilateral trade flows whereas industry 1 and 2 exhibit purely unilateral trade flows i.e. either exports or imports.

[4] As indicated earlier, this modified measure reflects a more equitably balanced assessment of IIT between developed and developing countries as unilateral flows are factored out.

[5] According to Greenaway et al. (1994) measures of trade composition should be related to other variables such as gross trade, industry production or sales and employment etc. for this indicator to be interpreted as suitable and valid for assessing structural change. Brulhart (1994) further noted that if the aim is to maintain analytical and presentational appeal of the A index, scaling for the aforementioned variables can be conducted when indices are aggregated across sub industries or industries. It follows that A_w can be scaled by any variable besides the gross change in trade flows.

Industry 3 can be regarded as displaying neither purely unilateral nor strictly bilateral trade flows but rather is introduced for its role in biasing the magnitude of the Brulhart A_j index. It can be observed that MIIT calculated for the individual industries are the same regardless of the measurement procedure employed since the difference lies with the aggregate scores and the industries that they are comprised of. In particular, the computation of A_j constituted the summation of $\left|\Delta X_j - \Delta M_j\right|$ and $\left|\Delta X_j\right| + \left|\Delta M_j\right|$ for all six industries which produced values of 3501 and 10097, respectively. The A_{ij}^*, however, accounted for similar total values but for industry 4, 5 and 6 only as these industries registered bilateral trade. The values generated hereafter were 960 and 5100, respectively. Scenario 1 therefore reveals an aggregate index score of 0.65 for the A_j index and 0.81 for the proposed measure.

Scenario 2 introduces the first permutation to our computations by removing unilateral trade flows for industry 1 only in order to evaluate the impact this value has on the magnitude of the aggregate Brulhart A_j index. The aggregate outcomes reflect an overvaluation of the A_j index of the magnitude 0.18 (0.83 as compared to 0.65 prior) and 0.02 in comparison to the 0.81 score in the A_{ij}^* case. A_{ij}^* remains unaffected by changes in unilateral flows. Scenario 3, permutation 2 shows the removal of trade flows for industry 2 only, which also reveals an overvaluation, marginal in size of 0.02 (i.e. 0.67 as compared to 0.65). Permutation 3 (see scenario 4) demonstrates divergent aggregate MIIT scores between the two approaches when trade flows for industry 3 only is removed. Indeed, the A_j index reveals an undervaluation of magnitude 0.10. This finding seems to imply that once trade flows are not strictly bilateral or purely unilateral, the A_j index can be overvalued or undervalued.

The overarching conclusion that can be drawn from this analysis is that not only is the A_j index skewed in the presence of non-bilateral trade flows but the magnitude of these flows also greatly determines the overall index value. The A_{ij}^* index differs from the Brulhart A_j construct in another facet; that being by the inclusion of an intensity instrument as its denominator term. The intensity instrument is simply the sum of all industries demonstrating both import and export trade that had been included in the computation of the numerator term. In each of the four scenarios, industry 4, 5 and 6 demonstrated bilateral trade flows and so were included in the computation of the numerator. It follows that a value of 3 i.e. 3 industries were conferred for the instrument. The measure introspectively is an average bilateral MIIT index and when compared to the average (Brulhart A_j) MIIT index, it assumes a higher value. In particular, the average (Brulhart A_j) MIIT index revealed scores of 10.8 per cent, 16.6 per cent, 13.40 per cent and 11 per cent for scenarios 1, 2, 3 and 4, respectively whilst the A_{ij}^* index registered a consistent 27.1 per cent. Table 6 (see appendix) provides a concise comparison between the A_j index and the A_{ij}^* index, outlining the key similarities and differences between the two measures.

Table 7 and Figure 1 depict a numerical demonstration of the difference between the two measures using live data for Trinidad and Tobago and Barbados for the period 1999-2010. The results revealed that the disparity between the A_j and the modified index[6] ranged between 3.86 per cent and 19.67 per cent, respectively with the modified index recording markedly higher index scores for all periods considered. Given that both measures report similar trends, it is arguable that unilateral flows were the primary cause for the undervaluation of the A_j index and once removed (in the case of modified index) reflected the true MIIT position between the two trading partners.

4. Conclusion

This paper provided a succinct yet comprehensive overview of the key static IIT and dynamic MIIT measurement indicators for the period 1962-2010. The corresponding strengths and weaknesses of each of these measures were documented and a clear evolution of these indices beginning with the Michaely and GL indices for the static case and the Hamilton and Kniest index for the dynamic case were traced as a means of documenting the value added of each successive index to the literature. Building from this analysis, this paper identified a key shortcoming of the aggregate Brulhart A MIIT index and proceeded to propose a modified measure; the Seecharan-Hosein A_{ij}^* index to account for this failing. The Seecharan-Hosein A_{ij}^* index, though different in several ways to the A index; its contribution to the literature is substantively three-fold: it measures MIIT for commodities that register bilateral trade only, minimizes geographic and product biases and can be easily transformed into an intensity measure of MIIT.

[6] For computational purposes, the A_{ij}^* index (numerator only) is referred to as the 'modified index'.

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Appendix

Table 1: Summary Table-Static IIT Measures

Author	Index- Modifications and Extensions	Strengths	Weaknesses
Michaely (1962)	$\bar{H} = 1 - \frac{1}{2}\sum_i \left\lvert \frac{X_{ij}}{\sum_i X_{ij}} - \frac{M_{ij}}{\sum_i M_{ij}} \right\rvert$	Index was designed to assess the likeness of export and import structures (intra industry specialization) rather than IIT.	Index is not a suitable measure of IIT; a simple correlation coefficient can easily measure similarity of actual trade flows.
Balassa (1966)	$A_j = \frac{\lvert X_j - M_j \rvert}{(X_j + M_j)}$	As compared to Michaely (1962) this index is a more analytical measure of trade overlap between countries.	The weighting effect - For different absolute values of exports and imports A_j will take on a value of 0; and the opposite sign effect - at the sub-group level (and ultimately the aggregate level), all signs of the trade imbalances must be the same for A_j to represent a weighted average of the sub-group indices.
Grubel and Lloyd (1975)	$B_j = \frac{(X_j + M_j) - \lvert X_j - M_j \rvert}{(X_j + M_j)} = 1 - \frac{\lvert X_j - M_j \rvert}{(X_j + M_j)} = 1 - A_j$ Modifications 1. $\Delta GL = GL_t - GL_{t-n} = \left(1 - \frac{\lvert M_j - X_j \rvert}{(M_j + X_j)}\right)_t - \left(1 - \frac{\lvert M_j - X_j \rvert}{(M_j + X_j)}\right)_{t-n}$	First accepted measure of IIT. Remains the most popular indicator of IIT today.	Given B_j=1-A_j the GL index shares the same weighting issues as the Balassa index. Most notably though are categorical aggregation - this is associated with

	2. Lloyd (1998) $B_j = \frac{\left\{(X_j + M_j) - \left\lvert \sum_{g=1,2} X_j^g - \sum_{g=1,2} M_j^g \right\rvert \right\}}{(X_j + M_j)}$ Extensions 1. Mercan and Yergin (2012) $HM_j = \frac{(X_j - M_j)}{(X_j + M_j)}$ $B_j = 1 - \lvert HM_j \rvert$ 2. Boring (2012) $GL^*_{kjt} = \frac{\sum_{i \in j}\left(1 - \frac{\lvert X_{it} - M_{it}\rvert}{(X_{it} + M_{it})}\right)}{I_{kit}}$		the inappropriate classification or aggregation of commodities from the same industry such that products that possess different factor ratios are produced in the same industry resulting in an overvaluation of the index; and trade imbalance- the specific weighting effect within industries is contingent on the consistency of the signs of trade imbalances (X_{ij}-M_{ij}) of each sub group (i) within industry (j). Adjustments to B_j were undertaken to correct for both shortcomings, however, mechanical issues still persist.
Aquino (1978)	$Q_j = 1 - \frac{\lvert \hat{X}_j - \hat{M}_j \rvert}{(\hat{X}_j + \hat{M}_j)}$ Modifications 1. Balassa (1979) $Q_j^b = \frac{\lvert X_j^b - M_j^b \rvert}{(X_j^b + M_j^b)}$ 2. Loertscher and Wolter (1980) $Q_{ijk} = \frac{(a_{jk} * X_{ijk} + b_{jk} * M_{ijk}) - \lvert a_{jk} * X_{ijk} - b_{jk} * M_{ijk} \rvert}{(a_{jk} * X_{ijk} + b_{jk} * M_{ijk})} * 100$ 3. Bergstrand (1983) $G_{ij}^k = 1 - \left[\frac{\hat{X}_{ij}^k - \hat{X}_{ji}^k}{\hat{X}_{ij}^k + \hat{X}_{ji}^k}\right]$	The Aquino index is superior to the GL index in that it does not require correction for overall trade imbalance and is unaffected by the data aggregation problem. Aquino further assumed that the balancing effect is "equiproportional in each single industry." It follows that, the ensuing adjustment to be made to the industry's B_j indices is dependent on the relationship between the signs on industry and aggregate trade imbalances i.e. $Q_j \gtreqless B_j$ if $X_j \gtreqless M_j$ and $\sum_{j=1}^{n} X_j \gtreqless \sum_{j=1}^{n} M_j$ but $Q_j \lesseqgtr B_j$ if $X_j \gtreqless M_j$ and $\sum_{j=1}^{n} X_j \lesseqgtr \sum_{j=1}^{n} M_j$	The Q_j index has been criticized on five grounds. Firstly, Vona (1991) argued that this index is a measure of trade composition similarity rather than trade overlap and secondly, it assumes that any trade imbalance is equiproportionately spread across all industries. Therefore, a country may have moved strongly into a trade surplus based on the performance of just one or two sectors and not through the contribution of all the sectors considered. Thirdly, the Aquino measure is equivalent to the Michaely index and therefore shares similar shortcomings. Fourthly, the Q_j index fails to allow for cyclical fluctuations in the level of economic activity. Lastly, inconsistent results are revealed when the Q_j is used as a measure for both industry and sub-group IIT when one group experiences a surplus (deficit) whilst the other experiences a deficit

			(surplus).
Rajan (1996)	$R_j = \left\{ \left[\frac{\min(X_j, M_j)}{2M_j} \right] + \left[\frac{\min(X_j, M_j)}{2X_j} \right] \right\}$	R_j corrects for the problem of trade imbalance and reduces the disparity in IIT shares and so is regarded as more appropriate for econometric modelling. R_j has a very desirable property, in that it "ensures that more or less equal weight is given to non-zero IIT regardless of the actual volume of trade"	R_j takes on a value of infinity when there is no IIT between partners given that one of the divisors assumes a zero value. For index values below 0.5, "if a larger share of the trade between two countries is of an inter-industry nature, Rajan's index can be shown to fall outside the stipulated bounds between 0.5 and 1." The R_j has infinite values which according to Rajan must be replaced by zeroes. This adjustment is deemed unsuitable as the industry level R_j index is a subset of the country level index.
Nilsson (1999)	$\mathrm{IIT_{pij}} = \frac{\text{Level of } \mathrm{IIT_{ij}}}{\text{No. of products traded}}$	$\mathrm{IIT_{pij}}$ is reflective of the actual level of IIT between two trading partners and also allows for comparison of the extent of IIT between large and small partners, thereby presenting a less biased representation of the extent and importance of IIT as compared to the GL index. Even further, this index is transparent, easily computed, can be calculated at various aggregation levels and also it corresponds better to the main determinants of IIT.	Using the levels of IIT has a major drawback in that it becomes difficult to compare the extent of IIT specialization between countries especially since large countries trade in a greater number or commodities and usually display a higher volume of trade (and IIT by extension).
Egger et al. (2004)	$GLI^c = \sum_k \frac{2 * \min(EX_{ik}, IM_{ik})}{\sum_k EX_{ik} + \sum_k IM_{ik} - \left| \sum_k EX_{ik} - \sum_k IM_{ik} \right|}$	GLI^c is the first measure of IIT applicable to a multinational firm setting. The index captures all income flows outside of those deriving from merchandise trade. In a bilateral multi-sector case the GLI^c should equal to 1 for strict IIT.	Egger et al. proposed twelve alternative definitions of his GLI^c index. Given that no information is available on the true values, assumptions are therefore made when deciding on the most favourable approach.
Source: Author's Compilation.			

Table 2: Evolution of Static IIT measures	
Michaely (1962)	$\bar{H} = 1 - \frac{1}{2}\sum_i \left\lvert \frac{X_{ij}}{\sum_i X_{ij}} - \frac{M_{ij}}{\sum_i M_{ij}} \right\rvert$
Balassa (1966)	$A_j = \frac{\lvert X_j - M_j \rvert}{(X_j + M_j)}$
Grubel and Lloyd (1975)	$B_j = \frac{(X_j + M_j) - \lvert X_j - M_j \rvert}{(X_j + M_j)} = 1 - \frac{\lvert X_j - M_j \rvert}{(X_j + M_j)} = 1 - A_j$
	$\Delta GL = GL_t - GL_{t-n} = \left(1 - \frac{\lvert M_j - X_j \rvert}{(M_j + X_j)}\right)_t - \left(1 - \frac{\lvert M_j - X_j \rvert}{(M_j + X_j)}\right)_{t-n}$
Lloyd (1998)	$B_j = \frac{\left\{(X_j + M_j) - \left\lvert \sum_{g=1,2} X_j^g - \sum_{g=1,2} M_j^g \right\rvert\right\}}{(X_j + M_j)}$
Boring (2012)	$GL^*_{kjt} = \frac{\sum_{i \in j}\left(1 - \frac{\lvert X_{it} - M_{it} \rvert}{(X_{it} + M_{it})}\right)}{I_{kit}}$
Mercan and Yergin (2012)	$HM_j = \frac{(X_j - M_j)}{(X_j + M_j)}$ $B_j = 1 - \lvert HM_j \rvert$
Aquino (1978)	$Q_j = 1 - \frac{\left\lvert \hat{X}_j - \hat{M}_j \right\rvert}{\left(\hat{X}_j + \hat{M}_j\right)}$
Balassa (1979)	$Q_j^b = \frac{\lvert X_j^b - M_j^b \rvert}{(X_j^b + M_j^b)}$
Loertscher and Wolter (1980)	$Q_{ijk} = \frac{(a_{jk} * X_{ijk} + b_{jk} * M_{ijk}) - \lvert a_{jk} * X_{ijk} - b_{jk} * M_{ijk} \rvert}{(a_{jk} * X_{ijk} + b_{jk} * M_{ijk})} * 100$
Bergstrand (1983)	$G_{ij}^k = 1 - \left[\frac{\hat{X}_{ij}^k - \hat{X}_{ji}^k}{\hat{X}_{ij}^k + \hat{X}_{ji}^k}\right]$
Rajan (1996)	$R_i = \left\{\left[\frac{\min(X_i, M_i)}{2M_i}\right] + \left[\frac{\min(X_i, M_i)}{2X_i}\right]\right\}$
Nilsson (1999)	$\mathrm{IIT_{pij}} = \frac{\text{Level of } \mathrm{IIT_{ij}}}{\text{No. of products traded}}$
Egger et al. (2004)	$GLI^c = \sum_k \frac{2 * \min(EX_{ik}, IM_{ik})}{\sum_k EX_{ik} + \sum_k IM_{ik} - \left\lvert \sum_k EX_{ik} - \sum_k IM_{ik} \right\rvert}$
Source: Author's Compilation.	

Table 3: Summary Table - Dynamic IIT Measures

Author	Index- Modifications and Extensions	Strengths	Weaknesses
Hamilton and Kniest (1991)	$MIIT_{HK} = \begin{cases} \frac{X_t - X_{t-n}}{M_t - M_{t-n}} \text{ for } M_t - M_{t-n} > X_t - X_{t-n} > 0 \\ \frac{M_t - M_{t-n}}{X_t - X_{t-n}} \text{ for } X_t - X_{t-n} > M_t - M_{t-n} > 0 \\ \text{Undefined for } X_t < X_{t-n} \text{ or } M_t < M_{t-n} \end{cases}$	Hamilton and Kniest developed an index of marginal IIT which measures "the degree of IIT in new trade." The HK index was the first measure of dynamic or marginal IIT.	The HK index has been criticized on four substantive grounds. Firstly, it is unable to draw inferences about the structure of the change in trade flows as it is undefined for negative values of either exports or imports. Secondly, it does not reflect real (inflation adjusted) MIIT but rather provides estimates of the nominal values of exports and imports. Thirdly, it fails to incorporate the importance of IIT in new trade with that of the amount of new trade or initial trade levels and lastly, it is unsuitable for drawing inferences about adjustment pressure.
Vona (1991)	$IIT_{A,B,j} = \frac{\sum_i I_{A,B,i}}{X_{A,B,j} + X_{B,A,j}}$	This index is unaffected by trade imbalance and is very responsive to data disaggregation levels. And unlike the GL index, this index arrives at its maximum and minimum values very easily such that the frequency distribution of the calculated IIT is quite polarized.	The index is dependent on the number of commodity groups included in each industry. That is, it is likely to record a lower value as the number of commodity groups increases.
Shelburne (1993)	$IIT^i = 1 - \frac{\lvert EX^i - IM^i \rvert}{(\lvert EX^i \rvert + \lvert IM^i \rvert)}$	By focusing on the change in net imports or exports across industries over two time periods, this approach reflects adjustments to initial period trade imbalances and those resulting from trade liberalization.	Although the debate on the issue of comparing IIT indices at different time periods has been recognized in the literature; no consensus has been reached at this time on how to adjust for trade imbalances.
Greenaway et al. (1994)	$\Delta IIT_j = \Delta[(X_j + M_j) - \lvert X_j - M_j \rvert]$	This index is one that could be defined at all ranges and one that could be easily applied to gross or real trade as related to adjustment problems.	The GHME measure suffers from the same shortcoming as the HK index i.e. its inability to assess the structure of change in trading patterns since it measures differences in IIT patterns over two periods. Further, the unscaled GHME index fails to determine the share of marginal IIT relative to marginal inter industry trade.
Brulhart (1994)	**A index** $A = 1 - \frac{\lvert (X_t - X_{t-n}) - (M_t - M_{t-n}) \rvert}{\lvert X_t - X_{t-n} \rvert + \lvert M_t - M_{t-n} \rvert} = 1 - \frac{\lvert \Delta X - \Delta M \rvert}{\lvert \Delta X \rvert + \lvert \Delta M \rvert}$ Modifications 1. Brulhart and Hine (1999) $A^r = 1 - \left(\left\lvert \frac{\Delta X}{X_{t-n}} - \frac{\Delta M}{M_{t-n}} \right\rvert \Big/ \left\lvert \frac{\Delta X}{X_{t-n}} \right\rvert + \left\lvert \frac{\Delta M}{M_{t-n}} \right\rvert \right)$ 2. Thom and McDowell (1999) $TM_j = 1 - \frac{\lvert \Delta X_j - \Delta M_j \rvert}{\sum_{l=1}^{N} \lvert \Delta X_l \rvert + \sum_{l=1}^{N} \lvert \Delta M_l \rvert}$ 3. Annicchiarico and Quintieri (2000) $AQ = \begin{cases} -A \text{ if } \Delta M < 0 \text{ and } \Delta X < 0, \\ A \text{ otherwise} \end{cases}$ 4. Thorpe and Zhang (2005)	The A index is a 'transposition' of the GL index in first differences. Furthermore, given that the index is dynamic by construct, it makes the link between adjustment costs and changes in trade patterns.	The A index though useful for multilateral studies lacks relevance for single country studies as it does not incorporate information on the dispersal of sectoral or country specific trade-induced gains.

	$IIT_{ijt} = 1 - \frac{\left\vert \sum_{k=1}^{n} \Delta X_{kt} - \sum_{k=1}^{n} \Delta M_{kt} \right\vert}{\sum_{k=1}^{n} \left\vert \Delta X_{kt} \right\vert + \sum_{k=1}^{n} \left\vert \Delta M_{kt} \right\vert}$ 5. Shen and Gu (2007) $DIIT_{ipjt} = 1 - \frac{\left\vert \sum_{k=1}^{n} \Delta X_{ipkt} - \sum_{k=1}^{n} \Delta M_{ipkt} \right\vert}{\sum_{k=1}^{n} \left\vert \Delta X_{ipkt} \right\vert + \sum_{k=1}^{n} \left\vert \Delta M_{ipkt} \right\vert}$ Extensions 1. Lloyd (1998) $B_i^{*} = \frac{\left\{ (\Delta X_i + \Delta M_i) - \left\vert \sum_{j=1,2} \Delta X_i^{j} - \sum_{j=1,2} \Delta M_i^{j} \right\vert \right\}}{\left(\left\vert \Delta X_i \right\vert + \left\vert \Delta M_i \right\vert \right)}$		
	B index $B = \frac{\Delta X - \Delta M}{\vert \Delta X \vert + \vert \Delta M \vert}$ Modifications 1. $B^{r} = \frac{\frac{\Delta X}{X_{t-n}} - \frac{\Delta M}{M_{t-n}}}{\left\vert \frac{\Delta X}{X_{t-n}} \right\vert + \left\vert \frac{\Delta M}{M_{t-n}} \right\vert}$	The B index is most useful for investigating sectoral trade patterns. The B index provides an indication of the sectors a country "specialized into" and sectors "specialized out of" as well as those sectors with trade flows that do not affect international adjustment patterns and inter-industry specialization.	Contingent upon varying signs of all industries, the B index cannot be aggregated across industries since the outcome of such a task would produce a value closer to 0 (high MIIT). In addition, when ΔX and ΔM take on opposite signs, the B index is non-responsive to variations in ΔX and ΔM. When compared to the S index, the latter is superior since it can distinguish between the relative sizes of diverging changes in net trade.
	C index $C = \left(\vert \Delta X \vert + \vert \Delta M \vert \right) - \vert \Delta X - \Delta M \vert$	C produces an absolute value of MIIT relating to matched trade changes and can take only positive values. C can also be scaled at the disaggregated level by using scaling factors.	The C index computes only balanced trade changes without providing any meaningful insights into the nature of unmatched trade changes.
Dixon and Menon (1997)	$DM^{IIT} = GL_{t-n} \left(\frac{\Delta \left[(X+M) - \vert X-M \vert \right]}{\left[(X+M) - \vert X-M \vert \right]_{t-n}} * 100 \right)$ $DM^{NT} = \left(1 - GL_{t-n} \right) \left(\frac{\Delta \vert X-M \vert}{\vert X-M \vert_{t-n}} * 100 \right)$	The researchers developed measures that captured trade expansion free from factor market disruption.	These measures cannot consistently disentangle marginal IIT from marginal inter industry trade i.e. a shift from a trade deficit to a matched trade position with exports remaining constant results in DM^{IIT} (DM^{NT}) recording positive (negative) values even though inter industry adjustment is clear.
Menon and Dixon (1997)	$UMCIT = \vert \Delta X - \Delta M \vert$	This measure assumes only positive values and can be scaled and aggregated.	The UMCIT index together with the Brulhart A and B indices are criticized for their delay in responding to variations in adjustment changes especially when opposite signs are apparent. Further, when there is an equal change in exports and imports UMCIT= |ΔX - ΔM|= |ΔM - ΔX| such that it is impossible to determine whether adjustment pressures are due to expansionary or contractionary effects.
Azhar and Elliott (2003)	$S_t = \frac{(\Delta X - \Delta M)}{2\left(\max\left\{ \vert \Delta X \vert_t, \vert \Delta M \vert_t \right\} \right)} = \frac{1}{2L} (\Delta X - \Delta M)_t$	The S index allows for scaling by the largest value for a particular time scale (months, years, decades) thus enabling policy makers to track the progression of adjustment pressures over the time period considered.	Although the S index can differentiate between the "relative sizes of opposing net trade changes" in contrast to the Brulhart B index, under certain ranges, a clear interpretation of its value is difficult.

Source: Author's compilation.

Table 4: Evolution of Dynamic IIT measures	
Hamilton and Kniest (1991)	$MIIT_{HK} = \begin{cases} \frac{X_t - X_{t-n}}{M_t - M_{t-n}} \text{ for } M_t - M_{t-n} > X_t - X_{t-n} > 0 \\ \frac{M_t - M_{t-n}}{X_t - X_{t-n}} \text{ for } X_t - X_{t-n} > M_t - M_{t-n} > 0 \\ \text{Undefined for } X_t < X_{t-n} \text{ or } M_t < M_{t-n} \end{cases}$
Vona (1991)	$IIT_{A,B,j} = \frac{\sum_i I_{A,B,i}}{X_{A,B,j} + X_{B,A,j}}$
Shelburne (1993)	$IIT^i = 1 - \frac{\lvert EX^i - IM^i \rvert}{(\lvert EX^i \rvert + \lvert IM^i \rvert)}$
Brulhart (1994)	$A = 1 - \frac{\lvert (X_t - X_{t-n}) - (M_t - M_{t-n}) \rvert}{\lvert X_t - X_{t-n} \rvert + \lvert M_t - M_{t-n} \rvert} = 1 - \frac{\lvert \Delta X - \Delta M \rvert}{\lvert \Delta X \rvert + \lvert \Delta M \rvert}$
Brulhart and Hine (1999)	$A^r = 1 - \left(\left\lvert \frac{\Delta X}{X_{t-n}} - \frac{\Delta M}{M_{t-n}} \right\rvert \Big/ \left\lvert \frac{\Delta X}{X_{t-n}} \right\rvert + \left\lvert \frac{\Delta M}{M_{t-n}} \right\rvert \right)$
Thom and McDowell (1999)	$TM_j = 1 - \frac{\lvert \Delta X_j - \Delta M_j \rvert}{\sum_{l=1}^{N} \lvert \Delta X_l \rvert + \sum_{l=1}^{N} \lvert \Delta M_l \rvert}$
Annicchiarico and Quintieri (2000)	$AQ = \begin{cases} -A \text{ if } \Delta M < 0 \text{ and } \Delta X < 0, \\ A \text{ otherwise} \end{cases}$
Thorpe and Zhang (2005)	$IIT_{ijt} = 1 - \frac{\left\lvert \sum_{k=1}^{n} \Delta X_{kt} - \sum_{k=1}^{n} \Delta M_{kt} \right\rvert}{\sum_{k=1}^{n} \lvert \Delta X_{kt} \rvert + \sum_{k=1}^{n} \lvert \Delta M_{kt} \rvert}$
Shen and Gu (2007)	$DIIT_{ipjt} = 1 - \frac{\left\lvert \sum_{k=1}^{n} \Delta X_{ipkt} - \sum_{k=1}^{n} \Delta M_{ipkt} \right\rvert}{\sum_{k=1}^{n} \lvert \Delta X_{ipkt} \rvert + \sum_{k=1}^{n} \lvert \Delta M_{ipkt} \rvert}$
Lloyd (1998)	$B_i^* = \frac{\left\{ (\Delta X_i + \Delta M_i) - \left\lvert \sum_{j=1,2} \Delta X_i^j - \sum_{j=1,2} \Delta M_i^j \right\rvert \right\}}{(\lvert \Delta X_i \rvert + \lvert \Delta M_i \rvert)}$
Dixon and Menon (1997)	$DM^{IIT} = GL_{t-n} \left(\frac{\Delta[(X+M) - \lvert X - M \rvert]}{[(X+M) - \lvert X - M \rvert]_{t-n}} * 100 \right)$
Greenaway et al. (1994)	$\Delta IIT_j = \Delta[(X_j + M_j) - \lvert X_j - M_j \rvert]$
Brulhart (1994)	$B = \frac{\Delta X - \Delta M}{\lvert \Delta X \rvert + \lvert \Delta M \rvert}$
	$B^r = \frac{\frac{\Delta X}{X_{t-n}} - \frac{\Delta M}{M_{t-n}}}{\left\lvert \frac{\Delta X}{X_{t-n}} \right\rvert + \left\lvert \frac{\Delta M}{M_{t-n}} \right\rvert}$
Azhar and Elliott (2003)	$S_t = \frac{(\Delta X - \Delta M)}{2(\max\{\lvert \Delta X \rvert_t, \lvert \Delta M \rvert_t\})} = \frac{1}{2L} (\Delta X - \Delta M)_t$
Brulhart (1994)	$C = (\lvert \Delta X \rvert + \lvert \Delta M \rvert) - \lvert \Delta X - \Delta M \rvert$
Menon and Dixon (1997)	$UMCIT = \lvert \Delta X - \Delta M \rvert$
Source: Author's Compilation.	

Table 5: Brulhart A index and Seecharan-Hosein index compared.												
SCENARIO 1												
Industry	X_1	M_1	X_2	M_2	ΔX_j	ΔM_j	$\|\Delta X_j - \Delta M_j\|$	$\|\Delta X_j\|$	$\|\Delta M_j\|$	$\|\Delta X_j\|-\|\Delta M_j\|$	A_j	A_{ij}*
1	1260	..	3430	..	2170	..	**2170**	2170	..	**2170**	0.00	0.00
2	..	700	..	390	..	-310	**310**	0	310	**310**	0.00	0.00
3	1228	1954	..	665	-1228	-1289	**61**	1228	1289	**2517**	0.98	0.98
4	1390	400	1120	95	-270	-305	**35**	270	305	**575**	0.94	0.94
5	445	180	1915	1160	1470	980	**490**	1470	980	**2450**	0.80	0.80
6	1655	1730	400	910	-1255	-820	**435**	1255	820	**2075**	0.79	0.79
Total	5978	4964	6865	3220	887	-1744	**3501**	6393	3704	**10097**	**0.65**	..
Total bilateral trade	3490	2310	3435	2165	-55	-145	**960**	2995	2105	**5100**	..	**0.81**
No. of industries exhibiting bilaterally trade					3	3					..	..
MIIT intensity index											10.89% (0.65/6)	27.06% (0.81/3)
SCENARIO 2												
Industry	X_1	M_1	X_2	M_2	ΔX_j	ΔM_j	$\|\Delta X_j - \Delta M_j\|$	$\|\Delta X_j\|$	$\|\Delta M_j\|$	$\|\Delta X_j\|-\|\Delta M_j\|$	A_j	A_{ij}*
1	..	..	..	..	..	..	..	..	..	..	..	..
2	..	700	..	390		-310	**310**	0	310	**310**	0.00	0.00
3	1228	1954	..	665	-1228	-1289	**61**	1228	1289	**2517**	0.98	0.98
4	1390	400	1120	95	-270	-305	**35**	270	305	**575**	0.94	0.94
5	445	180	1915	1160	1470	980	**490**	1470	980	**2450**	0.80	0.80
6	1655	1730	400	910	-1255	-820	**435**	1255	820	**2075**	0.79	0.79
Total	4718	4964	3435	3220	-1283	-1744	**1331**	4223	3704	**7927**	**0.83**	..
Total bilateral trade	3490	2310	3435	2165	-55	-145	**960**	2995	2105	**5100**	..	**0.81**
No. of industries exhibiting bilaterally trade					3	3					..	..
MIIT intensity index											16.64% (0.83/5)	27.06% (0.81/3)
SCENARIO 3												
Industry	X_1	M_1	X_2	M_2	ΔX_j	ΔM_j	$\|\Delta X_j - \Delta M_j\|$	$\|\Delta X_j\|$	$\|\Delta M_j\|$	$\|\Delta X_j\|-\|\Delta M_j\|$	A_j	A_{ij}*
1	1260	..	3430	..	2170	..	2170	2170	..	2170	0.00	0.00
2	..	..	..	..	..	..	..	..	..	..	..	..
3	1228	1954		665	-1228	-1289	61	1228	1289	2517	0.98	0.98
4	1390	400	1120	95	-270	-305	35	270	305	575	0.94	0.94
5	445	180	1915	1160	1470	980	490	1470	980	2450	0.80	0.80
6	1655	1730	400	910	-1255	-820	435	1255	820	2075	0.79	0.79
Total	5978	4264	6865	2830	887	-1434	3191	6393	3394	9787	**0.67**	..
Total bilateral trade	3490	2310	3435	2165	-55	-145	960	2995	2105	5100	..	**0.81**
No. of industries exhibiting					3	3					..	..

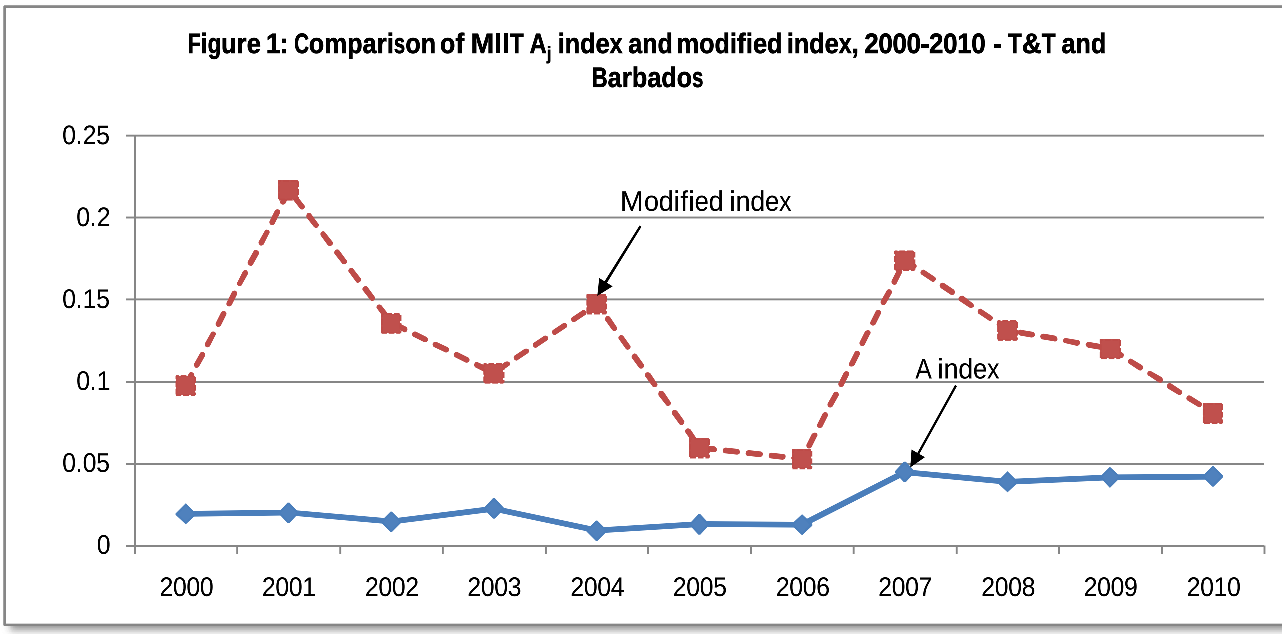
bilaterally trade												
MIIT intensity index											13.40% (0.67/5)	27.06% (0.81/3)
SCENARIO 4												
Industry	X_1	M_1	X_2	M_2	ΔX_j	ΔM_j	$\lvert\Delta X_j - \Delta M_j\rvert$	$\lvert\Delta X_j\rvert$	$\lvert\Delta M_j\rvert$	$\lvert\Delta X_j\rvert - \lvert\Delta M_j\rvert$	A_j	A_{ij}*
1	1260	..	3430	..	2170	..	**2170**	2170	..	**2170**	0	..
2	..	700	..	390	..	-310	**310**	0	310	**310**	0	..
3	..	..	..	..	..	..	..	..	..	..	..	..
4	1390	400	1120	95	-270	-305	**35**	270	305	**575**	0.94	0.94
5	445	180	1915	1160	1470	980	**490**	1470	980	**2450**	0.80	0.80
6	1655	1730	400	910	-1255	-820	**435**	1255	820	**2075**	0.79	0.79
Total	4750	3010	6865	2555	2115	-455	**3440**	5165	2415	**7580**	**0.55**	..
Total bilateral trade	3490	2310	3435	2165	-55	-145	**960**	2995	2105	**5100**	..	**0.81**
No. of industries exhibiting bilaterally trade					3	3						
MIIT intensity index											11.23% (0.55/5)	27.06% (0.81/3)
Source: Author's computations.												

Table 6: The Brulhart A_j index and Seecharan-Hosein A_{ij}^* index compared		
	Brulhart A_j index	Seecharan-Hosein A_{ij}^* index
	Similarities	
1.	Both make the link between adjustment costs and changes in trade patterns.	
2.	Structurally similar.	
3.	Theoretical Range: (marginal inter industry trade) $0 \leq A \leq 1$ (marginal intra industry trade) .	
4.	Both can be scaled for structural variables in either the initial or last time period.	
	Differences	
1.	Measures MIIT for commodities that register bilateral and unilateral trade flows.	Measures MIIT for commodities that register bilateral trade only.
2.	Biases MIIT score upward/downward.	Prevents overvaluation/undervaluation of MIIT.
3.	MIIT gap large if total trade is small between developed and developing country trading partners as compared to two developed country trade partners and if total trade between the former countries is the sum of only a few product groups.	Minimizes product biases by removing unilateral trade flows which are normally associated with manufactured/value added products exported by the developed country and that cannot be produced in the developing country for international exchange. A_{ij}^* is therefore a less coloured comparator measure of MIIT between developed and developing countries.
4.	Average MIIT measure reflects a downward bias on account of geographic bias problem.	Minimizes geographic bias and so it is a more accurate measure of average bilateral MIIT/ MIIT intensity. Some geographic bias will still persist in this case though to a much smaller extent depending on the size of the respective commodity trade balances.
5.	Theoretically valid as a transposition of the GL index.	Theoretically valid as a transposition of the GL index and in its underlying property of strict bilateral trade flows.
6.	N/A.	Introduces an intensity measure I_i however, numerator can be applied independently of I_i. Produces an overall percentage score.
Source: Author's compilation.		

Table 7: MIIT between T&T and Barbados-The A_j index and modified index compared

year	A_j	**A modified**	**No. of bilateral products**	A_j %	**A modified %**	*Difference*	**MIIT Intensity index %** [7]
1999	..	**..**	**87**	..	..	..	**..**
2000	0.019	**0.098**	**70**	1.94	9.78	7.84	**0.11**
2001	0.020	**0.217**	**71**	2.00	21.67	19.67	**0.31**
2002	0.015	**0.135**	**72**	1.46	13.54	12.08	**0.19**
2003	0.023	**0.105**	**57**	2.26	10.51	8.25	**0.15**
2004	0.009	**0.147**	**111**	0.92	14.72	13.80	**0.26**
2005	0.013	**0.059**	**113**	1.30	5.94	4.65	**0.05**
2006	0.013	**0.053**	**110**	1.28	5.28	4.00	**0.05**
2007	0.045	**0.174**	**96**	4.47	17.38	12.91	**0.16**
2008	0.039	**0.131**	**79**	3.87	13.13	9.25	**0.14**
2009	0.042	**0.120**	**66**	4.15	11.98	7.82	**0.15**
2010	0.042	**0.081**	**56**	4.22	8.07	3.86	**0.12**

Source: Author's computations.



Source: Author's computations.

[7] The choice of period for which the A modified index is to be divided when computing the MIIT Intensity index was made based on the procedure applied for computing the percentage change in an index between any two periods. In particular, the percentage change in an index between any two periods is calculated by subtracting the index value for the earlier period from the later period and dividing the result by the value for the <u>earlier</u> period, then multiply by 100.