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INTENSITY AND STRUCTURE OF INTRA-INDUSTRY TRADE IN AGRI-FOOD PRODUCTS OBSERVED IN POLISH AND EU FOREIGN TRADE WITH THE US¹

Key words: intra-industry trade, horizontal intra-industry trade, vertical intra-industry trade, agri-food products, Poland, the EU, the US

ABSTRACT. The aim of this paper was to investigate the intensity and determine the type of intra-industry trade in agri-food products of Poland and the EU with the US. Analysis was based on data coming from the Comext-Eurostat database applying the 6-digit HS classification in 2007 and 2018. The intensity of intra-industry trade was established using the Grubel-Lloyd index, taking the diversification of intra-industry trade into horizontal, high-quality vertical, and low-quality vertical trade into consideration. The individual types were determined applying the criteria of similarity in unit values in exports and imports, proposed by David Greenaway et al. [1994]. Analysis showed that trade in agri-food products of Poland and the EU with the US developed mainly following a model of inter-industry specialisation. Intra-industry trade was observed primarily in trade in highly processed products. Analyses of EU trade with the US indicate the greatest role of intra-industry trade in high quality differentiated products, which may hardly be supplemented by other goods, while in Polish trade with the US it was vertical trade in low quality goods, which may be relatively readily replaced by products coming from other countries, in turn potentially leading to the loss of Poland's share in the target market.

INTRODUCTION

The traditional theory of trade reflected in the Heckscher-Ohlin-Samuelson model, together with its dynamic modifications, is generally a theory of inter-industry trade, in which it is assumed that homogeneous products manufactured within one industry or branch of economy are traded in accordance with comparative advantage distribution [Falvey 1981]. Due to technological progress and an increase in *per capita* personal income, leading to a diversification of industrial production and services and, at the same, resulting in a broadening variety of consumer preferences, trade in homogeneous goods is being increasingly replaced by trade in differentiated products. Trade in homogeneous and differentiated goods, satisfying specific consumer preferences and being close substi-

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tutes in the sphere of production and consumption or both these spheres simultaneously, is explained by the theory of intra-industry trade, consisting of the simultaneous import and export of products from the same branches of industry [Grubel, Lloyd 1975].

The importance of intra-industry trade varies depending on the branch of industry and the degree of product differentiation within a given branch [Loertscher, Wolter 1980]. Research conducted to date has concerned both intra-industry trade in industrial products [Jensen, Lüthje 2009] and agri-food products. The latter aspect has been investigated e.g. by Steve McCorrison and Ian Sheldon [1991], Renato Pieri et al. [1997], Štefan Bojnec [2001], Bashir Qasmi and Scott Fausti [2001], Jing Wang [2009], Attila Jámor [2015] and Viet Hoang [2019].

The EU and the US are the largest world food exporters. In 2018, their shares in the global exports of agri-food products amounted to 9.8% (USD 153.6 billion, considering only the value of agri-food exports from the EU to third countries) and 8.9% (USD 139.0 billion) respectively, while the value of EU exports to the US was USD 25.4 billion, which accounted for 16.5% of exports from the EU to non-EU markets [UNCTAD 2019]. Steve McCorrison and Ian Sheldon [1991], when investigating trade in processed agricultural products of the US and the EU, found a greater intensity of intra-industry trade in the case of the EU. The role of intra-industry trade in EU agri-food trade on the global market was also analysed by Štefan Bojnec and Imre Fertő [2016], while this trade within the Single European Market was investigated by Imre Fertő [2015] and Attila Jámor [2014]. However, those authors did not study bilateral relations of the US and the EU. For Poland, the US is the greatest non-EU partner in exports and ranks fifth in imports of agri-food products. In 2018, the value of the positive balance (trade surplus) in bilateral trade of Poland with the US was over EUR 325 million (384 million USD), which constituted 22% of total trade balance with third countries [Comext-Eurostat 2019]. While research to date has been conducted on the intensity of intra-industry trade in agri-food products of Poland with the US, its structure has not been investigated. Thus, the aim of this paper is to analyse the intensity and define the type of intra-industry trade in agri-food products of Poland and the EU with the US.

RESEARCH MATERIAL AND METHODS

This study was conducted on data coming from the Comext database of the Statistical Office of the European Union (Comext-Eurostat). Analyses comprised 24 groups of agri-food products, distinguished following the Harmonized Commodity Description and Coding System (HS) nomenclature. Research, using a 6-digit HS code system, was conducted for 2007 and 2018.

The intensity of intra-industry trade (IIT) is most frequently measured applying the Grubel-Lloyd index [Grubel-Lloyd 1975]:

$$IIT_{ik} = 1 - \frac{|X_{ik} - M_{ik}|}{(X_{ik} + M_{ik})}$$

where: X_{ik} and M_{ik} denote export and import, respectively, of a given category of products i from/to country k (total or in bilateral relations).

The IIT index assumes values ranging from 0 to 1. High IIT values approaching 1 indicate intra-industry trade, while IIT indexes close to zero indicate inter-industry trade.

According to Bashir Qasmi and Scott Fausti [2001], four groups of products differing in the intensity of intra-industry trade may be distinguished: 1) $0.00 < IIT \leq 0.25$ – strong inter-industry trade; 2) $0.25 < IIT \leq 0.50$ – weak inter-industry trade; 3) $0.50 < IIT \leq 0.75$ – weak intra-industry trade; and 4) $0.75 < IIT \leq 1.00$ – strong intra-industry trade, respectively.

Based on the terminology introduced by Kelvin Lancaster [1979], intra-industry trade in heterogeneous products is divided into horizontal and vertical. Horizontal differentiation of goods subjected to intra-industry trade is found when individual varieties of a product are of the same quality, but differing in other, more superficial rather than functional characteristics, or the products are identical, but buyers consider them to be different (apparent differentiation). In turn, intra-industry trade in vertically differentiated goods consists of the parallel import and export of products differing in quality (for more details see David Greenaway [1984]).

The classification of intra-industry trade to Horizontal Intra-industry Trade (HIIT) is determined based on the similarity criterion, according to which the relation of unit values of export (UV^X) and import (UV^M) falls within the range established as follows [Greenaway et al. 1994]:

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

where: $\alpha = 0.15$

If the relation of export prices to import prices exceeds 1.15, we are dealing with ‘High-quality’ Vertical Intra-industry Trade ($VIIT_{high}$) means that a country sells better quality products abroad and imports poorer quality goods.

In contrast, if this ratio is lower than 0.85, ‘Low-quality’ is observed. Vertical Intra-industry Trade ($VIIT_{low}$) means that the country exports goods of a relatively lower quality compared to its imports. According to the concept by David Greenaway et al. [1994], trade is considered vertical intra-industry trade when it meets either of the conditions given below:

$$\frac{UV_{ik}^X}{UV_{ik}^M} > 1 + \alpha \quad \text{or} \quad \frac{UV_{ik}^X}{UV_{ik}^M} < 1 - \alpha$$

Distinguishing flows of horizontal and vertical trade and applying the transformation proposed by David Greenaway et al. [1994], in this study, the Grubel-Lloyd index was calculated using the formula:

$$IIT_{ik} = 1 - \left(\frac{|X_{ik}^{HIIT} - M_{ik}^{HIIT}| + |X_{ik}^{VIITlow} - M_{ik}^{VIITlow}| + |X_{ik}^{VIIThigh} - M_{ik}^{VIIThigh}|}{X_{ik} + M_{ik}} \right)$$

RESEARCH RESULTS

Analysis of Grubel-Lloyd index values, determined based on the formula proposed by David Greenaway et al., [1994] indicates that trade in agri-food products of Poland and the EU with the US was predominantly of an inter-industry character ($IIT \leq 0.50$). In 2007, in EU trade with the US, strong or weak inter-industry trade was observed for 18 out of 24 groups of products (Table 1). For objective reasons these groups included e.g. coffee, tea and spices, as well as cocoa and cocoa preparations, while those ranking high in the structure of imports from the US included fruit and nuts (approx. 18% of total imports in 2007), oil seeds and oleaginous fruits (15%), cereal (13%), fish and seafood (10% of imports) as well as non-alcoholic and alcoholic beverages (10%). Jointly five of the above-mentioned groups of products absorbed over 65% of expenditure for food imports from the US [Comext-Eurostat 2019]². The main products imported to the EU included pistachios and almonds, soy (and by-products of soybean extraction), maize and wheat, seafood, wines and whisky. The characteristics of intra-industry trade ($IIT > 0.50$) were manifested in 2007, primarily in the trade of plant origin products of marginal importance in the structure of EU exports and imports to/from the US, as well as trade in live animals and miscellaneous food preparations. However, it needs to be stressed that excluding the latter, tobacco and tobacco products, sugar and sugar confectionery, fats and oils, as well as coffee, tea and spices, intra-industry trade was vertical trade in high quality products, which are relatively difficult to substitute with other products.

In 2018, the situation was not markedly different, apart from the fact that the characteristics of intra-industry trade were manifested in EU-US trade in preparations of meat or fish ($IIT = 0.18$ in 2007 and $IIT = 0.63$ in 2018), as well as residue and waste from food industries ($IIT = 0.34$ in 2007 and $IIT = 0.56$ in 2018, Table 1). While in the case of the former group of products, the EU exported products varying in the level of their processing, thus some being of low and others being of high quality ($VIIT_{low} = 0.27$ and $VIIT_{high} = 0.35$), in the case of the latter, solely high quality goods were sold to the US ($VIIT = VIIT_{high} = 0.56$). They constituted, primarily, residue from starch production and animal fodder, while in US imports – apart from animal fodder – residue from soybean oil extraction and brewing or distilling dregs and waste predominated. The change in the character of bilateral trade, in agri-food products of the EU with the US towards intra-industry trade, may also be observed in the trade in fish, crustaceans and molluscs, as well as meat and edible offal. In contrast to the above-mentioned groups of products, in the case of meat, trade was predominant in horizontally differentiated products, i.e. those with a slight difference in unit values between exports and imports. This indicates an exchange of substitute products of comparable quality purchased by consumers in the countries of these two trade partners mainly due to a preference for variety, which confirms the importance of the theory of product differentiation when explaining the level and structure of contemporary trade in agri-food products. In 2018, a similar type of intra-industry trade was also observed in EU trade with the US in the case of live animals. In relation to 2007, the intensity of intra-industry trade decreased in this assortment group ($IIT = 0.77$

² It also needs to be stressed that the latter of the above-mentioned groups of products provided almost 56.0% of total EU revenue from exports of agri-food products to the US market [Comext-Eurostat 2019].

Table 1. Intra-industry trade in agri-food products between the EU and the US in 2007 and 2018 by HS code

HS code	2007					2018				
	IIT	HIIT	VIIT			IIT	HIIT	VIIT		
			total*	VIIT _{low}	VIIT _{high}			total*	VIIT _{low}	VIIT _{high}
01	0.77	0.00	0.77	0.06	0.71	0.46	0.32	0.14	0.10	0.04
02	0.25	0.11	0.14	0.12	0.02	0.45	0.43	0.01	0.01	0.00
03	0.23	0.07	0.16	0.01	0.15	0.48	0.13	0.35	0.12	0.22
04	0.20	0.05	0.15	0.01	0.13	0.06	0.01	0.05	0.03	0.02
05	0.72	0.20	0.53	0.39	0.14	0.90	0.05	0.85	0.77	0.08
06	0.50	0.00	0.50	0.03	0.46	0.09	0.00	0.09	0.05	0.04
07	0.78	0.18	0.60	0.05	0.55	0.15	0.00	0.14	0.06	0.09
08	0.11	0.00	0.11	0.04	0.07	0.11	0.02	0.09	0.02	0.07
09	0.10	0.02	0.08	0.06	0.02	0.14	0.06	0.08	0.04	0.04
10	0.03	0.00	0.03	0.00	0.03	0.15	0.00	0.15	0.03	0.12
11	0.32	0.10	0.23	0.10	0.12	0.14	0.00	0.14	0.10	0.04
12	0.23	0.06	0.16	0.05	0.12	0.17	0.08	0.09	0.08	0.01
13	0.77	0.07	0.70	0.17	0.54	0.56	0.07	0.49	0.09	0.40
14	0.54	0.00	0.54	0.00	0.54	0.69	0.00	0.69	0.61	0.08
15	0.24	0.00	0.23	0.18	0.05	0.23	0.16	0.07	0.02	0.05
16	0.18	0.03	0.15	0.03	0.12	0.63	0.01	0.62	0.27	0.35
17	0.40	0.15	0.24	0.20	0.05	0.24	0.04	0.20	0.20	0.00
18	0.13	0.00	0.13	0.01	0.12	0.19	0.14	0.05	0.05	0.00
19	0.21	0.02	0.19	0.05	0.14	0.15	0.09	0.06	0.05	0.01
20	0.44	0.15	0.29	0.10	0.19	0.42	0.13	0.29	0.04	0.25
21	0.87	0.01	0.86	0.60	0.26	0.89	0.12	0.77	0.70	0.07
22	0.20	0.01	0.19	0.01	0.19	0.24	0.00	0.24	0.09	0.15
23	0.34	0.00	0.34	0.00	0.34	0.56	0.00	0.56	0.00	0.56
24	0.44	0.00	0.44	0.29	0.15	0.31	0.00	0.31	0.30	0.01

* total vertical intra-industry trade being a sum of vertical intra-industry trade in high and low quality products

HS codes: 01 – live animals; 02 – meat and edible meat offal; 03 – fish and crustaceans, molluscs and other aquatic invertebrates; 04 – dairy produce; 05 – products of animal origin, not elsewhere specified or included; 06 – live trees and other plants; 07 – edible vegetables and certain roots and tubers; 08 – edible fruit and nuts; 09 – coffee, tea, maté and spices; 10 – cereal; 11 – products of the milling industry; 12 – oil seeds and oleaginous fruits; 13 – lac; gums, resins and other vegetable saps and extracts; 14 – vegetable plaiting materials; vegetable products not elsewhere specified or included; 15 – animal or vegetable fats and oils; 16 – preparations of meat, fish or crustaceans, molluscs or other aquatic invertebrates; 17 – sugar and sugar confectionery; 18 – cocoa and cocoa preparations; 19 – preparations of cereal; 20 – preparations of vegetables, fruit, nuts or other parts of plants; 21 – miscellaneous edible preparations; 22 – beverages, spirits and vinegar; 23 – residue and waste from food industries; prepared animal fodder; 24 – tobacco and manufactured tobacco substitutes

Source: own calculations and [Comext-Eurostat 2019]

in 2007 and $IIT = 0.46$ in 2018), while exports of higher quality goods in comparison to imports ($VIIT_{high} = 0.71$ in 2007) was partly replaced by trade in products showing no significant differences in quality ($HIIT = 0.32$ in 2018). This change in specialization from intra-industry to strongly inter-industry trade was also recorded in EU-US trade in vegetables ($IIT = 0.78$ in 2007 and $IIT = 0.15$ in 2018).

In the trade of Poland with the US, in 2007, the characteristics of inter-industry trade ($IIT \leq 0.50$) were manifested in the case of 22 and in 2018 – 23 groups of products (Table 2), which provided 97% of Poland's revenue from exports of agri-food products to the US market and accounted for 95% of total imports [Comext-Eurostat 2019]. The most important goods in the structure of Polish exports to the US included meat and edible offal, preparations of meat or fish, fresh, chilled or frozen pork, cocoa and cocoa preparations, preparations of vegetables, fruit or nuts, fruit juices, as well as alcoholic beverages. In turn, key US imports to Poland included residue and waste of the food industry, as well as prepared animal fodder, mainly oil cake and other residue from soybean oil extraction, unprocessed tobacco and beverages, fresh, chilled or frozen fish, as well as fruit and edible nuts. Imports of the latter group of products primarily comprised almonds, hazelnuts and walnuts, as well as dried fruit [Comext-Eurostat 2019].

In both years of analysis, a relatively high intensity of intra-industry trade was only observed in the trade of miscellaneous edible preparations, while, in 2007, it also encompassed fish, crustaceans and molluscs (Table 2). However, it also needs to be mentioned that the exchange in food preparations was mainly vertical trade in low quality products, which means that Poland exported lower quality products to the US compared to imported goods. The assortment group exported to the US predominantly comprised preparations for sauces and prepared sauces, soups, broths and preparations as well as roasted chicory and other roasted coffee substitutes, while imports, apart from preparations for sauces and prepared sauces, were predominantly protein concentrates and textured protein substances [Comext-Eurostat 2019]. Such a trade structure may be disturbing, since products of relatively low quality may relatively easily be replaced by standard products from other countries, which may lead to progressing losses in Poland's already very small share in the US market. At the intensity of intra-industry trade growing in relation to 2007, yet nevertheless still relatively low ($0.18 < IIT < 0.21$, Table 2), in 2018, the unit values of fruit and nuts, cereal, as well as oil seeds and oleaginous fruits exported from Poland to the US were still lower compared to imports. Poland mainly exported frozen fruit to the US, including raspberries and strawberries, while it imported fresh or dry almonds and pistachios and prunes. In the export of cereal to the US, rice in various forms predominated, while in the exports of oil seeds and oleaginous fruits – parts of plants used primarily in perfumery, pharmacy or for insecticidal, fungicidal or similar purposes. In turn, from the US, Poland imported maize and peanuts [Comext-Eurostat 2019]. In the years 2007-2018, in Polish-US trade in agri-food products, the coverage ratio of export and import flows also increased for fats and oils ($IIT = 0.03$ in 2007 and $IIT = 0.16$ in 2018, Table 2). However, these products varied in quality and their exchange had a vertical trade character, partly in high quality and partly in low quality products, consisting of exports of fixed vegetable fats and oils and imports of edible mixtures or preparations of animal or vegetable fats or oils [Comext-Eurostat 2019].

Table 2. Intra-industry trade in agri-food products between Poland and the US in 2007 and 2018 by HS code

HS code	2007					2018				
	IIT	HIIT	VIIT			IIT	HIIT	VIIT		
			total*	VIIT _{low}	VIIT _{high}			total*	VIIT _{low}	VIIT _{high}
01	0.40	0.00	0.40	0.00	0.40	0.03	0.00	0.03	0.03	0.00
02	0.13	0.00	0.13	0.13	0.00	0.00	0.00	0.00	0.00	0.00
03	0.52	0.00	0.52	0.00	0.52	0.00	0.00	0.00	0.00	0.00
04	0.05	0.00	0.05	0.00	0.05	0.00	0.00	0.00	0.00	0.00
05	0.08	0.02	0.06	0.06	0.00	0.02	0.00	0.02	0.02	0.00
06	0.02	0.00	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00
07	0.02	0.00	0.02	0.02	0.00	0.02	0.01	0.01	0.00	0.01
08	0.02	0.00	0.02	0.00	0.02	0.21	0.00	0.21	0.15	0.06
09	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
10	0.02	0.00	0.02	0.00	0.02	0.18	0.00	0.18	0.12	0.06
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.18	0.15	0.03	0.02	0.01	0.19	0.00	0.19	0.15	0.04
13	0.01	0.00	0.01	0.01	0.00	0.05	0.00	0.05	0.05	0.00
14	0.22	0.00	0.22	0.22	0.00	0.47	0.00	0.47	0.00	0.47
15	0.03	0.00	0.03	0.03	0.00	0.16	0.00	0.16	0.08	0.08
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.04	0.00	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.08	0.06	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00
20	0.04	0.00	0.04	0.03	0.01	0.01	0.00	0.01	0.01	0.00
21	0.62	0.10	0.52	0.52	0.00	0.64	0.15	0.49	0.48	0.01
22	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.00
23	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.03	0.00	0.03

* total vertical intra-industry trade being a sum of vertical intra-industry trade in high and low quality products, HS codes: as in Table 1

Source: own calculations and [Comext-Eurostat 2019]

SUMMARY

Summing up the conducted study, it may be stated that, in the years 2007-2018, trade in agri-food products of the EU, particularly Poland with the US, mainly developed following a model of inter-industry specialisation. Intra-industry specialisation was observed more often in trade of more processed products. In the structure of intra-industry trade between the analysed countries, the lowest share was recorded for trade in horizontally differentiated products – of comparable quality, differing in superficial rather than functional characteristics, or perceived by consumers as differentiated despite a lack of significant quality differences (e.g. due to the country of origin, as the Armington specification model indicates). In the intra-industry trade of the EU with the US, the greatest role was

played by trade in high quality differentiated products, which may hardly be substituted by other products and the exchange of which may provide the most promising prospects for development in food exports from EU countries to the US market. In turn, in Poland's trade with the US, intra-industry trade was vertical trade in low quality products, relatively easily replaceable with standard products coming from other countries, which may result in a loss of the share in the target market.

In relation to studies conducted by Rudolf Loertscher and Frank Wolter [1980], Attila Jámor [2015] and Justyna Łapińska [2016], the low intensity of intra-industry trade in agri-food products of the EU, including Poland, with the US may be explained e.g. by the considerable geographical distance and different absolute sizes of markets in the case of these trade partners, as well as the discrepancy in economic development of the analysed countries. It may also be assumed that an increase in intra-industry specialisation may be promoted by the affiliation of the investigated countries to the same preferential trade area [see Bojnec, Fertő 2016]. However, since negotiations on the establishment of such an area have been suspended, further research on factors determining the intensity of intra-industry trade in agri-food products of EU countries with the US needs to focus on the sector level.

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INTENSYWNOŚĆ I STRUKTURA WYMIANY WEWNĄTRZGAŁĘZIOWEJ W HANDLU ZAGRANICZNYM PRODUKTAMI ROLNO-SPOŻYWCZYMI POLSKI I UNII EUROPEJSKIEJ Z USA

Słowa kluczowe: handel wewnątrzgałęziowy, poziomy handel wewnątrzgałęziowy, pionowy handel wewnątrzgałęziowy, produkty rolno-spożywcze, Polska, UE, USA

ABSTRAKT

Celem artykułu jest zbadanie intensywności i określenie typu handlu wewnątrzgałęziowego produktami rolno-spożywczymi Polski i UE z USA. Analizę przeprowadzono na podstawie danych pochodzących z bazy Comext-Eurostat, na 6-cyfrowym poziomie klasyfikacji HS w latach 2007 i 2018. Intensywność handlu wewnątrzgałęziowego wyznaczono za pomocą wskaźnika Grubela-Lloyda, uwzględniającego zróżnicowanie wymiany wewnątrzgałęziowej na poziomą i pionową wysokiej oraz niskiej jakości. Poszczególne typy wymiany określono na podstawie kryteriów podobieństwa wartości jednostkowych w eksporcie i imporcie, zaproponowanych przez Davida Greenawaya i współautorów [1994]. Na podstawie zrealizowanych badań można stwierdzić, że handel produktami rolno-spożywczymi Polski i UE z USA rozwijał się głównie zgodnie z modelem specjalizacji międzygałęziowej. Wymianę wewnątrzgałęziową obserwowano przede wszystkim w obrotach produktami o wyższym stopniu przetworzenia. W obrotach UE z USA stosunkowo największe znaczenie miał handel wewnątrzgałęziowy produktami zróżnicowanymi wysokiej jakości, które względnie trudno jest substytuować innymi wyrobami, natomiast w wymianie Polski z USA – handel pionowy artykułami niskiej jakości, stosunkowo łatwo dającymi się zastąpić standardowymi wyrobami pochodzącymi z innych krajów, co może prowadzić do utraty udziałów w rynku docelowym.

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