A Measure of Trade Intensity and Country Market Potential

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ABSTRACT

Trade is important in driving a country’s economic growth. It has also become essential to go beyond own soil as the infrastructures and communications across countries are becoming better every year. Hence it is of great importance for policy makers to be able to measure the trade intensity of a country to identify market potential. A simple ratio between export and import of trade activities demonstrates imbalanced characteristics which add up to drawbacks in term of scaling, proportionality and symmetry issues of the existing Trade Intensity (TI) measurements. As such the analysis could potentially be erroneous due to biased and skewed characteristics. In addition, the existing TI measurements focus on bilateral trade activities between countries which do not explicitly address country market potential dimension for export opportunities that change throughout times. Thus we propose an innovative new measure of trade intensity focusing on precision trade between change in import and export elements which we named as “TI Index”. It is geometrically symmetrical, proportional and scale invariant to the changes in market potential of all products and across the world market. The pinnacle of this paper is the design and construction of an innovative new TI index for possible use in measuring country market potential. The design and construction of the TI index is geometrically illustrated using a newly constructed Geometric Trade Intensity Space Box (GTISB). This TI index provides a single number that is easy to calculate, comparable and change sensitive across all products/countries combinations globally.

JEL Classification: F17, F40

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INTRODUCTION

Trade is one of the key drivers of a country economy. Countries across the world perform trades for various reasons and factors. Some countries do trades due to competitive advantage while others do it to satisfy domestic market demands. Along the way, trade also opens up opportunities for countries to do business and increase their economic growth. As such it is an advantage for a country policy maker who is able to identify market potential in advance. Existing Trade Intensity (TI) measurements such as Cho and Doblas-Madrid (2014), World Integrated Trade Solution (WITS) software by World Bank, The Asia-Pacific Research and Training Network on Trade (ARTNeT) and Sundar Raj and Ambrose (2014) widely used the Balassa’s Revealed Comparative Advantage (BRC A) foundation in measuring export share ratio as indicator in bilateral TI perspectives. However there are concerns on the scaling, proportionality and symmetry characteristics of these methodologies due to ratios being naturally biased and unbalanced as variables in numerator and denominator experience changes particularly as the changes approaches zero that lead to disproportionate scaling. As such consistent interpretation through space of time could not be accomplished that could lead to mismeasurement and therefore to biased and/or erroneous conclusions. Furthermore the existing TI measurements do not really lead to market potential insights of a country as they do not consider change in flow of imports and exports directions across period of time as this could signal a contraction or expansion of a product or an industry. With that, it is the objective of this paper to propose an innovative new TI index to measure the TI of a country as well as its market potential for export opportunities by means of precision trade mechanism which we call the “TI Index” that can be geometrically illustrated and a country’s market potential is able to be interpreted and derived from it. This TI index comes with symmetrical, proportional and scale invariant features that are able to capture changes in market potential of all products/countries combination across the globe within the span period of analysis. In this way the TI index produce a single number that is comparable and change sensitive.

LITERATURE REVIEW

This section is to review the literature on S index by Azhar and Elliott (2003) in Marginal Intra Industry Trade (MIIT) as well as literatures on existing TI measurements proposed by scholars and practised by researchers. The purpose of reviewing S index in MIIT is purely because of its fundamental concept of symmetrical, proportional and scale invariant in measuring change of trade flows in MIIT is to be reviewed and applied into TI measurement scenario. The new interpretation shall be done concurrently whilst reviewing whereas the innovation part is to be discussed in Section Three. The structures and methods of the existing TI indices will be studied and systematically reviewed too. This includes; for example, the functional forms of the parameters used by the existing TI index in measuring TI. From the observations and gaps found in the literatures, this paper will then propose a new TI index that can measure a country TI as well as supply insights of the country market potentials.

S Index in MIIT Scenario and New Interpretation in TI and Country Market Potential Context

Azhar and Elliott (2003) developed the Trade Adjustment Space (TAS) and derived the S index. The purpose was to measure MIIT in explaining the Smooth Adjustment Hypothesis (SAH) of the adjustment costs associated with changes in trade patterns. The S index is as per equation (1) below:

\[
S_i = \frac{(\Delta X_i - \Delta M_i)}{2(\max\{ |\Delta X_i|, |\Delta M_i| \})}, \quad -1 \leq S_i \leq 1
\]

(1)

where for home country of product i, \(\Delta X\) is the changes for export value and \(\Delta M\) is the changes for import value from start year to end year during the period. From equation (1), when \(\Delta X > \Delta M\) then \(0 < S_i \leq 1\), when
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$\Delta M_i > \Delta X_i$ then $-1 \leq S_i < 0$ and when $\Delta M_i = \Delta X_i$ then $S_i = 0$. The calculated S index can be visualised inside TAS which could help and enhance the comprehension of trade flow evolution. The associated TAS geometrical diagram of volume induced adjustment space for S indices from the perspective of home country is shown in Figure 1.

In terms of home country market potential from foreign country point of view, if home country change in imports is dominating for product i ($\Delta M_i > \Delta X_i$), it indicates that home country is importing more of product i against exporting it. From equation (1), $\Delta M_i > \Delta X_i$ occurs when the S index is less than zero ($S_i < 0$) which signalling the home country is possessing market potential for foreign country to export product i into home country. The home country market potential intensity is positive towards foreign country and the extent of it increases as S index value decreases. Reversely if home country change in exports is dominating for product i ($\Delta X_i > \Delta M_i$), it indicates that home country is exporting more of product i against importing it. From equation (1), $\Delta X_i > \Delta M_i$ occurs when the S index is more than zero ($S_i > 0$) which signalling the home country is possessing niche market potential for foreign country to export product i into home country. The home country market potential intensity is negative towards foreign country and the extent of it increases as S index value increases. Note that when $\Delta X_i > \Delta M_i$, its implying that home county does still importing of product i but in lesser volume thus explaining the niche market condition. From Equation (1), when $\Delta X_i = \Delta M_i$, then $S_i = 0$ indicating equivalent change in export and import activity. In this situation the home market potential is regarded in equilibrium condition. As such, the relationship between S index and home country market potential can be regarded as inversely proportionate i.e. $S \propto \frac{1}{\text{market potential}}$ from foreign country point of view.
Next Azhar and Elliott (2008) extent the concept of S index in analysing the quality changes of product i by employing the Marginal Quality (MQ) index as given as follows:

\[
MQ = \frac{\Delta UV_X - \Delta UV_M}{2 \max(\vert \Delta UV_X \vert, \vert \Delta UV_M \vert)}, \quad -1 \leq MQ \leq 1 \tag{2}
\]

where for product i, \(\Delta UV_X\) is the changes for unit export value and \(\Delta UV_M\) is the changes for unit import value from start year to end year during the period. From equation (2), when \(\Delta UV_X > \Delta UV_M\) then \(0 < MQ \leq 1\), when \(\Delta UV_X < \Delta UV_M\) then \(-1 \leq MQ < 0\) and when \(\Delta UV_X = \Delta UV_M\) then \(MQ = 0\). The Product Quality Space (PQS) for MQ index is given in Figure 2. The PQS was developed by Azhar and Elliott (2006) which is a square box scaled by the maximum of either export unit value (UV_X) or import unit value (UV_M) so that the dimensions of each axis are defined by the maximum value of either UV_X or UV_M in the analysis. Referring to Figure 2 it can be seen that it is fairly similar to Figure 1. The difference is the change in export unit value is represented on vertical axis (+/-\(\Delta UV_X\)) and change in import unit value is represented in horizontal axis (+/-\(\Delta UV_M\)). Thus MQ index is similar to S index but translated for use in unit value space (UVS) in measuring changes of trade flows of quality differentiated products. Azhar and Elliott (2006) highlighted that the ground for using unit value in measuring quality is based on Stiglitz (1987) which pointed that products of a higher quality should charge a higher price so that price can be considered an (albeit imperfect) indicator of quality. The cut-off of MQ indices for quality Smooth Adjustment Hypothesis (SAH_Q) is between range [-0.4, 0.4]. In term of market potential, the same explanation as equation (1) could be derived from equation (2) as they used the same basic structure and principal, substituting only volume with quality. As such, the relationship, from foreign country point of view would be

\[
MQ \propto \frac{1}{\text{market potential (quality)}}
\]

In addition Azhar and Elliott (2011) suggested extra extension procedure where both volume and quality induced adjustment measures are integrated by adding both of them together. According to Azhar and Elliott (2011), existing literatures examined volume and quality separately. The volume literatures examined the Intra Industry Trade (IIT) trade flows and the associated adjustment costs in debating on Smooth Adjustment Hypothesis (SAH) that hypotheses that trade changes in IIT will experience trade induced adjustment costs that are less severe than the costs associated with inter-industry changes. The quality literatures examined the extent to which products are differentiated in terms of quality within matched trade flows. Azhar and Elliott (2011) highlighted that quality has become important up to the point where Cabral et al. (2006) split the IIT into horizontal and vertical IIT in examining the quality implications and demonstrated that the adjustment implications differs which has important implications for the SAH. Thus, Azhar and Elliott (2011) purpose was to produce an index that can visualise both changes in
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volume and quality simultaneously, a gap that they found missing in the family of static and dynamic trade measures. Their proposed equation is as follows:

\[
VQ = S + MQ, \quad -2 < VQ < 2 \quad (3)
\]

\[
MQ = -S + VQ, \quad -2 < VQ < 2 \quad (4)
\]

Hence the straight line should go down from left to right across the MQ and S plane. There is a fall in change of MQ while change of S run across. This shall produce negative gradient, hence indicating decrease rate of change, which is at the same constant rate. Thus, the associated diagrammatic representation of VQ isolines is depicted in following Quality Adjusted Trade Adjustment Space (QTAS) diagram as shown in Figure 3 below.

From Figure 3, the S index is represented on horizontal axis and MQ index is represented on vertical axis. Any change in volume and/or quality in trade flows changes is captured by the QTAS. The diagonal lines represent lines of equal VQ indices. The cut-off of VQ indices for volume and quality Smooth Adjustment Hypothesis (SAH\(_{VQ}\)) is between range \([-0.4, 0.4]\). Referring to QTAS in Figure 3, within the SAH\(_{VQ}\) strip where VQ \([-0.4, 0.4]\), the combined adjustment pressure for both home and foreign country are considered benign. A combined adjustment pressure of volume and quality occur outside the cut-off strip as indicated in Figure 3 as:

\[
\begin{align*}
\text{Adj}_{V} & = \text{quality induced adjustment in foreign country} \\
\text{Adj}_{Q} & = \text{volume induced adjustment in foreign country} \\
\text{Adj}_{Q} & = \text{quality induced adjustment in home country} \\
\text{Adj}_{V} & = \text{volume induced adjustment in foreign country} \\
\text{Adj}_{Q} & = \text{quality induced adjustment in foreign country} \\
\text{Adj}_{V} & = \text{volume induced adjustment in home country}
\end{align*}
\]

The combined adjustment pressure of volume and quality analysis is further explained in Table 1 below as indicated in Figure 3 for the home and foreign country by using QTAS and the calculated S, MQ and VQ indices.
For example, in the region of $0.4 < VQ < 1$, there shall be multiple combinations of adjustment pressure depending on the value of S and MQ. In situation where $S < 0$ and $MQ > 0$, the home country shall have volume induced adjustment while foreign country shall have quality induced adjustment. If within the period of study is divided into several phases, the analysis of Table 1 can be repeated for several phases accordingly.

Table 1 Analysis of volume and quality induced adjustment pressure for home and foreign country by using QTAS and the calculated S, MQ and VQ indices.

<table>
<thead>
<tr>
<th></th>
<th>VQ</th>
<th>S</th>
<th>MQ</th>
<th>Home</th>
<th>Foreign</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$1 &lt; VQ &lt; 2$</td>
<td>&gt; 0</td>
<td>&gt; 0</td>
<td>$F_v, F_Q$</td>
<td>$F_v, F_Q$</td>
</tr>
<tr>
<td>2</td>
<td>$0.4 &lt; VQ &lt; 1$</td>
<td>(a) &lt; 0</td>
<td>&gt; 0</td>
<td>$H_v$</td>
<td>$F_v$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(b) &gt; 0</td>
<td>&gt; 0</td>
<td>$H_v$</td>
<td>$F_v$</td>
</tr>
<tr>
<td>3</td>
<td>$0 &lt; VQ &lt; 0.4$</td>
<td>(a) &lt; 0</td>
<td>&gt; 0</td>
<td>$H_v$</td>
<td>$F_v, F_Q$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(b) &gt; 0</td>
<td>&gt; 0</td>
<td>$H_v$</td>
<td>$F_v$</td>
</tr>
<tr>
<td>4</td>
<td>$-0.4 &lt; VQ &lt; 0$</td>
<td>(a) &lt; 0</td>
<td>&gt; 0</td>
<td>$H_v$</td>
<td>$F_v$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(b) &gt; 0</td>
<td>&lt; 0</td>
<td>$H_Q$</td>
<td>$F_v$</td>
</tr>
<tr>
<td>5</td>
<td>$-0.4 &lt; VQ &lt; -1$</td>
<td>(a) &lt; 0</td>
<td>&lt; 0</td>
<td>$H_v$</td>
<td>$F_v$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(b) &gt; 0</td>
<td>&lt; 0</td>
<td>$H_Q$</td>
<td>$F_v$</td>
</tr>
<tr>
<td>6</td>
<td>$-2 &lt; VQ &lt; -1$</td>
<td>&lt; 0</td>
<td>&lt; 0</td>
<td>$H_v$</td>
<td>$H_Q$</td>
</tr>
</tbody>
</table>

Note: $H_v$ and $H_Q$ are the volume and quality induced adjustment in home country, $F_v$ and $F_Q$ are the volume and quality induced adjustment in foreign country.

After reviewing the S index, next the existing TI measurements available in literatures shall be reviewed.

Existing Trade Intensity Measurements

Prior to reviewing existing TI measurements, let review the Balassa (1965) Revealed Comparative Advantage (RCA) index first. This is because Balassa (1965) had popularised the Balassa Index, the concept of share ratio through actual export trade flows in revealing a country strong sectors, thus it is also known as the RCA index.

The RCA index is as per equation (5) below:

$$RCA_{ij} = \frac{(x_{ij}/X_{it})}{(x_{wj}/X_{wt})}$$

where $x_{ij}$ is the values of country i’s exports of product j, $x_{wj}$ is the values of world exports of product j, $X_{it}$ is the country i’s total exports, $X_{wt}$ is the world total exports. When a value of RCA is less than unity implies that the country i has a revealed comparative disadvantage in the product j. Likewise, if the RCA value exceeds unity, the country i is said to have a revealed comparative advantage in the product j. The RCA concept has set forth the foundation for existing TI measurements.

In reference to Cho and Doblas-Madrid (2014), they measured TI by the following equation:

$$\text{tradeint}_{x,y,t}^{\text{max}} = \max \left\{ \frac{\text{export}_{x,y,t} + \text{export}_{y,x,t}}{\sum_{x} \text{export}_{x,t} + \text{export}_{x,t}} \frac{\text{export}_{x,y,t} + \text{export}_{y,x,t}}{\sum_{y} \text{export}_{y,t} + \text{export}_{y,t}} \right\}$$

Where $\text{export}_{x,y,t}$ is the exports from country X to country Y at year t. According to equation (6), TI only needs to be high for one of the two countries in the bilateral trade relationship. Cho and Doblas-Madrid (2014) also defined $\text{tradeint}_{x,y,t}^{\text{avg}}$ as an alternative measure to equation (6). Instead of choosing the highest and disposing the lowest percentage, equation (7) takes both percentages into account.
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\[
\text{tradeint}_{X,Y,t}^{\text{avg}} = \text{avg} \left\{ \frac{\text{export}_{X,Y,t} + \text{export}_{Y,X,t}}{\sum_{all} \text{export}_{X,i,t} + \sum_{all} \text{export}_{i,X,t}} , \frac{\text{export}_{X,Y,t} + \text{export}_{Y,X,t}}{\sum_{all} \text{export}_{Y,i,t} + \sum_{all} \text{export}_{i,Y,t}} \right\}
\]  

(7)

Thus, equation (7) averages the two functions in the bilateral trade affiliation.

The World Bank via its World Integrated Trade Solution (WITS) software defined TI as below:

\[
T_{ij} = \frac{x_{ij}}{x_{ij} / X_{wi}}
\]  

(8)

where \(x_{ij}\) is the values of country i’s exports to country j, \(x_{wj}\) is the values of world exports to country j, \(X_{wi}\) is the country i’s total exports and \(X_{wj}\) is the total world exports. The equation (8) is used to determine whether the value of trade between two countries is greater or smaller than would be expected on the basis of their importance in world trade. From equation (8) it can be seen defined as the share of one country’s exports going to a partner divided by the share of world exports going to the partner. Thus an index of \(T_{ij} > 1\) indicates a bilateral trade flow that is larger than expected, given the partner country’s importance in world trade while \(T_{ij} < 1\) indicates a bilateral trade flow that is smaller than expected, given the partner country’s importance in world trade.

A quick look at The Asia-Pacific Research and Training Network on Trade (ARTNeT), they also used similar definition as the WITS as follow:

\[
\text{Trade Intensity} = \frac{\sum_{sd} X_{sd} / \sum_{sd} X_{sd} / \sum_{sw} X_{sw}}{\sum_{wd} X_{wd} / \sum_{w} X_{w}} \]

(9)

where \(s\) is the set of countries in the source, \(d\) is the destination countries, \(w\) is the countries in the world, \(y\) is the countries in the world and \(X\) is the bilateral flow of total exports. In essence equation (9), the numerator is the export share of the source region to the destination while the denominator is export share of the world to the destination. Equation (9) Trade Intensity shall takes a value between zero and \(+\infty\). Trade Intensity \(> 1\) indicates an ‘intense’ trade relationship. Thus equation (8) and (9) are indeed the same whereby they can be interpreted as an export share.

Sundar Raj and Ambrose (2014) used below equations in analysing the bilateral trade intensity between India and Japan:

\[
XII_{ij} = \frac{[X_{ij}/X_{i}] / [M_{j} / (M_{w} - M_{i})]} * 100
\]  

(10)

\[
MII_{ij} = \frac{[M_{ij}/M_{j}] / [X_{j} / (X_{w} - X_{i})]} * 100
\]  

(11)

\[
XII_{ji} = \frac{[X_{ji}/X_{j}] / [M_{j} / (M_{w} - M_{i})]} * 100
\]  

(12)

\[
MII_{ji} = \frac{[M_{ji}/M_{j}] / [X_{j} / (X_{w} - X_{i})]} * 100
\]  

(13)

where \(XII_{ij}\) and \(XII_{ji}\) is the Export Intensity Index of trade India with Japan and Japan with India, \(MII_{ij}\) and \(MII_{ji}\) is Import Intensity Index of trade India with Japan and Japan with India, \(X_{ij}\) and \(X_{ji}\) is exports of India to Japan and Japan to India, \(X_{i}\) is total exports of India, \(X_{j}\) is total exports of Japan, \(X_{w}\) is total world exports, \(M_{ij}\) and \(M_{ji}\) is imports of India from Japan and Japan from India, \(M_{j}\) is total imports of Japan, \(M_{i}\) is total imports of India, \(M_{w}\) is total world imports and \(t\) is year.

The value of TI index ranges from 0 to 1 (0 to 100 when multiplied with 100). If TI is zero this implies that there is no trade relationship between partner countries. If TI is one this implies high trade relations. If Import Intensity Index is more (or less) than 100, it indicates that India is importing more (or less) from Japan than might be expected from that country’s share in total world trade. The same goes for export too, if the value is zero it implies...
export link between these two countries is negligible and if the value is nearer to 100 it indicates that performance is significant and if it exceeds 100 it indicates that India is exporting more to Japan than might be expected from that country’s share in world trade.

Thus, comparing equations (6), (7), (8) and (9) with equation (5), their fundamental can be regarded as actually derived from RCA foundation which is measuring a country export share. The RCA equation is measuring in the perspective of country/product while the TI equations are measuring the bilateral trade intensity between countries. Nevertheless their fundamental concepts are similar. However Azhar and Elliott (2006) highlighted that the RCA index is having issues in term of scaling, proportionality and symmetry characteristics. This issue can be seen at the functional form of a ratio as illustrated by Azhar ad Elliott (2006) through an example. Referring to their paper, an example shown in Table 2 below provides two cases, A and B, consist of two equal but opposite pairs of unit value (UV). Consider the equal but opposite changes in \( r \) over four periods as shown in column 6. Note that the \( \Delta r \) values are generated from different changes in \( \Delta UV_X \) and \( \Delta UV_M \). For example in case A, in period 1, \( \Delta r = -0.50 \) is associated with \( \Delta UV_M = 0.50 \) in column 8. However for same period 1, in case B, \( \Delta r = 0.50 \) is associated with \( \Delta UV_X = 0.88 \) in column 7. Azhar ad Elliott (2006) indicated that for any two equal but opposite \( \Delta UV_X \) and \( \Delta UV_M \) coordinates, as in example of cases A and B, an equal but opposite change in value of \( \Delta r \) should be associated with an equal but opposite increase in \( UV_X \) in case B and \( UV_M \) in case A. However as demonstrated in Table 2, \( r \) exhibit disproportionate scaling with respects to \( \Delta UV_M \) and \( \Delta UV_X \). Due to this issue there is possibility implication on misinterpretation of result in analysis.

### Table 2 The disproportionate scaling characteristic of the UV ratio \( r \)

<table>
<thead>
<tr>
<th>Period</th>
<th>( UV_X )</th>
<th>( UV_M )</th>
<th>( r = UV_X/UV_M )</th>
<th>( \Delta r )</th>
<th>( \Delta UV_X ) from period 0</th>
<th>( \Delta UV_M ) from period 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1.50</td>
<td>1.00</td>
<td>1.50</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td>1.50</td>
<td>1.00</td>
<td>0.50</td>
<td>-0.50</td>
<td>0</td>
<td>0.50</td>
</tr>
<tr>
<td>2</td>
<td>1.50</td>
<td>1.50</td>
<td>0.86</td>
<td>-0.64</td>
<td>0</td>
<td>0.75</td>
</tr>
<tr>
<td>3</td>
<td>1.50</td>
<td>2.00</td>
<td>0.75</td>
<td>-0.75</td>
<td>0</td>
<td>1.00</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1.00</td>
<td>1.50</td>
<td>0.75</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td>1.88</td>
<td>1.50</td>
<td>1.25</td>
<td>+0.50</td>
<td>0.88</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>2.09</td>
<td>1.50</td>
<td>1.39</td>
<td>+0.64</td>
<td>1.09</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>2.25</td>
<td>1.50</td>
<td>1.50</td>
<td>+0.75</td>
<td>1.25</td>
<td>0</td>
</tr>
</tbody>
</table>

The equations (9), (10), (11) and (12) did deviate to some extend from RCA concept by introducing import element in measuring bilateral trade intensity perspective. Nonetheless Azhar et al. (2016) highlighted that simple ratio is naturally unbalanced. Perhaps this issue can be analysed from the range perspective of equation (5) as an example. According to Balassa (1965), when \( 0 < \text{RCA} < 1 \), a country i has no comparative advantage in product j while when \( 1 < \text{RCA} < \infty \), a country i has comparative advantage in product j. Note that the range to distinguish between those two is imbalanced; no comparative advantage range is very much smaller as compared to comparative advantage range. Thus the results of any analysis could be regarded as asymmetrical and skewed.

In addition from observation of all the existing equations above, there is lack of consideration on the concept of change. By considering change, gaps can be identified and their strengths can be analysed to infer useful information. Fertő and Soós (2008) pointed out that in MIIT the structure of the change in flows of goods affect the adjustment rather than the trading pattern in any given time period in IIT. The MIIT is used in measuring adjustment costs which is dynamic in nature. In the same connotation, it is suggesting to apply this concept in measuring trade intensity by considering they are dynamic too. Another point to note is that by considering change there is possibility to do cross-sectional analysis which could possibly show the evolution and trend of trade intensity. With that in below section the methodological framework of the new proposed TI index shall be detailed out. This index can be considered new since as reviewed above, the existing trade intensity measurements do not take into account the change element and this index is an attempt to apply MIIT concept in measuring trade intensity. The innovative
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element of the new TI index in the context of country market potential would be elaborated, particularly focusing on
the symmetrical, proportionality and scale invariant aspects while in parallel introducing a change concept.

A METHODOLOGICAL INNOVATION

This section shall deliberate the methodological derivation and foundation of the new proposed TI index and its
representation in a geometrical Trade Intensity Space (TIS) square box. Its innovation from an intuitive of an index
of a simple ratio between change in export and import towards an index of a ratio that addressed the scale invariant,
proportionality and symmetrical issues shall be elaborated and discussed. The dynamic measurement of TI index
and its properties inside a geometrical square box as well as its possible extension in measuring a country market
potential shall also be illustrated accordingly.

TI Index Derivations and GTISB Foundations

Consider trade activity of host country A for a period of time \((t, t + \Delta)\) of product \(i\) as shown in Figure 4 below.

Host Country A Trade Activity for Product i

Figure 4: Country A Trade Activity

From Figure 4 above, there is a trade intensity activity occurs between time interval \((t, t + \Delta)\) for country A
for a product \(i\). There would be change in export as well as change in import occurs. It is to note that in dynamic
setting, the \(\Delta X_i\) and \(\Delta M_i\) over time interval \((t, t + \Delta)\) where \(\Delta > 0\) can be in day, week, month, quarter or year. Thus
an export and import changes would be measured as \(\Delta X_i = X_{i,t+\Delta} - X_{i,t}\) and \(\Delta M_i = M_{i,t+\Delta} - M_{i,t}\) respectively.
Thus, the pillar definitions of the dynamic components of trade intensity, over a time interval:

1. \(\Delta\text{TTI} = \Delta X_i + \Delta M_i\) is the change in total trade intensity of product \(i\)
2. \(\Delta\text{NTI} = \Delta X_i - \Delta M_i\) is the change in net trade intensity of product \(i\)

where \(\Delta\text{TTI}\) is change in Total Trade Intensity and \(\Delta\text{NTI}\) is change in Net Trade Intensity.

From Figure 4 and literatures review, an intuitive impetus to suggest that a simple ratio of \(\Delta X/\Delta M\) can be
used to create an index to measure the Trade Intensity (TI) of product \(i\) as shown in equation (14):

\[
TI_i = \frac{\Delta X_i}{\Delta M_i} \quad (14)
\]

However Azhar et al. (2016) highlighted that ratios are naturally biased and unstable. This concern could be
explained through an example of a simple functional ratio as follows. Consider a functional form of a ratio \(y/x = \lambda\)
or \(y = \lambda x\). For this ratio to produce consistent interpretation across all parameters where \(\lambda\) is a constant, strict
proportionality must be controlled and adhered regardless of the change in the values of \(y\) and \(x\). However in the
presence of an intercept: \(y = \lambda x + k\) or \(y = y/x - k/x\) the strict proportionality is deviated. This deviation occurs
when there are very small variables, the value of \(x\) will be small enough for the intercept, \(k\), to impact the relationship
between x and y but with a bias toward x. Thus, control on strict proportionality is not adhered and results of any analysis could be biased. Consider \( T_{Ii} = f(\Delta X_i, \Delta M_i) = \frac{\Delta X_i}{\Delta M_i} \) for product i.

\[
T_{Ii} = f(\Delta X_i, \Delta M_i) = \frac{\Delta X_i}{\Delta M_i} = \Delta X_i(\Delta M_i)^{-1}
\]

The behaviours of when \( T_{Ii} \) changes with respect to \( \Delta X_i \) and \( \Delta M_i \) can be summarised and compared as in Table 3 below.

<table>
<thead>
<tr>
<th>Differentiation</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>When ( T_{Ii} ) changes with respect to ( \Delta X_i ):</td>
<td>( \frac{\partial T_{Ii}}{\partial \Delta M_i}\frac{\partial \Delta X_i}{\partial \Delta M_i} = \frac{\Delta X_i[-1,(\Delta M_i)^{-2}]}{(\Delta M_i)^2} = -\frac{\Delta X_i}{(\Delta M_i)^2} ) ( \text{As } \Delta M_i \to 0, \left[ \frac{\partial T_{Ii}}{\partial \Delta M_i} \right] \to -\infty )</td>
</tr>
<tr>
<td>When ( T_{Ii} ) changes with respect to ( \Delta M_i ):</td>
<td>( \frac{\partial T_{Ii}}{\partial \Delta X_i}\frac{\partial \Delta M_i}{\partial \Delta X_i} = 1 ) ( \text{As } \Delta X_i \to 0, \left[ \frac{\partial T_{Ii}}{\partial \Delta X_i} \right] \to \frac{1}{\Delta M_i} )</td>
</tr>
</tbody>
</table>

As can be seen from the Table 3 above, the rate of changes of \( T_{Ii} \) with respect to \( \Delta X_i \) and \( \Delta M_i \) are not similar. A major methodological issue occurs when \( \Delta X_i \) and \( \Delta M_i \) approaches zero. The rate of change for the numerator is disproportionately higher than the denominator (as \( \Delta M_i \to 0 \)) while the rate of change remains constant (as \( \Delta X_i \to 0 \)). Additionally, consider a scenario where an intercept exist for a straight line equation in a Cartesian plane of \( \Delta X_i \) and \( \Delta M_i \) as Y-axis and X-axis respectively. The equation would be 
\[
\Delta X_i = T_{II} \cdot \Delta M_i + k \quad \text{or} \quad \frac{\Delta X_i}{\Delta M_i} = T_{II} + \frac{k}{\Delta M_i}.
\]

When \( \Delta M_i \) has very small value, the impact of \( k \) to the relationship between \( \Delta X_i \) and \( \Delta M_i \) can be negligible however still bias toward \( \Delta M_i \). Therefore, as pointed by Azhar et al. (2016), strict proportionality is not adhered and results of any analysis could be biased and skewed. In deduction, the equation (14) as a ratio exhibits disproportionate scaling. This leads to mismeasurement, biased and/or erroneous conclusions. With that, in the below section we will discuss an innovation of the ratio formula in order to overcome this disproportionate and bias issues.

**TI Index Innovations**

Consider again the \( \Delta NTI = \Delta X_i - \Delta M_i \) for interval of time. This equation would measure the gap of both changes for an interval of time. The gap would be referred back to either \( \Delta X_i \) or \( \Delta M_i \) indicating which is dominant. Thus if the gap is relative back to the dominant, a percentage trade intensity can be calculated. This is suggesting equation (14) can be rewritten as below:

\[
T_{II} = \frac{\Delta X_i - \Delta M_i}{\max(|\Delta X_i|,|\Delta M_i|)} \quad (15)
\]

By adding a scaling factor of two in the denominator, it would allow this index to possess a scaling factor, i.e., scaling by the largest value for a given time scale. Thus:

\[
T_{II} = \frac{\Delta X_i - \Delta M_i}{2\max(|\Delta X_i|,|\Delta M_i|)}, -1 \leq T_{II} \leq 1 \quad (16)
\]

Now consider situations when either \( |\Delta X_i| \) or \( |\Delta M_i| \) is the highest and \( T_{II} \) changes with respect to \( \Delta X_i \) and \( \Delta M_i \) as summarised and compared in Table 4 below. From Table 3, it looks like this equation has scale feature but does
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not have the symmetrical and proportionality features. However when innovatively set the highest value of both \(|\Delta X_i|\) and \(|\Delta M_i|\) as the same value, according to which ever is the highest, the symmetrical and proportionality features can be materialised. In other word, the TI index is scaled to the highest value of either \(|\Delta X_i|\) or \(|\Delta M_i|\) for a given period of time. This will ensure when \(|\Delta X_i|\) or \(|\Delta M_i|\) approaching zero, both \(\frac{\partial TI}{\partial \Delta X_i} \rightarrow -\frac{1}{2\Delta X_i}\) and \(\frac{\partial TI}{\partial \Delta M_i} \rightarrow \frac{1}{2\Delta M_i}\) has the same value but opposite. Hence scale, symmetrical and proportionality features are achieved.

Table 4 Summarisation of the innovated TI index mathematical behaviour

<table>
<thead>
<tr>
<th>Situation</th>
<th>Differentiation</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>(</td>
<td>\Delta X_i</td>
<td>) the highest</td>
</tr>
<tr>
<td>(</td>
<td>\Delta M_i</td>
<td>) the highest</td>
</tr>
</tbody>
</table>

Comparing to the simple ratio of \(\Delta X/\Delta M\), the limiting behaviour is asymmetrical and disproportionate between both positive and negative sides. As such the result interpretation for the innovated TI index would show holistic and monotonous scenarios across changes. In parallel, symmetrical issues is tackled too along the way as consistency of behaviour is obtained on both positive and negative sides. This implies control is achieved. Perhaps the proportionality, scaling and symmetrical discussion can be visualised clearer when geometrically discuss in below section.

The Geometrical Model Structure of TI Index (The GTISB)
The geometrical model structure of the TI index is graphically shown in Figure 5 below.
As can be seen from Figure 5 above, the dynamic measurement of TI index is through the relationships between $\Delta X_i$ and $\Delta M_i$ of product $i$ over multiple time periods. The proposal is that the Trade Intensity Space (TIS) to measure how TI evolves over time. The relationship is disentangled via a Cartesian plane which is divided into four quadrants ($I$, $II$, $III$ and $IV$) to accommodate all possible positive and negative changes in values of $\Delta X_i$ and $\Delta M_i$. This will create a host country TIS box which enables the measurement of host country TI evolves over time. Thus this TIS box is to be named as Geometric Trade Intensity Space Box (GTISB).

The assumption is that for product $i$ over $n$ years (or quarters) for all $t$, $n = 1, 2, 3, \ldots, n$. The space dimensions of the GTISB on all four sides are determined by the maximum of $\Delta X_i$ or $\Delta M_i$. The length ($L$) of any of the four sides is determined by twice the maximum of the highest absolute change value of the denominator of equation (16) whichever the highest during the span period of consideration $t$. Hence, the total area of the GTISB for $i$ is an element of $t$ ($i \in t$) is $2 \times \max|\Delta X_i| = 2L$ or $2 \times \max|\Delta M_i| = 2L$. This is the key innovation whereby it enable this index to possess a scaling factor for a given time scale. In a way, it also enables the space to have a shape of a square box. With that, any changes within the square box should be symmetrical, scale invariant and proportional within the span period of times.

As can be seen in Figure 6 below, the square box is divided into two triangles, lower triangle ADC and upper triangle ABC. The triangle ADC is defined as the Net TI for $M_i$ (NTIM) while the triangle ABC is defined as the Net TI for $X_i$ (NTIX). The origin $O$ represents the unique case where the coordinate $(\Delta X_i, \Delta M_i) = (0, 0)$. The AOC line is a line representing perfectly matched TI changes or balance TI where $\Delta X_i = \Delta M_i$ and $TI = 0$. All other lines parallel to the AOC line are defined as equi-TI lines. Hence when $TI > 0$ (means trade intensity $\Delta X > \Delta M$) as the value of TI increasing positively towards $TI = 1$ the host market potential is decreasing.

Likewise when $TI < 0$ (means trade intensity $\Delta X < \Delta M$) as the value of TI decreasing negatively towards $TI = -1$ the host market potential is increasing.
Referring back to Figure 5, point F and point G that are on the same dynamic TI line share same TI values. Point H that located on a higher equi-TI line has higher TI value than point F and G. For example, consider the transition from point G to point H, when the value of \( \Delta M_i \) rises while the value of \( \Delta X_i \) remain the same, the equi-TI line move towards the North-West direction further away from the AOC equi-TI line of balance TI value. Similarly, the transition from point F to point K where there is no net changes.

In essence, the GTISB measure the changes in the balance of TI (\( \Delta NTI = \Delta X_i - \Delta M_i \)) over a multiple time period. Dynamically measuring the \( \Delta NTI \) is more appropriate as opposed to measuring changes in total TI (\( \Delta TTI = \Delta X_i + \Delta M_i \)) due to \( \Delta TTI \) is invariant to \( \Delta X_i \) or \( \Delta M_i \). The \( \Delta TTI \) line is in fact parallel to BOD line although not indicated in the figure. Mathematically it can be shown via the straight line equation \( Y = mX + C \) as follows: \( \Delta TTI = \Delta X_i + \Delta M_i; \Delta X_i = -\Delta M_i + \Delta TTI \) which is line parallel to BOD line with \( m = -1 \). This is because due to its summation equation \( \Delta TTI \) will always appear higher due to increase or decrease in either or both \( \Delta X_i \) and \( \Delta M_i \). Larger positive \( \Delta X_i \) while desirable theoretically may show higher TTI which may lead to erroneous interpretation that TI is increasing. Thus, \( \Delta NTI \) would show the correct evolution of TI due to \( \Delta X_i \) and \( \Delta M_i \). Due to its design, the TI index is scaled and has a ranking ability factor that shows how ranked TI changes over time and whether the direction of change is positive or negative.

**The Dynamic Measurement of TI Index in GTISB**

From Figure 5, assuming that changes are monotonically increasing, the TI value satisfy TI = 0 when \( \Delta X_i = \Delta M_i \), the measure of dynamic TIS that possess values that satisfies criteria I-IV of each quadrant for n years (or quarters) for t periods = 1, 2, 3, ...n and i product for I = 1, 2, 3, ...m is given by the TI index as depicted by equation (16).

Since Figure 5 is a square box, hence the point B and D would have coordinate of \((-\Delta M_i, \Delta X_i)\) and \((\Delta M_i, -\Delta X_i)\) accordingly. At these two points B and D, the value of \( \Delta X_i \) is equal to the value of \( \Delta M_i \) but with opposite sign. These two points are the farthest points. Hence, consider Table 5 below.
As shown in Table 5 above, the GTISB space boundary will take values from \(-1 < TI_i < 1\). This measurement is theoretically justified in describing the dynamic relationship between \(\Delta X_i\) and \(\Delta M_i\) over different time periods. If \(\Delta X_i > \Delta M_i\), the TI will take values in the range of \(0 < TI_i < 1\), the upper triangle ABC. In this case host country is experiencing greater change in export activity against change in import activity. This is signalling host country is having increasing demand and competitive advantage of product i from foreign countries while in the same time is importing lesser quantity of product i to cater niche host market. When \(\Delta X_i < \Delta M_i\), the TI will take values in the range of \(-1 < TI_i < 0\), the lower triangle ADC. In this case host country is experiencing greater change in import activity against change in export activity. This is signalling host country is having less demand and losing competitive advantage of product i from foreign countries while at the same time it is importing increasing quantity of product i to cater increasing host market demand.

### The Properties of TI Index in GTISB

After introducing the TI index as per equation (16), this section will propose four theorems that describe the desirable properties of the TI index.

**Theorem 1**

For every TI index, a unique straight line with constant gradient \(m = 1\) and an intercept of Y-axis exists. Hence, the TI index values will be the same for every point \((\Delta X_i, \Delta M_i)\) along the same iso-line. This can be proven as below:

\[
TI_i = \frac{(\Delta X_i - \Delta M_i)}{2(\max(\{|\Delta X_i|,|\Delta M_i|\}))}
\]

\[
(\Delta X_i - \Delta M_i)/2(\max(\{|\Delta X_i|,|\Delta M_i|\})).TI_i
\]

This is analogous to straight line equation \(Y = mX + C\) where \(m = 1\) while \(C = 2(\max(\{|\Delta X_i|,|\Delta M_i|\}))\).

**Theorem 2**

The TI index is symmetrical about the diagonal \(-\Delta X_i = \Delta M_i\) for each \(\Delta X_i = \Delta M_i\). This can be proven as below:

\[
TI_i = \frac{(\Delta X_i - \Delta M_i)}{2(\max(\{|\Delta X_i|,|\Delta M_i|\}))}
\]

\[
(\Delta X_i - \Delta M_i)/2(\max(\{|\Delta X_i|,|\Delta M_i|\})).TI_i
\]

\[
f(\Delta X_i, -\Delta M_i)
\]

\[
f(\Delta X_i, \Delta M_i) = \frac{(\Delta X_i + \Delta M_i)}{2(\max(\{|\Delta X_i|,|\Delta M_i|\}))}
\]

\[
f(\Delta X_i, -\Delta M_i) = \frac{(\Delta X_i - \Delta M_i)}{2(\max(\{|\Delta X_i|,|\Delta M_i|\}))}
\]

**Theorem 3**

The TI index is scaled to the largest value of either \(\Delta X_i\) or \(\Delta M_i\) for a given time period. It is therefore a proportionately scaled symmetrical measurement that allows the observation of how TI would evolve over time.
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across all countries/products combination without any further assumptions. This is proven as per derivation shown in section TI Index Innovations above. In either case ∆Xᵢ is highest or ∆Mᵢ is highest the same and opposite symmetrical proportionality limiting behaviour is observed.

Theorem 4
The space dimension of the GTISB is perfectly divided into symmetrical half by the equation of straight line ∆Xᵢ = ∆Mᵢ. This can be proven as below:

\[ TIᵢ = \frac{(ΔXᵢ - ΔMᵢ)}{2(\max(ΔXᵢ, ΔMᵢ))} \]

0 = ΔXᵢ - ΔMᵢ

ΔXᵢ = ΔMᵢ

Since the space dimension of the GTISB is a square box, thus the ∆Xᵢ = ∆Mᵢ is symmetrically dividing the space of GTISB into half when TIᵢ = 0

Supplementary Consideration
Consider equation (16) to be in below form instead:

\[ TIᵢ = \frac{(ΔXᵢ + ΔMᵢ)}{2(\max(ΔXᵢ, ΔMᵢ))} \]  \hspace{1cm} (17)

TIᵢ = 0 when ΔXᵢ = -ΔMᵢ and -ΔXᵢ = ΔMᵢ. This is the BOD line of the GTISB diagram in Figure 5. Since Figure 5 is a square box, hence the point A and C would have coordinate of (-ΔMᵢ, -ΔXᵢ) and (ΔMᵢ, ΔXᵢ) accordingly. At points A and C, the value of ΔXᵢ is equal to the value of ΔMᵢ with both will have same signs. These two points are the farthest points of the GTISB space. Hence consider Table 6 below.

<table>
<thead>
<tr>
<th>Table 6</th>
<th>The GTISB space boundary (supplementary consideration)</th>
</tr>
</thead>
<tbody>
<tr>
<td>At point A</td>
<td>[ TIᵢ = \frac{(ΔXᵢ + ΔMᵢ)}{2(\max(ΔXᵢ, ΔMᵢ))} ]</td>
</tr>
<tr>
<td>At point C</td>
<td>[ TIᵢ = \frac{(ΔXᵢ + ΔMᵢ)}{2(\max(ΔXᵢ, ΔMᵢ))} ]</td>
</tr>
</tbody>
</table>

As can be seen from Table 6 above, the boundary is still -1 ≤ TIᵢ ≤ 1. However the limiting behaviour is not the same. Consider Table 7 below which shows the limiting behaviour of equation (17). From Table 7 it can be seen that the constant limiting behaviours are on the positive side only while the infinity limiting behaviours are on the negative side only for both situations. It is asymmetrical which lead to imbalanced analysis. Thus, there is no symmetrical proportionality that can be obtained from equation (17). The analysis would produce bias result. Hence the rational for not choosing the total change of TI (ΔTIᵢ = ΔXᵢ + ΔMᵢ) due to its invariant to ΔXᵢ or ΔMᵢ changes.

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Table 7 Summarisation of the equation (17) mathematical behaviour

<table>
<thead>
<tr>
<th>Situation</th>
<th>Differentiation</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta X_i$ the highest</td>
<td>$T_i = \frac{\Delta X_i}{2\Delta X_i} + \frac{\Delta M_i}{2\Delta X_i}$</td>
<td>As $\Delta M_i \to 0$, $\left[ \frac{\partial T_i}{\partial \Delta M_i} \right] \to 1$</td>
</tr>
<tr>
<td></td>
<td>$T_i = \frac{1}{2} + \frac{\Delta M_i}{2\Delta X_i}$</td>
<td>$\left[ \frac{\partial T_i}{\partial \Delta X_i} \right] = \frac{1}{2\Delta X_i}$</td>
</tr>
<tr>
<td>$</td>
<td>\Delta M_i</td>
<td>$ the highest</td>
</tr>
<tr>
<td></td>
<td>$T_i = \frac{\Delta X_i}{2\Delta M_i} + \frac{1}{2}$</td>
<td>$\left[ \frac{\partial T_i}{\partial \Delta M_i} \right] \to -\infty$</td>
</tr>
</tbody>
</table>

**TI Index and GTISB Extension**

The host country A trade activity from Figure 4 can be broken down to two categories, volume and quality. Thus the TI\textsubscript{i} index of equation (16) can be extended to measure both categories. For the volume category:

$$V_i = \frac{(\Delta X_i - \Delta M_i)}{2(\max \{|\Delta X_i|, |\Delta M_i|\})}, \quad -1 \leq V_i \leq 1 \quad (18)$$

where $V_i$ is volume index of product $i$, $\Delta X_i$ is the changes for product $i$ export value and $\Delta M_i$ is the changes for product $i$ import value from start time to end time during a period. For the quality category:

$$MQ_i = \frac{(\Delta UX_i - \Delta UM_i)}{2\max \{|\Delta UX_i|, |\Delta UM_i|\}}, \quad -1 \leq MQ_i \leq 1 \quad (19)$$

where $MQ_i$ is Marginal Quality index of product $i$, $\Delta UX_i$ is the changes for unit export value and $\Delta UM_i$ is the changes for unit import value from start time to end time during a period. The associated GTISB are shown in Figure 7 and Figure 8 below.
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Additional extension to consider is when both of volume and quality are combined as per below suggestion equation:

\[ V_i + MQ_i = VQ_i -2 \leq VQ_i \leq 2 \]  \hspace{1cm} (20)

\[ MQ_i = -V_i + VQ_i -2 \leq VQ_i \leq 2 \]  \hspace{1cm} (21)

where \( VQ_i \) is the volume quality combination of product \( i \). Geometrically it is illustrated in Figure 9 below.
From equation (21) and Figure 9 above, it can be seen that $V_i$ and $MQ_i$ can be adjusted or trade-off while still maintaining the same respective $VQ_i$ iso-line. It is either to increase $V_i$ and decrease $MQ_i$ or vice versa while the total adjustment or trade-off would still be bound by the same respective $VQ_i$ iso-line. Furthermore, if the adjustment or trade-off of either $V_i$ or $MQ_i$ or both are too strong, it can causes jumping to other $VQ_i$ iso-line. As such this provides marketer a flexi strategy in either to focus either on volume or quality or both while still maintaining the same objective or change to new objective. From an initial value of $V_i$ and $MQ_i$, marketers can now have projected info and quantified visibility of what will happen by varying value of $V_i$ or $MQ_i$. Consider movement from a to b, b to c, c to a and a to d as illustrated in Figure 10 and explanation in Table 8 below.

![Figure 9: Geometric Volume Quality Intensity Space Box (GVQISB)](Adapted: Azhar and Elliott, 2011)

![Figure 10: Illustration of Adjusted V and MQ in GVQISB diagram](Adapted: Azhar and Elliott, 2011)

### Table 8 Effect of $V_i$, $MQ_i$, and $VQ_i$ by projecting their movements

<table>
<thead>
<tr>
<th>Movement</th>
<th>$V_i$</th>
<th>$MQ_i$</th>
<th>$VQ_i$</th>
<th>Host Market Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
<td>From</td>
<td>To</td>
<td>From</td>
</tr>
<tr>
<td>a to b</td>
<td>$V_i &gt; 0$</td>
<td>$V_i &lt; 0$</td>
<td>$MQ_i = 0$</td>
<td>$MQ_i &gt; 0$</td>
</tr>
<tr>
<td>b to c</td>
<td>$V_i &lt; 0$</td>
<td>$V_i &gt; 0$</td>
<td>$MQ_i &gt; 0$</td>
<td>$MQ_i &gt; 0$</td>
</tr>
<tr>
<td>c to a</td>
<td>$V_i &gt; 0$</td>
<td>$V_i &gt; 0$</td>
<td>$MQ_i &gt; 0$</td>
<td>$MQ_i = 0$</td>
</tr>
<tr>
<td>a to d</td>
<td>$V_i &gt; 0$</td>
<td>$V_i &gt; 0$</td>
<td>$MQ_i = 0$</td>
<td>$MQ_i &gt; 0$</td>
</tr>
</tbody>
</table>

Note: $H_v$ and $H_q$ is host country possessing market potential in volume and quality perspective, $F_v$ and $F_q$ is foreign country possessing market potential in volume and quality perspective.
From Table 8 above it can be observed that host market potential prediction effect and consequence by varying volume and quality trade-off can be visualised and quantified. This should be a strong tool for marketer planning strategy.

DISCUSSIONS

In this section, the empirical illustration of TI index in measuring trade intensity shall be discussed. The export and import data shall be secondary data obtained from International Trade Centre (ITC) by using Harmonised System (HS) product code of HS 6-digit. Consider Malaysia as host and Singapore as partner country for HS040630 (processed cheese, not grated or powdered) in measuring trade intensity between both countries. The host country TI range, market potential as well as net trade intensity direction can be allocated as Table 9 below. The TI index shall be compared with T index used by World Bank.

<table>
<thead>
<tr>
<th>TI range</th>
<th>Trade intensity (Host country point of view)</th>
<th>Net trade intensity direction</th>
<th>Host country market potential (partner country point of view)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.6 ≤ TI ≤ 1.0</td>
<td>HVH</td>
<td>HVH</td>
<td>HVH</td>
</tr>
<tr>
<td>TI = 0.5</td>
<td>H</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>0.1 ≤ TI ≤ 0.4</td>
<td>H</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>TI = 0</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>-0.1 ≤ TI ≤ -0.4</td>
<td>H</td>
<td>P</td>
<td>H</td>
</tr>
<tr>
<td>TI = -0.5</td>
<td>H</td>
<td>P</td>
<td>H</td>
</tr>
<tr>
<td>-0.6 ≤ TI ≤ -0.1</td>
<td>HV</td>
<td>PV</td>
<td>HV</td>
</tr>
</tbody>
</table>

Note: PVH = Partner Very High; P = Partner; H = Host; VH = Very High; IH = Intermediate High; HL = Host Low; HL = Intermediate Low; VL = Host Very Low; E = Equilibrium

The TI and T calculation matrix is shown in Table 10 while Figure 11 shows the associate GTISB of respective TI. As observed, T index indicates that Malaysia was having intense bilateral trade flow going to Singapore. Malaysia export share was tremendously high relative to world export share going to Singapore. In 2012 the T index was very high and increased in 2013 but then it suffered very significant decrease in the following years of 2014 and 2015 and further dropped in 2016. In 2017 the T index increased back again albeit not that significant compared to previous years. This implies that in 2012 Malaysia was having very intense bilateral trade flow going to Singapore and the intensity increased in 2013 but then it dropped drastically in following years of 2014 until 2016 but rose up again a bit in 2017. Nevertheless, according to the T formula, Malaysia was considered to be having an intense trade relationship with Singapore throughout the years from 2012 to 2017 by having significant export share relative to the world export share to Singapore despite Malaysia was in fact importing more from Singapore.

Whereas looking at TI index, initially it showed that Malaysia was having an intermediate low bilateral trade intensity with Singapore (2013 – 2012) and the TI moved further down towards very low range (2014 – 2013). However TI increased symmetrically to very high range in the following two years (2016 – 2014) but fell down again to intermediate low range (2017 – 2016). This means that for change period (2013 – 2012), (2014 – 2013) and (2017 – 2016), in term of Malaysia bilateral export and import with Singapore, Malaysia’s change in import was greater than change in export which implies that Malaysia was indeed importing more from Singapore despite T index indicated that Malaysia was having intense bilateral export share relative to world export share to Singapore. For change period (2015 – 2014) and (2016 – 2015) the TI and T indices matched in indicating that Malaysia was having very intense bilateral export to Singapore. In parallel, as the net trade intensity direction changes, the host country market potential from the point of view of partner/foreign country also changes which could be transformed into market selection information for potential export opportunity.
Table 10 Comparative of TI and T index between Malaysia and Singapore

<table>
<thead>
<tr>
<th>Host Country</th>
<th>Malaysia</th>
<th>Partner Country</th>
<th>Singapore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product (i)</td>
<td>HS040630</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>∆Year</td>
<td>X_{ms}</td>
<td>X_{mt}</td>
</tr>
<tr>
<td>2012</td>
<td></td>
<td>534</td>
<td>817</td>
</tr>
<tr>
<td>2013</td>
<td>2013 - 2012</td>
<td>567</td>
<td>808</td>
</tr>
<tr>
<td>2015</td>
<td>2015 - 2014</td>
<td>308</td>
<td>1516</td>
</tr>
<tr>
<td>2016</td>
<td>2016 - 2015</td>
<td>363</td>
<td>2611</td>
</tr>
<tr>
<td>2017</td>
<td>2017 - 2016</td>
<td>263</td>
<td>1405</td>
</tr>
</tbody>
</table>

Note: X_{ms} = Export Malaysia to Singapore; X_{mt} = Total Malaysia Export; X_{ws} = World Export to Singapore; X_{wt} = Total World Export; M_{ms} = Import Malaysia from Singapore; NTID = Net Trade Intensity Direction; HTI = Host Trade Intensity; HMP = Host Market Potential

CONCLUSIONS

The measurement of TI through the simple relationship ratio between ∆X_{i} and ∆M_{i} impetus has shown that simple ratio has bias and imbalance characteristics. This leads to disproportionate and asymmetrical result analysis. Nevertheless with the innovative idea produced by equation (16), a proportionate, symmetrical and scale invariant analysis of TI is able to be achieved and applied. The proposed TI index measured within GTISB diagram of a square box has enabled a new way of analysis. In addition, the possible extension of TI index and GTISB into
A Measure of Trade Intensity and Country Market Potential

volume and quality base together with doable trade-off mechanism of both is a new frontier of analysis. With that a country market potential in terms of volume and quality perspective are possible to be measured and derived through TI index and GTISB. This proposed measurement does not require the difficulty of choosing suitable base period as the entire time span periods of measurements are encapsulated inside the GTISB. Thus a country market potential across products and tim

REFERENCES


