Investigating Agricultural Intra-Industry Trade: A Comprehensive Case Study in Vietnam

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Abstract

Intra-industry trade (IIT) and trade dynamics play rising roles in the international economic literature recently. This article investigates Vietnam's agricultural IIT defined by GLI in the world market and the dynamics of GLI indicators in five ways: MIIT, OLS, Markov matrix, time series, and piecewise to understand economic changes from different angles. The paper finally tests the relationship between IIT and trade specialization. The results indicate that Vietnam has the inter-industry trade in 42 agricultural sectors while it has the IIT in only 19 sectors. The country's agricultural IIT pattern is convergent and the degrees of the IIT are relatively mobile over time. Vietnam obtains the increasing IIT trends in 21 agricultural sectors while it has the decreasing IIT trends in 13 sectors. The event in 2008 results in 14 agricultural IIT breakpoints. The study, remarkably, confirms that IIT and trade specialization are inversely correlated and this empirical result is consistent with international trade theory.

JEL: F10, F14, Q17

Keywords*:* Vietnam, agriculture, intra-industry trade, dynamics, specialization, consistency

1. INTRODUCTION

The traditional economic theories explain the global inter-industry trade based on comparative advantages with the assumption of constant returns to scale, homogeneous products, and perfect competition. The ratio of intra-industry trade (IIT) in the world trade, however, has strongly increased since the 1960s and it plays an even more important role in the trade of manufactured commodities among developed industrial nations, which accounts for the majority of world trade (Krugman et al., 2012). During recent decades, intra-industry trade has become a widespread phenomenon with an increasing volume of studies to deal with and provide a theoretical basis for this issue (Brulhart, 2009). The concept of intra-industry trade can be defined as the simultaneous export and import of products belonging to the similar statistical commodity category (Ferto & Jambor, 2015).

The literature on growth and trade states that the international trade flow and intra-industry trade are dynamic and they evolve endogenously over time. The dynamics of trade performances commonly reflects deep structural changes in the entire economy of a country, as the resources and competitive advantages cannot change quickly despite sudden shocks, new technology, and institutional systems (Zaghini, 2005; Ferto & Soos, 2008).

The studies in intra-industry trade, however, generally is focused on manufactured commodities and there have been very few attempts to measure the static and dynamic pattern of agricultural trade of developing and transiting economies in the context of new international trade theories. The research of McCorriston & Sheldom (1991) is one of the early attempts analyzing the pattern of IIT in agricultural products for the USA and the EU. The possible reason is that agricultural markets are assumed to be competitive. Sexton (2012) and Jambor (2015), however, confirm the view that agricultural markets can be characterized by imperfect competition and IIT has an increasing role in agricultural trade for both developed and developing countries. The other potential explanation is the limit of the qualities and characteristics of agricultural goods. The recent empirical studies in agricultural intra-industry trade such as Bojnec (2001), Qasmi & Fausti (2001), Sharma (2002), Wang (2009), Leitão (2011), Rasekhi & Shojaee (2012), Varma, (2012), Jambor (2014), and Ferto (2015) support to these literature views. Most of the authors measure and identify the determinants of IIT while none of them comprehensively analyzes agricultural IIT in both static and dynamic manners and test the relationship between intra-industry trade and trade specialization.

This paper is the initial attempt to investigate the static agricultural IIT by the Grubel–Lloyd (GL) index (Grubel & Lloyd, 1975) at 3-digit groups and analyze the dynamics pattern of the indicators by MIIT, OLS regression, Markov matrix, time series regression, and piecewise regression in the transiting and reforming economy of Vietnam over the period 1997-2014. It, moreover, measures the vertical and horizontal IIT at 5-digit items to understand the nature of Vietnam's agricultural IIT. The study, finally, tests the relationship between IIT defined by GLI and the specialization indicators defined by RCA and LFI.

Vietnam's economic system has been reformed with the goal of creating a socialist-oriented market economy since Doi Moi (Renovation) in 1986 and the country has comprehensively integrated into the global economy since the early 1990s. Vietnam has become the member of regional and global trade organizations and schemes such as AFTA, APEC, WTO, and TPP, and signed bilateral trade agreements with the U.S., Japan, Chile, Korea, EEU, and EU.

The country's economic development and restructure have been significantly supported by the strong agricultural export performances. Vietnamese agricultural sectors have the relative comparative advantages due to its favorable natural conditions and the low input costs such as labor, land, water, and energy to produce the plentiful kinds of agricultural products with competitive prices. The industry remains an essential and constant contributor to Vietnam's economy and society. In 2014, it contributes to 17.7 percent of the GDP and 17 percent of the export value (WB, 2017). It also accounts for about 48 percent of total employment as the third most dependent country on agricultural employment in the world (WB, 2017). The country's agricultural sectors, however, encounter poor productivities, low added value per workers, small-scale farms, increasing input costs, and serious environmental impacts with the growing import values and fierce competition in the global markets. This study, therefore, contributes to both academic literature and practical applications. First, this paper is the first empirical study of agricultural IIT in a transiting and reforming case. Second, the article broadens empirical trade analysis by employing the different dynamic frameworks to identify the mobility, stability, and trend of IIT and the impact of an event. Third, the results will provide the critical indicators of agricultural IIT for government in making policy and enterprises in building business strategy.

The rest of the paper is structured as follows: Section 2 provides the literature review in international economics and intra-industry trade; following part 2, Section 3 explains the frameworks and the data employed in this research; Section 4 presents and discusses the empirical results in Vietnam; and Section 5 concludes the findings and provides implications for the agricultural strategy in Vietnam and for the future research.

2. LITERATURE REVIEW

According to the classical economic theory, countries will gain the benefit from the international trade if they specialize in producing and exporting goods or services with relatively lower labor costs and import goods or service with relatively higher labor costs based on the assumption of constant returns to scale, homogeneous products and perfect competition. In other words, a country should produce and export products where it has comparative advantages in and import the other products. This process is called inter-industry trade. Countries, however, simultaneously export and import similar products belonging to the same statistical product classifications. The process is defined as the intra-industry trade and the notion is usually applied to international trade, where the same types of goods or services are both imported and exported by a nation. The traditional trade model fails to explain towards the intra-industry trade as under the assumptions countries with identical factor endowments would not trade while Lancaster (1980) shows that intra-industry trade certainly occurs when the economies are absolutely identical in all respects and can persist under conditions of comparative advantage. Helpman &

Krugman (1999) point out that comparative advantage drives inter-industry trade through specialization while economies of scale drive intra-industry trade.

The theory of intra-industry trade has been grown out of the empirical studies of Balassa (1966) and Grubel (1967). These scholars analyze the impact on trade among EEC countries resulting from increasing economic integration. The findings confirm that trade expansion of EEC countries is primarily intra-industry rather than inter-industry for industrial products. The result of the authors is surprising and contrary to traditional trade theory, which explains trade patterns resulting from differences in factor endowments among trading partners.

Finger (1975) supposes that the occurrence of intra-industry trade is ordinary because the existing classifications place goods of heterogeneous factor endowments in a single group. However, the evidence from scholars proves that even when industries are disaggregated to extremely levels intra-industry still comes up. The theoretical underpinnings of intra-industry trade are based on (i) product differentiation, (ii) monopolistic competition, (iii) economies of scales, (iv) variety of consumer demand, and (v) similarity in consumer preferences (Gray, 1973; Grubel & Lloyd, 1975; Lancaster, 1980; Falvey, 1981; Helpman, 1981; Brander & Krugman, 1983; Helpman & Krugman, 1985; Greenaway & Milner, 1986; Qasmi & Fausti, 2001).

There are three types of intra-industry trade: (i) trade in homogeneous goods; (ii) trade in horizontally differentiated goods; and (iii) trade in vertically differentiated goods. The first kind of IIT is explained simply that firms have a segmented markets perception and the possibility of the kind of two-way trade is relatively robust (Brander & Krugman, 1983). The horizontal IIT arises when different varieties of a homogeneous commodity with similar quality are characterized by different attributes (in Lancastrian theory). The vertical IIT relates to products traded with different quality and price at different levels of a commodity, typically at different stages in the global processing chain and multinational company (Greenaway et al., 1994; Pittiglio, 2012; Arip et al., 2011). The horizontal IIT is more potential between countries with similar factor endowments, while the vertical IIT arises because of factor endowment differences across countries (Falvey & Kierzkowski, 1987; Jambor, 2014).

In the empirical studies on evaluating intra-industry trade, the Grubel & Lloyd (1975) index (GLI) is the most common and basic measure employed to identify the level or degree of intra-industry trade of a product. In the case of an aggregate trade imbalance, the authors suggest the adjustment to the above index. These indices have been employed and modified in several theoretical and empirical studies.

Greenaway et al. (1995), based on the approach of Abd-el-Rahman (1991), suggest an empirical method to identify the horizontal IIT and the vertical IIT. Products are horizontally differentiated if the unit values of exports compared to the unit values of imports are within a 15 percent range, otherwise, they are vertically differentiated products. Fontagne & Freudenberg (1997) build, upon also the approach of Abd-el-Rahman (1991), a different method for classifying trade flows and measuring the share of each category in total trade. The scholars define trade to be two-way when the value of the minority flow represents more than 10 percent of the majority flow. If the value of the minor flow is less than 10 percent, trade is classified as inter-industry in nature. Both these indices use the ratio of export to import crude unit values to reveal quality differences. A unit value is computed by dividing the monetary value of trade by the quantity to give a price per ton (or other units).

Blanes & Martın (2000) verify the distinction between high and low vertical intra-industry trades by the relative unit value of a good. A unit value below 0.85 indicates low vertical intra-industry trade while a unit value above 1.15 shows high vertical intra-industry trade.

Nilsson (1997) proposes a new index to measure the level of intra-industry trades instead of the share between unequal partners. The matched trade is divided by the number of products traded to produce the average degree of IIT per product. The author explains that this indicator provides a better indication of the extent and volume of IIT than GLI indices and is more appropriate in cross-country IIT analyses.

The GLI, however, is a static measure and it fails to reflect the changes in the structure of trade flows and patterns over time (Thorpe & Zhang, 2005). The index is also limited to apply for one-country analyses and it provides no implications of the sectoral and geographical distribution of the costs and benefits from specialization (Brulhart, 1994). Hamilton & Kniest (1991) introduce the concept of a marginal or dynamic measure of intra-industry trade and scholars have suggested frameworks to measure the dynamics of intra-industry trade over time (abbreviated as MIIT) such as Brulhart (1994, 2000), Oliveras & Terra (1997).

The empirical studies, recently, emphasize on identifying the determinants of vertical or horizontal intra-industry trade at country level by various econometric models such as Panel regression, Generalized estimating equation, OLS, Fixed effects, GMM-SYS, FGLS, Pooled regression, Fixed effect, Random effect, and Tobit. The vertical IIT and horizontal IIT indicators are determined by the explanatory variables such as Difference in per capita GDP, Difference in GDP, Average of GDP, MinGDP, Max GDP, Economic size, Geographical distance, Market structure, Scale economies, Common border, Foreign direct investment, Liberalized trade, Capital, Human capital, Land, and Gini (Greenaway et al., 1999; Blanes & Martın, 2000; Thorpe & Zhang, 2005; Sichei et al., 2007; Cabral et al., 2011; Jansen & Luthje, 2009; Leitao et al., 2010; Pittiglio, 2012; Ferto & Jambor, 2015; Bojnec & Ferto, 2016).

3. METHODOLOGY AND DATA

Measuring the agricultural intra-industry trade and trade specialization

This paper employs the Grubel–Lloyd (GL) index (Grubel & Lloyd, 1975) to measure the intra-industry trade of Vietnam's agricultural sectors over the period at the product category level. According to the authors, to facilitate comparisons of the balance trade measures for different industries and countries it is useful to present them as a percentage of each industry's combined exports and imports. The index can be presented formally as follows:

$$GLI_j = 100\ \frac{[(X_j + M_j) - |X_j - M_j|]}{(X_j + M_j)}$$

where X_j and M_j are the values of export and import of product category *j* of Vietnam in the world market. The index implies the degree of balanced trade or overlap between exports and imports. The GLI values vary between 0 (complete inter-industry trade) and 100 (complete intra-industry trade). The higher the GLI values are, the stronger intra-industry trade would be, and vice versa. The GL index can also be empirically expressed as follows:

$$GLI_j = 1 - \frac{|X_j - M_j|}{(X_j + M_j)}$$

The GLI values, in this case, vary between 0 (complete inter-industry trade) and 1 (complete intra-industry trade) and the economic indications are the same. To identify a trade as intra- or inter-industry, it is useful to classify the values of GLIs into four groups. Following Qasmi & Fausti (2001) and Banterle & Carraresi (2007), this paper uses the classification as table 1:

Table 1: The classification of GLI values

Class 1	$0.00 \leq GLI \leq 0.25$	Strong inter-industry trade
Class 2	$0.25 < GLI \leq 0.50$	Weak inter-industry trade
Class 3	$0.50 < GLI \leq 0.75$	Weak intra-industry trade
Class 4	$0.75 < GLI \leq 1$	Strong intra-industry trade

The GL index can be aggregated to the level of a country and an industry to compare between countries and industries as follows:

$$GLI = \sum_{j=1}^{n} GLI_j\, w_j, \qquad \text{where } w_j = \frac{(X_j + M_j)}{\sum_{j=1}^{n}(X_j + M_j)}$$

where w_j denotes the share of industry *j* in total trade.

According to Greenaway et al. (1995), it is important to assess the vertical and horizontal intra-industry trade and a satisfactory method must be found to measure the quality difference in trade. The authors propose an approach to disentangle the vertical and horizontal intra-industry trade using relative unit values (UV) indices of exports and imports. The UV indices measure the average price of a bundle of items in a given group based on assuming perfect information, a product sold at a higher price must be higher quality than a product sold at a cheaper price. Even with imperfect information, prices still tend to reflect quality (Stiglitz, 1987). The approach is presented formally as follows:

$$1-\alpha \leq \frac{UV_j^X}{UV_j^M} \leq 1+\alpha$$

where UV means unit values, X and M means exports and imports for goods j and α = 0.15 (or 0.25). A product is horizontally differentiated if the unit value of exports compared to the unit value of imports lies within a 15 (or 25) percent range, otherwise, they define vertically differentiated products. Greenaway et al. (1995) and Ferto & Jambo (2015) state that results coming from the selection of 15 percent and 25 percent ranges are not significantly changed.

According to Brulhart (1994), the GLI is defined to be static by empirical investigation. Even though the index reflects the trade flows of goods, it is still referred to be a static nature as it measures the IIT for one year. Brulhart (1994), based on the first suggestion of Hamilton & Kniest (1991) proposes the index of marginal intra-industry trade (MIIT) which relate to the change in these intra-industry trade flows between two years. The MIIT of product *j* between any two years under investigation is stated as follows:

$$MIIT_j = 1 - \frac{|\Delta X - \Delta M|}{|\Delta X| + |\Delta M|}$$

This index, similar to the GLI measure, varies between 0 and 1, where 0 indicates marginal trade in the particular industry to be complete inter-industry trade, and 1 represents marginal trade to be entire intra-industry trade.

The specialization indicators are calculated by the revealed comparative advantage (RCA) index (Balassa, 1965) and the Lafay (LF) index (Lafay, 1992) to test the relationship between intra-industry trade and trade specialization. The RCA index can be formally defined as follows:

$$RCAI_j = \left[\frac{X_j}{X_t}\right] \div \left[\frac{X_{wj}}{X_{wt}}\right]$$

where X_j represents the country's export of product j, X_t is the total export of the country. X_{wj} is the world's export of commodity j, and X_{wt} is the total export of the world. It is noted that t may be a group of products and w may also mean a group of countries. The value of RCAI ranges between 0 and + ∞, and the comparative-advantage-neutral point is 1. A greater than 1 RCAI value indicates that the country has a comparative advantage while a smaller than 1 RCAI value indicates a comparative disadvantage.

The LF index of a country in product j is expressed as follows:

$$\mathrm{LFI_j} = 100 \times \left[\frac{\mathrm{X_j} - \mathrm{M_j}}{\mathrm{X_j} + \mathrm{M_j}} - \frac{\sum_{\mathrm{j=1}}^{\mathrm{N}}(\mathrm{X_j} - \mathrm{M_j})}{\sum_{\mathrm{j=1}}^{\mathrm{N}}(\mathrm{X_j} + \mathrm{M_j})}\right] \times \frac{\mathrm{X_j} + \mathrm{M_j}}{\sum_{\mathrm{j=1}}^{\mathrm{N}}(\mathrm{X_j} + \mathrm{M_j})}$$

where $\mathrm{X_j}$ and $\mathrm{M_j}$ are export and import of product j realized by the country to the rest of world. N is the number of analyzed items under investigation. The value of LFI is between -∞ and +∞ and the comparative-advantage-neutral point is zero. The positive values of LFI imply comparative advantage and specialization, higher values of LFI confirm higher degrees of specialization and the sectors make bigger contributions to the trade balance. On the other hand, the negative values of LFI state the reliance on imports or an absence of specialization.

Assessing the dynamics of the agricultural GLI indicators

There are various approaches to assess the dynamics of the international trade performance. This paper, as well as the MIIT index above, employs: (i) OLS regression to analyze the general GLI pattern of a country from one period to the next; (ii) Markov transition matrix to measure the stability and mobility of the GLI values and; (iii) time series regression to analyze and predict the GLI trends of specific agricultural commodity groups over time.

Following Dalum et al. (1998), the first type of stability of the GLI is analyzed by using ordinary least squares (OLS) regression model employed by Hart & Prais (1956) and Cantwell (1989) for the first time. The regression model applied to estimate the stability of the GLI of a particular country in this paper can be defined as follows:

$$\mathrm{GLI}_j^{t2} = \alpha + \beta \mathrm{GLI}_j^{t1} + \varepsilon_j$$

where t_1 and t_2 are the initial and the final year respectively, j is the commodity group under investigation, α is a constant, β is a coefficient regression, and ε_j is a residual term. The GLI_j^{t2} denotes the GLI at time t_2 for commodity group j, is the dependent variable and tested against the independent variable of the GLI at time t_1 for the same commodity group, GLI_j^{t1}. Dalum et al. (1998) affirm that the method is one of the ways to compare two cross-sections or cross-countries at two points in time. In the present study, it is assumed that the regression is linear and the residual ε_j is stochastic ($\varepsilon_j \sim N(0, \sigma)$).

The explanation of the regression results is as follows. If $\beta = 1$, the country has unchanged pattern of intra-industry trade from t_1 to t_2. If $\beta > 1$, the country obtains higher intra-industry trade in the initially strong intra-industry trade commodities and becomes higher inter-industry trade in the initially strong inter-industry trade commodities. The values of $0 < \beta < 1$ indicate the opposite economic implications. If $\beta = 0$, then there is no relation between the GLIs in the two periods. If $\beta < 0$, the intra-industry trade positions of the groups are reversed.

According to Dalum et al. (1998) and Cantwell (1989), another feature of the regression analysis is to test whether the degree of intra-industry trade changes over time and $\beta > 1$ is not a necessary condition for growth in the overall intra-industry trade pattern. The authors explain the sufficient condition for intra-industry trade is as follows. The variance of the IIT index at year $t2$ of group j is denoted by $(\sigma_j^{t2})^2$ then:

$$(\sigma_j^{t2})^2 = \beta_j^2(\sigma_j^{t1})^2 + \sigma_\varepsilon^2$$

where β_j^2 is the square of regression coefficient, $(\sigma_j^{t1})^2$ is the variance of the IIT at year $t1$, and σ_ε^2 is the variance of the error term. The coefficient of determination R_j^2 is defined as:

$$R_j^2 = 1 - \frac{\sigma_\varepsilon^2}{(\sigma_j^{t2})^2} = ((\sigma_j^{t2})^2 - \sigma_\varepsilon^2)(\frac{1}{(\sigma_j^{t2})^2})$$

combining these two above equations, we have

$$(\sigma_j^{t2})^2 - \sigma_\varepsilon^2 = \beta_j^2(\sigma_j^{t1})^2 = R_j^2(\sigma_j^{t2})^2$$

rewriting this equation to present the relationship between the variance of the two distributions:

$$\frac{(\sigma_j^{t2})^2}{(\sigma_j^{t1})^2} = \frac{\beta_j^2}{R_j^2}$$

this equation can be simplified to:

$$\frac{\sigma_j^{t2}}{\sigma_j^{t1}} = \frac{|\beta_j|}{|R_j|}$$

The dispersion of a given GLI distribution is unchanged when $\beta = R$. The $\beta > R$ means an increase in the dispersion of the GLI distribution. The $\beta < R$ indicates a decrease in the dispersion of the GLI distribution.

Employing the OLS regression in the study of Dalum et al. (1998), however, requires the intra-industry trade values to be symmetry with the neutral point of zero, normality distribution, and eliminating extreme values. This study, thus, transforms GL index into TGL index without impact on the economic nature of the indicator by the formula as follows:

$$TGLI = 2GLI - 1$$

where the TGLI is the transformed values of the GLI indicators. The TGLI values are in (-1, +1) and zero is the neutral point of inter- and intra-industry trade. The GLI and the TGLI present the similar economic indications. The GLI values in the mentioned OLS regression will be replaced by the TGLI values with the similar economic explanation.

The second type of stability the GLI is assessed in two ways. First, following the empirical method utilized first by Proudman & Redding (2000), this study employs the one-step Markov chains to analyze the probability of transition between four classes in terms of the moving from an initial class to other classes in one-step of moving (moving within two adjacent years) and the persistence of stability in the initial class. In a second way, the paper utilizes a mobility index to analyze the mobility degree of the GLI indicators. The index identifies the degree of mobility throughout the entire distribution of the GLI and facilitates direct cross-sectors comparisons over the full period. The index M, following Shorrocks (1978), assesses the trace of the transition probability matrix. This M index, thus, directly captures the relative and medium magnitude of diagonal and off-diagonal terms, and the equation of M index can be shown as follows:

$$M = \frac{n - tr(P)}{n - 1}$$

where, M is Shorrocks index; n is the number of classes; P is the transition probability matrix; and $tr(P)$ is the trace of P. A higher value of M index states greater mobility (the upper limit is two in our case), with a value of zero indicating perfect immobility.

The paper, moreover, uses the time series regression to test and predict the GLI trend of a particular commodity over time. This analysis for the trends in increasing, decreasing, or maintaining intra-industry trade in a commodity is based on comparing the changes of the GLI values between the two years in the period. The model is presented as follows:

$$\text{GLI}_{j,t} = \alpha_j + \beta_j t + \varepsilon_{j,t}$$

where α_j is constant; β_j is the regression coefficient showing the GLI trend; t is the time index; and $\varepsilon_{j,t}$ is a residual term. Vietnam's GLI in agricultural commodity j can be considered unchanged if the estimated β_j is close to zero (this study uses the significance level of 10 percent). The value of $\beta_j > 0$ indicates a trend in increasing the intra-industry trade while the value of $\beta_j < 0$ means a trend in decreasing the intra-industry trade.

Analyzing the breakpoints of the agricultural GLI indicators by piecewise regression

Following Toms et al. (2003) and Chen et al. (2010), this paper employs the piecewise (also known as segmented or broken-stick) regression to investigate the breakpoints or structure changes of the GLI values after the world food and financial crisis in 2008 (from 1997 to 2008, and from 2008 to 2014). This approach is recently applied by Seleka & Kebakile (2017) for the comparative advantage change of Botswana's beef industry. To conduct a statistical test for this purpose, this study estimates a two-period piecewise growth regression of the IIT as follows:

$$\text{GLI} = \beta_0 + \beta_1 Y_t + \beta_2 (Y_t - 2008) D_t + \varepsilon_t$$

where GLI is the intra-industry trade indicators of agricultural commodities of Vietnam, Y_t represents the year (1997, 1998,..., 2014). D_t is the dummy variable for capturing the differential growth for period 2 (D_t = 0 for 1997 to 2008 and D_t = 1 otherwise). β_0, β_1, and β_2 are parameters to be estimated; ε_t is the error term. In the equation, β_1 means the annual change in the GLI indicators during the period 1997 - 2008 and $\beta_1 + \beta_2$ is the annual change in the GLI indicators for the period 2008 - 2014. The paper statistically test the hypotheses that the GLI indicators increase during the period 1997 - 2008 ($\beta_1 > 0$) and they decrease during 2008 - 2014 ($\beta_1 + \beta_2 < 0$; therefore $\beta_2 < 0$ and $|\beta_2| > \beta_1$).

Testing the relationship between intra-industry trade and trade specialization

In the traditional economic theory, the international trade specialization trade is identified as the only source of global trade, and practically the entire body of normative trade literature is based upon this faith. However, it is relatively evident, from the global trade data, that substantial trade flows are not related to specialization (Aquino, 1978). Helpman & Krugman (1999), especially, point out that comparative advantage drives inter-industry trade through specialization while economies of scale drive intra-industry trade.

This study employs the Pearson correlation coefficient to test the relationship between intra-industry trade and trade specialization. The variable of intra-industry trade is defined by the GLI and the variable of trade specialization is defined by the RCAI and the LFI. The measures of relationship are to compare correlation coefficients for pairs of the GLI with the RCAI and the LFI for 61 agricultural commodity groups over the period 1997-2014. The positive correlation coefficients indicate the positive relationships between the indices and concepts, and vice versa. A correlation coefficient of unity confirms the perfect relationships between the indices (positive unity for directly related and negative unity for inversely related indices). The greater than or equal 0.7 correlation coefficients indicate the strong relationships.

Scopes and data

There are different definitions and scopes of agricultural products. This study follows the definition of EU and WTO in the Revision 3 of Standard International Trade Classification (SITC Rev. 3). According to the EU's definition in SITC Rev. 3 agricultural products cover the codes of 0 + 1 + 21 + 22 + 231 + 24 + 261 to 265 + 268 + 29 + 4. The trade data for this study is mainly extracted from the UN Comtrade based on the SITC Rev. 3. The SITC Rev. 3 offers five levels of commodity aggregation such as 1-digit sections down to 2-digit divisions, 3-digit groups, 4-digit subgroups and 5-digit items. This paper calculates the comparative advantages at 3-digits with 61 agricultural commodity groups over the period 1997 – 2014.

4. RESULTS AND DISCUSSION

Measuring the agricultural intra-industry trade by the GLI

The result in Table 2 shows that, in 2014, Vietnam has the highest export values in crustaceans,molluscs; coffee,coffee substitute; rice; fish,fresh,chilled,frozn; fruit,nuts excl.oil nuts; and fish etc.prepd,prsvd.nes with over two billions USD values and it also gains the most trade surplus in these products. The country has the most import values in animal feed stuff; cotton; wood,simply worked; and maize unmilled and it also incurs the most trade deficit in these commodities. Vietnam obtains the strongest intra-industry trade in five agricultural commodity groups such as non-alcohol.beverage,nes; fixed veg.fat,oils, soft; eggs,birds,yolks,albumin; sugars,molasses,honey; and cocoa with the GLI values of 0.96, 0.92, 0.85, 0.84, and 0.79 respectively. There is no complete intra-industry trade, the country, whereas, gains the complete inter-industry trade in eight commodity groups such as vegetable textile fibres; wool,other animal hair; wood in chips,particles; wheat,meslin,unmilled; butter,other fat of milk; barley,unmilled; furskins,raw; and cork,natural,raw,waste. In which, vegetable textile fibres and wood in chips,particles have the extremely higher exports than imports whilst other agricultural commodities have very small export values.

The country, at 3-digit level, has the intra-industry trade in 19 agricultural commodity groups (accounting for 31 percent) with 5 strong intra-industry trade groups and inter-industry trade in 42 agricultural commodity groups (accounting for 69 percent) with 30 strong inter-industry trade groups (Table 2). At 5-digit level, the share of the agricultural IIT is 20 percent while the share of the agricultural inter-industry trade is 80 percent in total 394 observations. This different result between the analyses at 3-digit level and at 5-digit level means that the more industries are disaggregated to extreme levels the less intra-industry trades come up.

Table 2: Vietnam's agricultural trade and intra-industry trade at 3-digits in 2014 (selected)

Code	Commodity	Export (*million $*)	Import (*million $*)	Trade balance (*million $*)	GLI
111	Non-alcohol.beverage,nes	84.12	78.09	6.03	**0.96**
421	Fixed veg.fat,oils, soft	125.49	107.27	18.22	**0.92**
025	Eggs,birds,yolks,albumin	6.78	9.13	(2.35)	**0.85**
061	Sugars,molasses,honey	253.88	183.87	70.02	**0.84**
072	Cocoa	6.68	10.22	(3.54)	**0.79**
047	Other cereal meal,flours	3.15	1.88	1.27	0.75
248	Wood, simply worked	274.51	1,222.11	(947.60)	0.37
034	Fish,fresh,chilled,frozn	2,691.29	499.96	2,191.32	0.31
036	Crustaceans,molluscs etc	3,000.65	543.90	2,456.75	0.31
081	Animal feed stuff	489.63	3,259.30	(2,769.66)	0.26
044	Maize unmilled	30.75	1,215.95	(1,185.20)	0.05
071	Coffee,coffee substitute	3,557.41	81.44	3,475.98	0.04
263	Cotton	24.64	1,439.47	(1,414.83)	0.03
042	Rice	2,936.93	40.49	2,896.44	0.03
265	Vegetable textile fibres	41.05	0.07	40.98	0.00
268	Wool, other animal hair	0.04	23.21	(23.18)	0.00
246	Wood in chips, particles	1,123.34	1.40	1,121.94	0.00
041	Wheat, meslin, unmilled	0.72	648.76	(648.04)	0.00
023	Butter,other fat of milk	0.06	73.91	(73.85)	0.00
043	Barley, unmilled	0.00	16.49	(16.49)	0.00
212	Furskins, raw	0.00	14.64	(14.64)	0.00
244	Cork, natural, raw,waste	0.00	0.17	(0.17)	0.00
	Intra-industry trade				**19**
	Inter-industry trade				**42**

Source: own calculation (2017)

This article calculates the vertical and horizontal agricultural intra-industry trade in 2014 at 5-digits agricultural items with 394 observations. However, the trade data is available for 250 observations only. Trade data being unavailable at 5-digit items are replaced by trade data at 4-digit subgroups or 3-digit groups. The result shows that Vietnam has vertical intra-industry trades in 107 agricultural items (accounting for 43 percent) and horizontal intra-industry trades in 143 items (accounting for 57 percent) with a 15 percent range of α. The country, however, obtains vertical intra-industry trades in 58 agricultural items (accounting for 23 percent) and horizontal intra-industry trades in 192 items (accounting for 77 percent) with a 25 percent range of α. The significant change between the selections of 15 and 25 percent range is relatively different to the statements of Greenaway et al. (1995) and Ferto & Jambo (2015).

Analyzing the dynamics of the agricultural GLI indicators

There are significant changes in the GLI values over the period 1997-2014. Cocoa and eggs,birds,yolks,albumin move from strong inter-industry trade to strong intra-industry trade whilst wool,other animal hair; maize unmilled; live animals, whilst fixed veg.fat,oils,other move from strong intra-industry trade to strong inter-industry trade between 1997 and 2014. The average values of the GLI in 18 years show that crude veg.materials,nes; sugar confectionery; cereal preparations are the strongest intra-industry trade (Table 3). The MIIT values, however, indicate a different result that non-alcohol.beverage,nes is complete intra-industry trade and silk; fixed veg.fat,oils, soft; cocoa; sugars,molasses,honey; cereal preparations are the strongest intra-industry trade. Vietnam has the complete inter-industry trade in 14 sectors by the MIIT.

Table 3: The changes of intra-industry trades of Vietnam's agricultural sectors (selected)

Code	Commodity	GLI *(1997)*	GLI *(2014)*	GLI *(1997-2014)*	MIIT *(1997&2014)*
111	Non-alcohol.beverage,nes	0.29	**0.96**	0.52	**1.00**
261	Silk	0.71	0.28	0.22	**0.95**
421	Fixed veg.fat,oils,soft	0.32	**0.92**	0.34	**0.88**
072	Cocoa	0.00	**0.79**	0.27	**0.82**
061	Sugars,molasses,honey	0.37	**0.84**	0.58	**0.79**
048	Cereal preparations	0.32	0.73	**0.76**	**0.77**
411	Animal oils and fats	0.10	0.67	0.43	0.66
292	Crude veg.materials,nes	**0.98**	0.70	**0.79**	0.65
047	Other cereal meal,flours	0.25	0.75	0.54	0.64
062	Sugar confectionery	**0.88**	0.67	**0.76**	0.64
025	Eggs,birds,yolks,albumin	0.06	**0.85**	0.51	0.00

Source: own calculation (2017)

Pattern of the agricultural GLI indicators by OLS regression

OLS regressions of the GLI indicators over three periods of 1997-2005, 2006-2014, and 1997-2014 result in the values of β and $R < 0.5$ and the values of $\beta/R < 1$. These results indicate the weak effects and correlations of the GLI values in the initial periods on the GLI values in the next periods. Vietnam, generally, has the convergent trends in the agricultural intra-industry trade pattern in all periods. In other words, the country decreases the intra-industry trade in the initial strong intra-industry trade sectors whilst it increases the intra-industry trade in the initial weak intra-industry trade sectors (or decreases the inter-industry trade in the initial strong inter-industry trade sectors).

Mobility and stability of the agricultural GLI indicators by Markov matrix

The mobility and stability analysis of the agricultural GLI indicators by Markov matrix shows that the strong inter-industry trade commodities (class 1) are the most stable to persist in their initial class over time with the probability of 84.5 percent while the stabilities of the GLI values in other classes are medium. A relatively high value of the M index (0.56) indicates that the GLI values are fairly mobile over classes, even the mobility between inter-industry trade categories and intra-industry trade categories.

Trends of the agricultural GLI indicators by time series regression

Time series regression shows that Vietnam obtains the growing trend of intra-industry trade in 21 agricultural sectors with the values of $\beta > 0$ whilst it has the declining trend of intra-industry trade in 13 sectors with the values of $\beta < 0$. The most growing GLI values are cocoa; eggs,birds,yolks,albumin; jute,oth.textl.bast fibr; other meat,meat offal; animal oils and fats and the sectors will continue to be stronger intra-industry trade in the future. Whereas, live animals; fixed veg.fat,oils,other; crude animal materls.nes; maize unmilled get the most declining trends in intra-industry trade and they will continue to be weaker intra-industry trade in the future.

Breakpoints of the agricultural GLI indicators by piecewise

The impact of the food and financial crisis in 2008 on the GLI indicators is tested by piecewise regression. The result shows that the event generates the breakpoints of the intra-industry trade in 14 agricultural commodities in Vietnam. The event results in the decreasing breakpoints of the intra-industry trade in 11 agricultural commodities with the values of $\beta_1 > 0$ and $\beta_1 + \beta_2 < 0$ such as meal,flour of wheat,msln; jute,oth.textl.bast fibr; and animal oils and fats, whereas it makes increasing breakpoints of the intra-industry trade in three agricultural commodities with the values of $\beta_1 < 0$ and $\beta_1 + \beta_2 > 0$ such as oilseed; silk; and fixed veg.fat,oils,other.

Testing the relationship between intra-industry trade and trade specialization

The relationship analysis between the pairs of GLI - RCAI and GLI - LFI by the Pearson correlation coefficient reveals the negative correlation coefficients. These results indicate the negative relationship between the GLI values and the RCA and the LFI values. In other words, the agricultural sectors with the high degree of trade specialization tend to have the weak degree of intra-industry trade, and vice versa. In conclusion, the intra-industry trade and the trade specialization are inversely correlated in the empirical case of Vietnam's agricultural sectors and this result is consistent with the international trade theory.

5. CONCLUSION AND IMPLICATION

The study shows that Vietnam, in 2014, has the strongest intra-industry trade in non-alcohol.beverage,nes; fixed veg.fat,oils, soft; eggs,birds,yolks,albumin; sugars,molasses,honey; and cocoa, while it has strong inter-industry trades in wheat,meslin,unmilled; butter,other fat of milk; barley,unmilled; furskins,raw; cork natural,raw, waste. The country tends to have the weak intra-industry trade in large trade values such as coffee,coffee substitute; fish etc.prepd,prsvd.; rice; wood in chips; maize unmilled; cotton; spices; and natural rubber. The country, in general, has the intra-industry trade in 19 agricultural commodity groups (accounting for 31 percent) with 5 strong intra-industry trade groups and the inter-industry trade in 42 agricultural commodity groups (accounting for 69 percent) with 30 strong inter-industry trade groups. There is a significant difference of the shares of intra- and inter-industry trade between the analyses at 3-digit level and at 5-digit level. The result means that the more industries are disaggregated to extreme levels the less intra-industry trades come up.

OLS regression shows that Vietnam has the convergent pattern of agricultural intra-industry trades with relatively weak effects and correlation between the initial GLI values and the next. Markov matrix explains that the values of agricultural intra-industry trades are relatively mobile between the classes in the matrix yearly. Time series regression indicates that Vietnam obtains the increasing intra-industry trade trends in 21 agricultural sectors while it has the decreasing intra-industry trade trends in 13 sectors. Piecewise regression presents that the food and financial crisis in 2008, generally, results in the breakpoints of intra-industry trade in 14 agricultural commodity groups with decreasing breakpoints of intra-industry trade in 11 sectors and increasing breakpoints of intra-industry trade in three sectors.

This empirical result, remarkably, confirms that intra-industry trade and trade specialization are inversely correlated in the case of Vietnam's agricultural sectors and this result is consistent with the international trade theory.

The GL index has been a basic and effective measure for empirical studies in intra-industry trade. The indicator can explain the various natures of static and dynamic intra-industry trade when combining with different approaches. The study, however, is limited in the scope of Vietnam in the world market. The paper also cannot identify the determinants of the GLI and explain the role of international trade agreements on intra-industry trade in agricultural products. There should be a comparison between agricultural and industrial commodities. There are still some open research questions related to this article for the future studies.

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