Structural Change and Economic Dynamics 49 (2019) 74–82

Contents lists available at ScienceDirect

Structural Change and Economic Dynamics

journal homepage: www.elsevier.com/locate/sced

The Dynamics of Agricultural Intra-Industry Trade: A Comprehensive Case Study in Vietnam

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ARTICLE INFO

Article history:
Received 11 December 2018
Received in revised form 13 February 2019
Accepted 9 April 2019
Available online 15 April 2019

JEL Classifications:
F10
F14
Q17

Keywords:
Vietnam
Agriculture
Intra-industry trade
Dynamics
Specialization

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 markets and the dynamics of GLI indicators by using the OLS method, Markov matrix, trend analysis, and piecewise regression. The paper finally tests the relationship between IIT and trade specialization. The results indicate that Vietnam' agricultural sector has the inter-industry trade with 42 sectors rather than the intra-industry trade with only 19 sectors. But the IIT pattern generally tends to increases over time. The dynamics analyses show that Vietnam's intra-industry trade is relatively dynamic and it mainly bases on the structural changes in the economy. The study provides empirical evidence in Vietnam that intra-industry trade and trade specialization seems to be inversely correlated.

1. Introduction

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 in the world trade, however, has strongly increased since the 1960s and it plays a 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 the 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 and 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 international trade performances commonly reflects deep structural changes in the entire economy of a country, as its resources and competitive advantages cannot change quickly despite sudden shocks, new technology, and institutional systems (Zaghini, 2005; Ferto and Soos, 2008).

The studies in intra-industry trade, however, generally is focused on manufactured commodities and there are 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 and Sheldon (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 in comparison with manufactured products. The recent empirical studies in agricultural IIT such as Bojnec (2001); Sharma (2002); Varma (2012), and Ferto (2015) support to these views. Most 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.

Vietnam's economic system has been reformed with the goal of creating a socialist-oriented market economy since Doi Moi (Ren-

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https://doi.org/10.1016/j.strueco.2019.04.004
0954-349X/

ovation) in 1986 and the country has comprehensively integrated into the global economy since the early 1990s. Vietnam has become a member of regional and global trade organizations and also signed bilateral trade agreements. Vietnam's agricultural sector has relative comparative advantages due to its favorable natural conditions and low input costs and significantly contributes to its economy. The agricultural export value significantly contributes to the total export value and GDP in Vietnam. In 2016, the sector's export value is USD 25,210 million, accounting for 14.28% of the national export, 12.2% of Vietnam's GDP, and 76.24% of the country's agricultural GDP. The agricultural export value increases stably whereas its share in the total export value and the national GDP decreases over time. The shares of Vietnam's agricultural export and import values in the world trade are relatively small but modestly increase. Vietnam's agricultural export and import values account for 1.24% and 0.63% of the world trade in 2009 and reach 1.66% and 1.24% in 2015 (GSO 2017; UN Comtrade 2017). Vietnam's agri-food export obtains the 2nd rank in the ASEAN and the 15th rank in the world. The main agricultural export products of Vietnam are wood and related products, spices, rice, rubber, coffee, crustaceans, fish, vegetables, tea and mate, and fruits and the top 10 biggest agricultural import markets of Vietnam are the USA, China, Japan, South Korea, Hong Kong, Germany, the UAE, Netherlands, the UK, and Malaysia (GSO, 2017; Ministry of Agriculture and Rural Development (MARD), 2018). The country's agricultural sector, however, faces losing comparative advantages due to 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 and have imported various agricultural products for the local increasing consumption and agricultural processing sector.

This paper is the initial attempt to investigate the static agricultural IIT by Grubel–Lloyd index (GLI) (Grubel and Lloyd, 1975) and analyze the dynamics of the indicators by using OLS method, Markov matrix, trend analysis, and piecewise regression in Vietnam over the period 1997–2014. The study, moreover, measures the vertical and horizontal IIT to understand the nature of Vietnam's agricultural IIT. The study finally tests the relationship between IIT defined by GLI and specialization indicators defined by the Revealed comparative advantage index (RCA) and Lafay index (LFI). This study, therefore, contributes to both academic literature and practical applications. First, this paper is the first empirical study of agricultural IIT in the case of Vietnam. Second, the article broadens empirical trade analysis by employing the different dynamic frameworks to identify the mobility, stability, trend of IIT, and the impact of an event. Third, it provides the empirical test for the consistency of intra-industry trade and specialization indicators. Finally, the results provide the critical indicators of agricultural IIT for the government in making policies and enterprises in building business strategies.

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 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 these assumptions, countries with identical factor endowments would not trade. Lancaster (1980) shows that intra-industry trade certainly occurs even when the economies are absolutely identical in all respects and can persist under conditions of comparative advantages. Helpman and Krugman (1999) point out that the comparative advantage drives the inter-industry trade through trade specialization while the economy of scale drives the 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 the increasing economic integration. The findings confirm that the 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 and Lloyd, 1975; Lancaster, 1980; Falvey, 1981; Helpman, 1981; Brander and Krugman, 1983; Helpman and Krugman, 1985; Greenaway and Milner, 1986; Qasmi and 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 may be simply explained that firms have a segmented markets perception and the possibility of the kind of two-way trade is relatively robust (Brander and Krugman, 1983). Horizontal IIT arises when different varieties of a homogeneous commodity with similar quality are characterized by different attributes (in Lancastrian theory). 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). Horizontal IIT is more potential between countries with similar factor endowments, while vertical IIT arises because of factor endowment differences across countries (Falvey and Kierzkowski, 1987; Jambor 2014). Vertical IIT can be related more to the traditional theory of comparative advantage whilst horizontal IIT falls more within the modern trade theory.

In the empirical studies on evaluating intra-industry trade, Grubel and Lloyd (1975) index is the most common and basic measure which has been 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 horizontal IIT and vertical IIT. Products are horizontally differentiated if the unit values of exports compared to the unit values of imports are within a 15% range, otherwise, they are vertically differentiated products. Fontagne and Freudenberg (1997) build, also upon the approach of Abd-el-Rahman (1991), a different method for classifying trade flows and measuring the share of each category in total trade. These scholars define trade to be two-way when the value of the minority flow represents more than 10% of the majority flow. If the value of the minority flow is less than 10%,

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. Unit value is computed by dividing the monetary value of trade by the quantity to give a price per ton. Blanes and Martín (2000) verify the distinction between high and low vertical IIT by the relative unit value of a good. A unit value below 0.85 indicates low vertical IIT while a unit value above 1.15 shows high vertical IIT. Nilsson (1997) proposes a new index to measure the level of IIT 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 and is more appropriate in cross-country IIT analyses.

Intra-industry trade, however, is a static measure and it fails to reflect the changes in the structure of trade flows and patterns over time (Thorpe and 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 and 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 and Terra (1997). The index relates to the change in these intra-industry trade flows between two years. The dynamics of the international trade indicators can be assessed by using OLS method, Markov matrix, trend analysis, and piecewise regression and they provide different economic implications (Hinloopen and Marrewijk, 2001; Hoang et al., 2017; Hoang, 2018). This paper measures the IIT indicator by GLI and assesses its dynamics by OLS method, Markov matrix, trend analysis, and piecewise regression.

3. Methodology and data

3.1. Grubel-Lloyd index of intra-industry trade

This paper employs Grubel–Lloyd index (Grubel and Lloyd, 1975) to measure the intra-industry trade of Vietnam's agricultural sector over the period at the product category level. According to these 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:

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

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. GLI values vary between 0 (complete inter-industry trade) and 100 (complete intra-industry trade). The higher GLI values are, the stronger intra-industry trade would be, and vice versa. GL index can also be empirically expressed and be used in this paper as follows:

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

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-industry or inter-industry, it is useful to classify the values of GLI into four groups. Following Qasmi and Fausti (2001) this paper uses the classification as in 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

Source: Qasmi and Fausti (2001).

GL index can be aggregated to the level of a country and a sector to compare between countries and sectors as follows:

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

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 quality differences in trade. The authors propose an approach to disentangle vertical and horizontal intra-industry trade using relative unit values (UV) indices of exports and imports. 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 mean exports and imports for goods j and $\alpha = 0.15$ (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%) range, otherwise, they define vertically differentiated products. Greenaway et al. (1995) state that results coming from the selection of 15% and 25% ranges are not significantly changed. The empirical studies, recently, emphasize on identifying the factors of vertical or horizontal intra-industry trade at country level by econometric models with explanatory variables such as difference in per capita GDP, difference in GDP, average of GDP, income dissimilarity, economic size, geographical distance, market structure, FDI, human capital, land, and Gini (Cabral and Mollick, 2011; Jensen and Luthje, 2009; Leitao et al., 2010; Pittiglio, 2012; Phan and Jeong, 2014; Ferto and Jambor, 2015; Chin et al., 2015; Bojnec and Ferto, 2016).

3.2. Dynamics measures for agricultural GLI indicators

There are various approaches to assess the dynamics of international trade performance. This paper employs: (i) OLS regression to analyze the general GLI pattern from one period to the next; (ii) Markov transition matrix to measure the stability and mobility of GLI values; (iii) the trend analysis to measure and predict GLI trends of specific agricultural commodity groups over time; and (iv) the piecewise analysis of the agricultural GLI indicators by piecewise regression.

First, following Dalum et al. (1998), the first type of stability of GLI is analyzed by using ordinary least squares (OLS) regression model employed by Hart and 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:

$$GLI_j^{t2} = \alpha + \beta GLI_j^{t1} + \varepsilon_j$$

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 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 this article, it is assumed that regression is linear in parameters and the residual ε_j is normal and identically distributed (ε_j ñ.i.d.$(0, \sigma)$).

The explanation of the regression results is as follows. If $\beta = 1$, the country has the 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 of a country. The scholars explain the sufficient condition for intra-industry trade is as follows. The variance of the GL index at year $t2$ is denoted by σ_{t2}^2 then:

$$\sigma_{t2}^2 = \beta^2\sigma_{t1}^2 + \sigma_{\varepsilon}^2$$

where β^2 is the square of regression coefficient, σ_{t1}^2 is the variance of the GLI at year $t1$, and σ_{ε}^2 is the variance of the error term. The coefficient of determination R^2 is defined as:

$$R^2 = 1 - \frac{\sigma_{\varepsilon}^2}{\sigma_{t2}^2} = \left(\sigma_{t2}^2 - \sigma_{\varepsilon}^2\right)\left(\frac{1}{\sigma_{t2}^2}\right)$$

combining these two above equations, we have:

$$\sigma_{t2}^2 - \sigma_{\varepsilon}^2 = \beta^2\sigma_{t1}^2 = R^2\sigma_{t2}^2$$

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

$$\frac{\sigma_{t2}^2}{\sigma_{t1}^2} = \frac{\beta^2}{R^2}$$

this equation can be simplified to:

$$\frac{\sigma_{t2}}{\sigma_{t1}} = \frac{|\beta|}{|R|}$$

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

Employing 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, normal distribution and to eliminate extreme values. Thus, this study transforms GL index into TGL index without an impact on the economic nature of the indicator by the formula as follows:

$$TGLI = 2GLI - 1$$

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

Second, the next type of stability of GLI values is assessed in two ways. First, following the empirical method utilized first by Proudman and 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 GLI indicators. The index identifies the degree of mobility throughout the entire distribution of GLI and facilitates direct cross-sectors comparisons over the full period. *M* index following Shorrocks (1978), assesses the trace of the transition probability matrix. *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 with a value of zero indicating perfect immobility.

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

$$GLI_{j,t} = \alpha_j + \beta_j t + \varepsilon_{j,t}$$

where α_j is constant; β_j is the regression coefficient showing 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%). 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.

Finally, following Toms and Lesperance (2003) and Chen et al. (2010), this paper employs the piecewise regression (also known as segmented or broken-stick regression) to investigate the breakpoints or structure changes of 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 and Kebakile (2017) for the comparative advantage change of Botswana's beef industry. To conduct the statistical test, this study estimates a two-period piecewise growth regression of IIT as follows:

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

where GLI is the intra-industry trade of an agricultural commodity of Vietnam, Y_t represents years (1997, 1998, ..., 2014). D_t is the dummy variable for capturing the differential growth for period 2 ($D_t = 0$ for 1997–2008 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 GLI indicators during the period 1997–2008 and $\beta_1 + \beta_2$ is the annual change in GLI indicators for the period 2008−2014. The paper statistically tests the hypotheses that 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 $|\beta_2| > \beta_1$).

3.3. Scopes and data

The export and import data for this study are obtained directly from the United Nations Comtrade Database (2017) (UN Comtrade) based on Revision 3 of the Standard International Trade Classification (SITC Rev. 3). SITC Rev. 3 offers five levels of commodity aggregation, including 1-digit sections down to 2-digit divisions, 3-digit groups, 4-digit subgroups, and 5-digit items. This article employs the notion of the WTO (2017) and World Bank (2017) in SITC Rev. 3 for "agricultural commodities" to cover the codes of

sections 0, 1, divisions 21, 22, group 231, division 24, groups 261, 263, 264, 265, 268, division 29, and section 4. This paper calculates intra-industry trade indicators at 3-digits with 61 agricultural commodity groups over the period 1997–2014. The term "commodity groups" is defined as "sector" and the names/descriptions of "commodity groups" are represented by their "codes" for effective presentations in this study.

4. Results and discussion

In general, Vietnam's agricultural international trades quickly grow over the period of 1997–2014. In 1997, Vietnam exports USD 9185 million and import USD 11,592 million of agricultural products while in 2014 the country exports USD 150,217 million and import USD 147,839 million of agricultural products. Vietnam's agricultural international trades reduce (-9% for export and -13% for import) in 2009 due to the global food and financial crisis in 2008 then recover and rise since 2010. The average yearly growth of agricultural export in the period is 18% while that of import is 17%. In the period of 1997–2011, Vietnam has the agricultural trade deficit but the country has gained the agricultural trade surplus in the period of 2012–2014 (Fig. 1).

4.1. Measuring the agricultural intra-industry trade by GLI

The result in Table 2 shows that, in 2014, Vietnam has the highest export values in 071, 036, 042, 034, 057, 037, 231, 075, and 246 with over USD 1 billion values and the country gains the most trade surplus in these products. On the other hand, Vietnam imports the most values in 081, 263, 248, and 044 with over USD 1 billion and it also incurs the most trade deficit in these commodities. Vietnam both exports and imports 057 in big values.

Vietnam obtains the strongest intra-industry trade in six agricultural sectors such as 111, 421, 025, 061, 072, and 047 with GLI values of 0.96, 0.92, 0.85, 0.84, 0.79, and 0.75, respectively. There is no agricultural sector with complete intra-industry trade, the country, whereas, gains the complete inter-industry trade in eight commodity groups such as 212, 043, 244, 023, 041, 246, 268, and 265. In which, 265 and 246 have 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 sectors (accounting for 31%) with 5 strong intra-industry trade sectors and the inter-industry trade in 42 agricultural sectors (accounting for 69%) with 30 strong inter-industry trade sectors (Table 2). At 5-digit level, the share of the agricultural IIT is 20% while the share of the agricultural inter-industry trade is 80% 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. This result is appropriate to both thought schools of Finger (1975) and theoretical underpinnings of intra-industry trade. Finger (1975) indicates that the intra-industry trade is ordinary because the existing classifications, thus, the more industries are disaggregated to extreme levels the less intra-industry trades happen. On the other hand, scholars explain the sources of intra-industry trade are product differentiation, monopolistic competition, economies of scales, variety of consumer demand, and similarity in consumer preferences, thus, Vietnam still obtains 20% share of the agricultural IIT at 5-digit level. As the result, the sources of intra-industry trade are from both the existing classifications and from economic factors.

This article, moreover, calculates the vertical and horizontal agricultural IIT in 2014 at 5-digits agricultural items with 394 observations. However, the trade data is available for 250 observations only. The unavailable trade data at 5-digit items are replaced by the trade data at 4-digit subgroups or 3-digit groups. The result shows that Vietnam has the vertical IIT in 107 agricultural items (accounting for 43%) and the horizontal IIT in 143 items (accounting for 57%) with a 15% range of α. With a 25% range of α, the country obtains the vertical IIT in 58 agricultural items (accounting for 23%) and the horizontal IIT in 192 items (accounting for 77%). The result indicates that Vietnam has the intra-industry trade pattern in homogenous products with the same quality but with different

Table 2
Vietnam's agricultural trade and intra-industry trade (top and selected) in 2014.

Code	Commodity	Export *(million USD)*	Import *(million USD)*	Trade balance *(million USD)*	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
048	Cereal preparations	188.01	327.33	−139.32	0.73
292	Crude veg.materials, nes	92.41	172.82	−80.41	0.70
017	Meat,offl.prpd,prsvd,nes	6.13	3.18	2.95	0.68
062	Sugar confectionery	102.18	50.97	51.21	0.67
411	Animal oils and fats	57.21	28.50	28.71	0.67
223	Oilseed(oth.fix.veg.oil)	13.53	6.59	6.94	0.65
112	Alcoholic beverages	178.15	80.41	97.73	0.62
098	Edible prod.preprtns,nes	410.81	924.75	−513.93	0.62
056	Vegtables,prpd,prsvd,nes	148.78	65.79	83.00	0.61
012	Other meat, meat offal	59.97	137.44	−77.47	0.61
057	Fruit,nuts excl.oil nuts	2,530.18	928.28	1,601.90	0.54
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
231	Natural rubber, etc.	1,668.85	153.59	1,515.26	0.17
075	Spices	1,330.65	95.68	1,234.98	0.13
071	Coffee,coffee substitute	3,557.41	81.44	3,475.98	0.04
042	Rice	2,936.93	40.49	2,896.44	0.03
037	Fish etc.prepd,prsvd.nes	2,001.55	16.32	1,985.22	0.02
246	Wood in chips, particles	1,123.34	1.40	1,121.94	0.00
	Intra-industry trade groups:				**19**
	Inter-industry trade groups:				**42**

Source: Author's own calculation (2017).

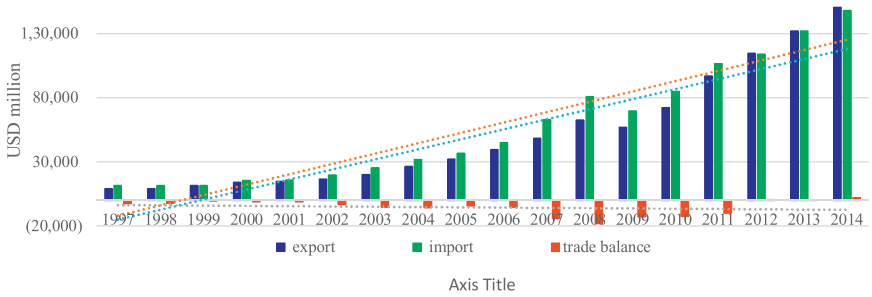

Fig. 1. Vietnam's international trade trends over the period of 1997–2014.

Source: Author's own calculation (2017).

Table 3
The OLS estimation results of TGLI values.

1997 – 2005			2006 – 2014			1997 – 2014		
β	R	β/R	β	R	β/R	β	R	β/R
0.36	0.36	0.99	0.38	0.42	0.91	0.24	0.27	0.90

Source: Author's calculation (2017).

Table 4
The Markov transition probability matrix for the GLI indicators.

M-Shorrocks	Obs. 1,037	*Class 1*	*Class 2*	*Class 3*	*Class 4*
0.56	*Class 1*	84.47	9.56	3.58	2.39
Average stability	*Class 2*	28.31	45.78	18.67	7.23
58.37	*Class 3*	12.34	22.73	46.75	18.18
Average mobility	*Class 4*	10.69	3.82	29.01	56.49
13.88	***Total***	***55.45***	***16.59***	***15.62***	***12.34***

Source: Author's calculation (2017).

characteristics rather than in products with different quality and price. The significant difference between the vertical and horizontal agricultural intra-industry trade values with the selections of 15% and 25% ranges seems to be opposite to the related statements of Greenaway et al. (1995) and Ferto and Jambor (2015).

4.2. Analyzing the dynamics of the agricultural GLI indicators

In general, there are strong dynamics or significant changes in GLI values over the period 1997–2014. The sectors of 072 and 025 move from strong inter-industry trade group to strong intra-industry trade group whilst the sectors of 268, 044, 001, and 422 move from strong intra-industry trade group to strong inter-industry trade group between 1997 and 2014. In average, intra-industry trade indicators of Vietnam's agricultural sectors increase over the period.

4.2.1. Pattern of the agricultural intra-industry trade by OLS regression

OLS regressions of intra-industry trade indicators by TGLI over three periods of 1997–2005, 2006–2014, and 1997–2014 result in the values of $0 < \beta < 1$, $R < 0.5$, and $\beta/R < 1$ (Table 3). These results indicate the weak effects and correlations of IIT values in the initial periods on IIT values in the next periods. Vietnam, generally, has convergent trends in the agricultural intra-industry trade pattern in all periods. In other words, the country decreases intra-industry trade in the initial strong agricultural intra-industry trade sectors whilst it increases intra-industry trade in the initial weak intra-industry trade agricultural sectors. Vietnam is under strong economic restructuring and globalization progress. Therefore, the country's agricultural IIT pattern seems to depend on current local agricultural production and demand patterns rather than on IIT values in the initial periods. This result provides the empirical evidence that a developing and transition economy like Vietnam would diversify its trade activities and IIT over the economic restructuring and globalization period.

4.2.2. Mobility and stability of the agricultural GLI indicators by Markov matrix

The mobility and stability analysis of agricultural GLI values by Markov matrix shows that the strong inter-industry trade sectors (class 1) are the most stable to persist in their initial class over time with the probability of 84.5% while the stabilities of GLI values in other classes are medium or low. High values of M index (0.56) and of other moving probabilities indicate that GLI indicators are relatively moving over classes, even the mobility between the strong inter-industry trade class and the strong intra-industry trade class (Table 4). The potential explanation for the high mobility of Vietnam's agricultural IIT is that the country's economy and globalization are in the initial period with the fast development and change.

4.2.3. Trends of agricultural GLI indicators

Trend analysis shows that Vietnam obtains the growing trends of intra-industry trade in 21 agricultural sectors with the values of $\beta > 0$ whilst it has the declining trends of intra-industry trade in 13 sectors with the values of $\beta < 0$ (Table 5). In overall, this means that the IIT trade of Vietnam's agricultural sector seems to increase over time. Agricultural sectors with the most growing GLI values are 072, 025, 264, and 012 and these sectors will continue to be stronger intra-industry trade in the future. Whereas, the agricultural sectors of 001, 422, 044, and 291 get the most declining trends in IIT and they will continue to be weaker IIT in the future.

4.2.4. Impact of the food and financial crisis in 2008 on Vietnam's agricultural intra-industry trade

The impact of the food and financial crisis in 2008 on 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. Thus, the impact of the food and financial crisis in 2008 on Vietnam's agricultural intra-industry trade is not significant and clear. In particular, 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 046, 264, and 411 whereas it makes increasing breakpoints of the intra-industry trade in 3 agricultural commodities with the values of $\beta_1 < 0$ and $\beta_1 + \beta_2 > 0$ such as 223, 261, and 422.

In overall, the dynamic analysis of agricultural intra-industry trade in Vietnam shows that the country would diversify its intra-industry trade activities with the convergent intra-industry trade pattern. The intra-industry trade values/ranks of Vietnam's agricultural sectors move and change significantly over the economic restructuring and globalization period. Whereas, the influence of the food and financial crisis in 2008 on Vietnam's agricultural intra-industry trade seems not to be really significant or clear. In

Table 5
The top gaining and losing trends of the GLI indicators.

Code	Commodity	β	p-value	R^2	**GLI** *(1997)*	**GLI** *(2014)*
072	Cocoa	0.05	0.00	0.83	–	0.79
025	Eggs, birds, yolks, albumin	0.05	0.00	0.78	0.06	0.85
264	Jute, oth.textl.bast fibr	0.05	0.00	0.59	–	0.42
012	Other meat, meat offal	0.05	0.00	0.65	0.22	0.61
411	Animal oils and fats	0.04	0.04	0.47	0.10	0.67
047	Other cereal meal, flours	0.03	0.02	0.32	0.25	0.75
421	Fixed veg.fat, oils, soft	0.03	0.00	0.45	0.32	0.92
261	Silk	−0.03	0.00	0.49	0.71	0.28
091	Margarine and shortening	−0.03	0.04	0.24	0.05	0.03
211	Hides, skins(ex.furs),raw	−0.03	0.01	0.36	0.58	0.09
291	Crude animal materls.nes	−0.04	0.00	0.52	0.16	0.12
044	Maize unmilled	−0.04	0.01	0.35	0.95	0.05
422	Fixed veg.fat, oils, other	−0.04	0.00	0.54	0.86	0.22
001	Live animals	−0.05	0.00	0.71	0.92	0.04

Source: Author's calculation (2017).

Table 6
The relationships between GLI & RCA, GLI & LFI.

		GLI & RCA	**GLI & LFI**
1	Cardinal	−0.24	−0.10
2	Ordinal	0.19	−0.15
3	Dichotomous	0.52	0.46

Source: Author's calculation (2017).

conclusion, Vietnam's intra-industry trade is relatively dynamic, increasing, and diversifying and the changes are mainly based on the structural changes in the economy rather than the outside factors.

4.3. Testing the relationship between intra-industry trade and trade specialization

In the traditional economic theory, the specialization 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 and Krugman (1999) point out that comparative advantage drives inter-industry trade through specialization while economies of scale drive IIT. Following Ballance et al. (1987), Ferto and Hubbard (2003), Seyoum (2007), and Hoang et al. (2017), this paper tests the consistency or the relationship between intra-industry trade defined by GLI and trade specialization defined by Revealed comparative advantage (RCA) (Balassa, 1965) and Lafay index (LFI) (Lafay, 1992) as cardinal, ordinal, and dichotomous measures by using Pearson correlation coefficient. The methodologies and results of trade specialization indicators are calculated and expressed in Hoang et al. (2017) and Hoang (2018).

The consistency test reveals the negative correlation coefficients by cardinal and ordinal measures (-0.10 and -0.15) and relatively low by dichotomous measure (0.46) (Table 6). These results indicate the negative or weak relationship between GLI values with RCA and LFI values. In other words, agricultural sectors with a high degree of trade specialization tend to have a 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 sector. This result is consistent with the international trade theory that explains the inter-industry trade is the process in which a country specializes in producing and exporting products where it has comparative advantages in and imports other products from the world markets.

5. Conclusion

The result shows that Vietnam has the intra-industry trade in 19 agricultural sectors (accounting for 31%) with 6 strong IIT sectors such as 111, 421, 025, 061, 072, and 047 and the inter-industry trade in 42 agricultural sectors (accounting for 69%) with 30 strong inter-industry sectors in 2014. There is a significant difference in the shares of intra-industry and inter-industry trade 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. In general, it seems that the majority of agri-food trade of Vietnam to the world markets mainly remains one-way (inter-industry rather than intra-industry trade) in nature. In other words, Vietnam's agricultural trade has a complementarity pattern rather than a competition pattern or the country has a relatively strong comparative advantage in the agricultural sector in the world markets. Moreover, the vertical and horizontal IIT analysis indicates that Vietnam has intra-industry trade pattern in homogenous products with the same quality but with different attributes rather than in products with different quality and price. These results may suggest the policy and the strategy that Vietnam should specialize in and export agricultural products with comparative advantages to increase the quality and diversify the characteristics of agricultural products. The country may import uncompetitive agricultural products with different price and quality to maximize economic efficiency and social welfare.

The dynamic analysis by OLS regression shows that Vietnam has the convergent pattern of agricultural intra-industry trades with relatively weak effects and the correlation between initial IIT values and the next values. The dynamic analysis by Markov matrix explains that the values of agricultural IIT are relatively mobile or moving between the classes yearly. Trend analysis indicates that Vietnam obtains increasing intra-industry trade trends in 21 agricultural sectors while it has decreasing intra-industry trade trends in 13 agricultural sectors. Piecewise regression presents that the food and financial crisis in 2008 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 3 sectors. That impact of the crisis on Vietnam's IIT is not really significant and clear. In general, the dynamics results show that Vietnam's agricultural intra-industry trade is relatively dynamic, increasing, and diversifying and the dynamics of the agricultural intra-industry are mainly based on the structural changes in the economy rather than the outside factors over the economic restructuring and globalization period.

The empirical result, remarkably, proves that intra-industry trade defined by GLI and trade specialization defined by RCA and LFI

are inversely correlated in the case of Vietnam's agricultural sector and this result is consistent with the common international trade theory. GLI, RCA, and LFI are all trade performance measures and based on the revealed trade data. These indices may, however, indicate and suggest the different implications of economic literature and policy. GLI is a useful indicator and it can explain the various natures of static and dynamic intra-industry trade when combining with different approaches.

Though the findings of this study provide empirical evidences and theoretical discussion to the international trade literature with policy implications, the methodology used is partially adequate due to the lack of data and the research scope. Future studies on the subject should deal with this limitation and expand the empirical studies in other countries.

Acknowledgement

This study is gratefully granted by the University of Economics Ho Chi Minh City (UEH).

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