Intra-industry trade in Latvian agricultural commodities and food products

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Abstract— **The share of simultaneous exports and imports of the same types of products by a country or intra-industry trade has gown continuously over the last century. At the same time, share of inter-industry trade when countries specialize in production and trade occurs only between industries has declined. Trade in differentiated products of the same sector and the same stage of processing is referred to as a horizontal intra-industry trade. Such products are close substitutes for each other in terms of factor inputs and consumption. Trade in products of the same sector at different stages of processing is referred to as a vertical intra-industry trade. According to economic theory, a rise in the share of intra-industry trade is occurring within the trade growth in general due to an economic development and broader integration. Since early nineties, Latvia has remained a net importer of agri-food products. At the same time, both exports and imports of agricultural commodities and processed food products has consistently grown, with total trade turnover increasing. The objective of the study is to determine the share of the intra-industry trade and structural changes in the sectors of Latvian agricultural production and food processing over the last decade. To reach the research objectives, Grubel-Lloyd intra-industry trade indexes, Brülhart marginal intra industry trade indexes and Thom-McDowell indexes of total marginal intra-industry trade were compiled for Latvian agri-food trade data over ten years period from 2002 to 2011. The research results show consistently high share of intra-industry trade in total Latvian trade in agricultural commodities and food products over the whole period. A shift from predominantly vertical marginal intra-industry trade towards horizontal marginal intra-industry trade is observed.**

Keywords—food and agriculture, intra-industry trade, marginal intra industry trade, inter-industry trade

I. INTRODUCTION

The global merchandise trade patterns have changed over the last century, with a shift from Ricardian model when countries specialize in production and trade occurs only between industries (inter-industry trade), towards an intra-industry or two-way trade when trade occurs within the industry. A dominance of inter-industry trade reflects the underlying comparative advantage in particular product or product group of the country. Simultaneous exports and imports of the same types of products by a country are defined as intra-industry trade. Trade in differentiated products of the same sector and the same stage of processing is referred to as a horizontal intra-industry trade. Trade in products of the same sector at different stages of processing is referred to as a vertical intra-industry trade. In general, countries with more developed economies tend to have higher levels of intra-industry trade. Nevertheless, developed countries can experienced declines in their intra-industry trade when they experience an boom in either primary or processed products sector. High bilateral intra-industry trade level in economy sectors indicates a similarity between two countries as they trade similar products with each other. However, the increase in intra-industry trade is more marked in countries with high and middle income. In 2006, about half of regional internal bilateral trade in Western Europe, North America and Australia-New Zealand was intra-industry. At the same time, the share of regional intra-industry trade in Western Asia and Eastern Africa was below 5%, and below 1% for Southern and Central Asia and other African countries. A comprehensive study by Brülhart [1] with the observed steady growth in global intra-industry trade suggests a process of world-wide structural convergence as countries are becoming more similar over time in terms of their sectoral compositions. However, the increase in intra-industry trade intra-industry trade was more pronounced in countries with high and middle income. Irrespective of the level of statistical aggregation, global intra-industry trade has followed an upward trend over last fifty years with leveling out in mid-nineties of the last century.

Since early nineties, Latvia has remained a net importer of agri-food products. At the same time, both exports and imports of agricultural commodities and processed food products has consistently grown, with total trade turnover increasing. Considering the rather stagnant domestic retail market demand and rising global prices, the trade in processed products does not change much over time in terms of volume. The growth in trade turnover is mainly attributed to increase in trade unit values. For agricultural commodities, two-way trade grow in almost every primary product group.

The objective of the study is to determine the share of the intra-industry trade and structural changes in the sectors of Latvian agricultural production and food processing over the last decade. To reach the research objectives, Grubel-Lloyd intra-industry trade indexes, Brülhart marginal intra industry trade indexes and Thom-McDowell indexes of total marginal intra-industry trade were compiled for Latvian agri-food trade data over ten years period from 2002 to 2011.

II. Materials and Methods

An availability of internationally comparable and sectorally disaggregated production and employment data has been limited due to country-specific collection and processing methods of industry statistics. Thus, the calculation of trade-based measures would provide a comprehensive indirect evidence on international specialization patterns.

The Grubel-Lloyd index of intra-industry trade measures the level of intra-industry trade of one industry or of the whole economy [2]. This index compares the total trade turnover of one industry expressed by sum of exports and imports, with the net exports expressed by the absolute value of the difference between exports and imports of this industry. Formally the Grubel-Lloyd index (GL) for a product i is defined as:

$$GL_i = 1 - \frac{|X_i - M_i|}{X_i + M_i} \qquad (1)$$

where X_i - exports of product i, M_i - imports of product i.

The values of the index vary between 0 and 1, where zero value indicates entirely inter-industry trade, and value of one represents entirely intra-industry trade. The GL index expresses the share of intra-industry trade in specified sector or whole economy. The GL index usually is calculated at the lowest disaggregated level possible. However, aggregated values of the index are used in analysis. Aggregation can be compiled at different levels. It can either be limited to a trade within the particular sector, or it can deal with the broader categories, such as industry sectors in the economy. In the latter case, the denominator i in the formula (1) would denote the industry sector. The aggregated Grubel-Lloyd index (GLA) is calculated as a weighted average of all indexes for products or industries:

$$GLA = \sum_{i=1}^{n} w_i GL_i \qquad (2)$$

where n - number of products or industries, w_i - weights for the product i.

The weights are calculated by formula:

$$w_i = \frac{X_i + M_i}{\sum_{i=1}^{n} X_i + \sum_{i=1}^{n} M_i} \qquad (3)$$

The Grubel-Lloyd index itself is a static measure as it refers to IIT for one year observed. Thus, the index is appropriate to quantify trade specialization at a fixed point of time and it does not show structure of changes in trade patterns. Moreover, the index is subject to a growing downward bias when the level of statistical disaggregation is increased. A study of Brülhart [1] shows that share of intra-industry trade in global trade declines from 44% if measured at the 3-digit level of statistical aggregation to 27% at 5-digit level of statistical aggregation.

Brülhart [3] introduced the dynamic measure, an index for the measurement of marginal intra-industry trade of specified industry which is calculated by formula:

$$B_i = 1 - \frac{|\Delta X_i - \Delta M_i|}{|\Delta X_i| + |\Delta M_i|} \qquad (4)$$

where $\Delta X_i = X_t - X_{t-n}$ and $\Delta M_i = M_t - M_{t-n}$.

ΔX_i and ΔM_i represent the differences in exports and imports, respectively, in observed years t and t-n. Upon previous research, the results are sensitive for the choice of length of period. Empirical findings by Brülhart [4] suggest one year time lag as the most suitable. Oliveras and Terra [5] have shown that the Brülhart index does not have a downward bias when the trade values are observed in a more disaggregated classification level. Similarly to GL index, an aggregated Brülhart index (BA) is calculated as a weighted average of all indexes for products or industries:

$$BA = \sum_{i=1}^{n} w_i B_i \qquad (5)$$

where n - number of products or industries, w_i - weights for the product i.

The weights are calculated by formula:

$$w_i = \frac{|\Delta X_i| + |\Delta M_i|}{\sum_{i=1}^{n} (|\Delta X_i| + |\Delta M_i|)} \qquad (6)$$

Although Thom and McDowell [6] consider Brülhart index an appropriate measure for horizontal intra-industry trade, they point out that it does not distinguish between horizontal and vertical intra-industry trade. They classify weighted average BA as representing horizontal marginal intra-industry trade. Total marginal intra-industry trade is calculated by formula:

$$BT = 1 - \frac{|\Delta \sum_{i=1}^{n} X_i - \Delta \sum_{i-1}^{n} M_i|}{\sum_{i=1}^{n} |\Delta X_i| + \sum_{i=1}^{n} |\Delta M_i|} \qquad (7)$$

Vertical marginal intra-industry trade is defined as:

$$BV = BT - BA \qquad (8)$$

Total marginal inter-industry trade is defined as:

$$BM = 1 - BT \qquad (9)$$

The statistical aggregation of trade information varies upon the availability of data and research objectives. Luka and Levkovych [7] use 6-digit data by HS nomenclature. for Ukrainian trade. Fertö and Hubbard [8] use 4-digit SITC code data for Hungarian trade. However, use of these classificators explicitly does not allow to provide a clear distinction between primary goods and processed products, and, consequently, the

conformity with horizontal or vertical intra-industry trade is difficult to recognize. Moreover, products from the same code group may have been processed by different industry sectors. A combined approach, using PRODCOM classification with references to HS nomenclature provided in EUROSTAT guidelines allows for an acceptable distinction both between primary and processing and between industry sectors. Latvian foreign trade data were retrieved from United Nations COMTRADE database [9]. In total, 740 products falling into 54 groups with data on both exports and imports over the period from 2002 to 2011 on annual basis.

III. RESULTS AND DISCUSSION

Grubel-Lloyd indexes were calculated for 740 products with aggregated indexes for 54 product groups over the period from 2002 to 2011. Latvian agri-food intra-industry trade with the world generally shows the rising pattern over the ten years period from 2002. Aggregated indexes for primary products, processed products and total trade were compiled (TABLE I.). The Grubel-Lloyd aggregated indexes clearly show the shift from inter-industry trade in the beginning of the period to rather balanced ratio between inter-industry and intra-industry trade towards the end of the period. While increase in intra-industry trade is consistent over the whole period for primary agricultural products, for processed products intra-industry trade somewhat declines after reaching the highest level in 2007. As processed products provide about 74% of the total trade turnover, the total intra-industry trade is affected more by changes in Grubel-Lloyd index for processed products.

TABLE I. GRUBEL-LLOYD INDEXES OF LATVIAN AGRI-FOOD TRADE WITH THE WORLD, 2002-2011

Group	2002	2007	2008	2009	2010	2011
Primary products	0.07	0.33	0.43	0.46	0.49	0.56
Processed products	0.35	0.55	0.53	0.53	0.53	0.50
Total	0.29	0.50	0.50	0.51	0.51	0.52

Source: research findings, UN Comtrade database

In every primary product group, the level of intra-industry trade increases over the ten years period from 2002 (TABLE II.). Product groups with their share less than 1% in total aggregated trade turnover are not included in table. Product groups are sorted descending upon their share in total trade turnover. For processed food products, every group shows an increase of intra industry trade to 2007 (TABLE III.). After this year, growth, in general, has ceased. Product groups are sorted descending upon their share in total trade turnover.

The change of Latvian intra-industry trade over time is showing resemblance with the patterns seen in developing countries, such as India. The analysis of Indian trade with the major trading partners by Varma [10] identified a slow shift from inter-industry trade towards intra-industry trade over nine years period.

TABLE II. GRUBEL-LLOYD INDEXES OF LATVIAN TRADE WITH THE WORLD IN MAIN PRIMARY PRODUCT GROUPS, 2002-2011

Products	2002	2007	2008	2009	2010	2011
Cereals	0.04	0.28	0.39	0.48	0.48	0.55
Fruits and nuts	0.02	0.22	0.24	0.32	0.38	0.47
Seeds	0.27	0.34	0.53	0.52	0.53	0.67
Vegetables	0.06	0.12	0.19	0.22	0.34	0.49
Live and chilled fish	0.07	0.51	0.62	0.71	0.61	0.75
Plants	0.06	0.53	0.50	0.57	0.75	0.74
Live animals	0.02	0.19	0.55	0.20	0.21	0.20
Ethyl alcohol	0.00	0.72	0.76	0.59	0.90	0.72
Eggs	0.88	0.57	0.83	0.61	0.61	0.77
Coffee and tea	0.01	0.04	0.11	0.13	0.07	0.08
Spices	0.20	0.50	0.39	0.46	0.53	0.64
Crude fats and oils	0.01	0.61	0.80	0.60	0.68	0.57
Raw tobacco	0.02	0.05	0.07	0.66	0.16	0.03
Cocoa beans	0.00	0.00	0.00	0.24	0.00	0.00
Vegetable extracts	0.14	0.01	0.21	0.34	0.27	0.47
Honey	0.28	0.69	0.09	0.28	0.76	0.80
Raw sugar	0.00	0.06	0.06	0.05	0.07	0.02
Plaiting materials	0.27	0.06	0.09	0.15	0.16	0.09
Products of animal origin	0.00	0.45	0.02	0.97	0.37	0.72
Food industry residues	0.00	0.00	0.03	0.04	0.00	0.04
Edible animal products	0.00	0.00	0.00	0.00	0.00	0.00

Source: research findings, UN Comtrade database

In every major product group, the increase of the share of intra-industry trade over the ten years period is marked, and a shift from inter-industry trade towards intra-industry trade is seen in product groups such as cereals, seeds, live and chilled fish and plants.

TABLE III. GRUBEL-LLOYD INDEXES OF LATVIAN TRADE WITH THE WORLD IN MAIN PROCESSED PRODUCT GROUPS, 2002-2011

Products	2002	2007	2008	2009	2010	2011
Fish and marine products	0.22	0.44	0.43	0.53	0.60	0.53
Dairy and cheese	0.56	0.48	0.60	0.56	0.58	0.55
Distilled beverages	0.65	0.84	0.80	0.66	0.45	0.37
Processed oils and fats	0.03	0.49	0.63	0.67	0.60	0.43
Tobacco products	0.88	0.91	0.79	0.85	0.66	0.71
Processed meat	0.02	0.18	0.15	0.23	0.20	0.20
Confectionery	0.40	0.56	0.45	0.52	0.59	0.62
Wine from grape	0.20	0.76	0.84	0.77	0.74	0.81
Miscellaneous products	0.31	0.34	0.33	0.48	0.51	0.46
Fruits and vegetables	0.18	0.34	0.34	0.34	0.41	0.47

Processed tea and coffee	0.16	0.31	0.37	0.42	0.46	0.45
Soft drinks and waters	0.54	0.67	0.73	0.71	0.67	0.66
Sugar	0.18	0.27	0.01	0.05	0.08	0.28
Processed poultry meat	0.02	0.36	0.36	0.46	0.55	0.61
Grain mill products	0.36	0.48	0.46	0.54	0.48	0.39
Meat products	0.22	0.52	0.56	0.49	0.50	0.63
Feed	0.91	1.00	0.91	0.88	0.88	0.95
Sweet oven products	0.49	0.91	0.85	0.82	0.79	0.83
Pet foods	0.02	0.01	0.01	0.06	0.17	0.14

Source: research findings, UN Comtrade database

The distribution of Grubel-Lloyd indexes has changed over the time period (TABLE IV.). In 2002, more than half of GL indexes for 54 main product groups had values less than 0.2, indicating low level of intra-industry trade. By the end of the period in 2011, GL index for almost 40% of products had values over 0.6. Such changes in frequency distribution indicate the pattern of increasing intra-industry trade.

TABLE IV.   FREQUENCY DISTRIBUTION OF GRUBEL-LLOYD INDEXES FOR MAIN PRODUCTS IN LATVIAN TRADE WITH THE WORLD, 2002-2011

Grubel-Lloyd index	2002	2007	2008	2009	2010	2011
0.0-0.2	55.6	29.6	31.5	18.5	20.4	20.4
0.2-0.4	22.2	22.2	20.4	18.5	14.8	13.0
0.4-0.6	13.0	27.8	24.1	35.2	29.6	27.8
0.6-0.8	3.7	11.1	11.1	20.4	29.6	27.8
0.8-1.0	5.6	9.3	13.0	7.4	5.6	11.1

Source: research findings, UN Comtrade database

Similarly to Grubel-Lloyd indexes, Brülhart indexes and Thom-McDowell indexes were calculated for 740 products with aggregated indexes for 54 product groups over the period from 2002 to 2011. Aggregated indexes for primary products, processed products and total trade were compiled (TABLE V.).

TABLE V.   LATVIAN MARGINAL INTRA-INDUSTRY AND INTER-INDUSTRY TRADE WITH THE WORLD, 2003-2011

Trade type	2003	2007	2008	2009	2010	2011
Primary products						
Total marginal intra-ind. trade	0.93	0.96	0.82	0.70	0.93	0.81
Vertical marginal intra-ind. trade	0.87	0.58	0.36	0.39	0.56	0.25
Horizontal marginal intra-ind. trade	0.06	0.38	0.45	0.31	0.37	0.56
Total marginal inter-industry trade	0.07	0.04	0.18	0.30	0.07	0.19
Processed products						
Total marginal intra-ind. trade	0.66	0.90	0.86	0.81	0.82	0.99
Vertical marginal intra-ind. trade	0.47	0.51	0.52	0.39	0.38	0.57
Horizontal marginal intra-ind. trade	0.19	0.39	0.34	0.42	0.44	0.42
Total marginal inter-industry trade	0.34	0.10	0.14	0.19	0.18	0.01
Total trade						
Total marginal intra-ind. trade	0.76	0.92	0.99	0.78	0.85	0.93
Vertical marginal intra-ind. trade	0.60	0.53	0.60	0.39	0.43	0.46
Horizontal marginal intra-ind. trade	0.16	0.39	0.39	0.39	0.42	0.47
Total marginal inter-industry trade	0.24	0.08	0.01	0.22	0.15	0.07

Source: research findings, UN Comtrade database

In line with the Brülhart's findings [1], the increase in Latvian intra-industry trade compiled by static measures is not accompanied by a comparable increase in marginal intra-industry trade compiled by dynamic measures. The level of Latvian total marginal intra-industry trade has been rather high over the ten years period from 2002. The gradual shift from predominantly vertical marginal intra-industry trade towards horizontal marginal intra-industry trade is seen, and over the last three years of the period, the share of vertical and horizontal trade in total marginal intra-industry trade is equal. Such a pattern differs from developments in China's agri-food trade over the decade from 1996, where findings by Wang [11] indicate a slow shift from inter-industry trade towards intra-industry trade which is attributed mainly to a vertical intra-industry trade. The level of marginal intra-industry trade is high both for primary products and processed products. However, the composition of marginal intra-industry trade differs for these two broad groups. While a shift from vertical marginal intra-industry trade towards horizontal marginal intra-industry trade for primary products is marked, for processed products, in general, the share of vertical trade is higher over the whole period.

IV.   CONCLUSIONS

The calculated static intra-industry trade measures prove that the share of intra-industry trade in total Latvian trade in agricultural commodities and food products has increased significantly over the ten years period from 2002. The share of intra-industry trade in primary products continuously increases, while for processed products the share after the increase has been stable. In 2011, almost 40% of main product groups were traded inside the industry, while in 2002, more than half of main product groups were trade predominantly between industries.

The calculated dynamic intra-industry trade measures show consistently high share of intra-industry trade in total Latvian trade in agricultural commodities and food products over the ten years period from 2002. A shift from predominantly vertical marginal intra-industry trade towards horizontal marginal intra-industry trade is seen which is attributed mainly to an increase of horizontal marginal intra-industry trade in primary products.

A rather high level of horizontal marginal intra-industry trade in processed products reflects the stable demand in integrated food retail market with diversified product supply.

A growth in horizontal marginal intra-industry trade in primary products reflects the increasing two-way trade in similar agricultural commodities.

The changes in Latvian intra-industry trade measures indicate an increase in the share of highly substitutable differentiated products in total agri-food trade.

A steady growth in Latvian intra-industry trade suggests a convergence with an increasing similarity of sectoral composition of the agri-food industries with the world.

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