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Does intra-industry specialisation enhance or limit comparative advantage? Evidence from the world citrus fruit trade

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Abstract: In this paper, we aim to identify the intensity and nature of intra-industry specialisation in the global trade in citrus fruits. We used data from the United Nations Comtrade database. We performed both static and dynamic assessments of the intensity of intra-industry trade (IIT) by using the traditional Grubel-Lloyd index and the marginal IIT (*MIIT*) index, respectively. We also separated IIT into horizontal and vertical trade, and we verified the relationship between changes in the intra-industry pattern of trade and the level of comparative advantage gained by the largest producers and exporters of citrus fruits in the world. We used the revealed symmetric comparative advantage (*RSCA*) index to evaluate the level of international competitiveness. Conducting these analyses allowed us to fill the existing research gap by identifying the nature of IIT in products with specific quality characteristics but at a lower processing stage. The study's results indicated that the stronger the IIT or the more intensive shifts toward deepening the intra-industry specialisation, the lesser the comparative advantage of a country in the global export of citrus fruits. Nevertheless, the increased intensity of intra-industry specialisation does not always lead to a deterioration in the value of the trade balance.

Keywords: citrus fruits; horizontal intra-industry trade; relative trade advantage; vertical intra-industry trade; world market

In the classical trade model based on the concept of comparative advantages and the related neoclassical theory of resource abundance, referred to as the Heckscher-Ohlin-Samuelson model, it is assumed that homogeneous products manufactured within a given sector are subject to trade (Falvey 1981), which means that trade is inter-industry in character. Despite numerous simplifying assumptions limiting the applicability of the traditional trade theory in analyses of contemporary international trade, this model explains relatively well the regularities in the directions and structure of the agri-food trade when justifying the traditional international division of labour among industrialised countries and those with the predominant primary sector. However, the progress of integration, globalisation and liberalisation of trade has led to changes in the pattern of comparative advantages and trade specialisation. Because of the diversification of the secondary (industrial production) and tertiary (services) sectors, as well as the diversification of consumer preferences driven by an increase in individual income per capita, the exchange of homogeneous goods started to be replaced by trade in varied goods. Thus, the inter-industry trade has evolved into intra-industry trade (IIT), consisting in the simultaneous import and export of products from the same branches of industry (Grubel and Lloyd 1975).

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Helpman and Krugman (1985) were the first to recognise the different drivers behind these two patterns of trade. They noticed that a comparative advantage provides grounds for inter-industry trade through specialisation, whereas economies of scale drive IIT. In turn, Globerman and Dean (1990) indicated that, apart from the efforts of producers to attain the advantages of scale in production and sale, the development of intra-industry specialisation is based on the similarity in consumer preferences manifested in the geographical scale, while at the same time together with the increased level of economic development and growing discretionary income consumers expect increasingly diverse goods.

According to works by Lancaster (1979) and Falvey (1981), IIT in diversified products may be divided into horizontal and vertical. Horizontal IIT (HIIT) is the individual variants of a product being of identical quality but differing in other characteristics. In turn, vertical IIT (VIIT) consists in two-way trade in products differing in quality and price. HIIT occurs between countries with similar factor endowments, whereas VIIT refers to countries with different levels of income and different factor endowments (Dadakas 2019).

IIT has been growing in importance in global trade since the 1960s (Brülhart 2009). Although initially intra-industry specialisation was observed mainly in the trade of highly processed industrial products between more economically developed countries, with time it also started to develop in the agri-food trade, and it was found both in accordance with the traditional division of labour and between developed countries (Qasmi and Fausti 2001; Sharma 2002; Majkovič et al. 2007; Leitão and Faustino 2008; Leitão 2011; Rasekhi and Shojaee 2012; Onogwu 2014; Jambor et al. 2016; Jambor and Leitão 2016; Cimpoies and Coser 2017; Dadakas 2019; Hoang 2019).

Most studies conducted to date refer to a single country and its overall agri-food trade (Majkovič et al. 2007) or selected bilateral relations (Rasekhi and Shojaee 2012; Cimpoies and Coser 2017; Dadakas 2019). Changes in intra-industry specialisation over time (Majkovič et al. 2007; Cimpoies and Coser 2017; Dadakas 2019), as well as country- and industry-specific determinants of IIT (Rasekhi and Shojaee 2012), have been investigated. Several studies were focused on agri-food trade in selected groups of countries. For example, Jambor and Leitão (2016) identified determinants of agri-food IIT between the new European Union (EU) member states and the other EU countries, and Jambor et al. (2016) discussed the case of the Baltic states. Bojnec and Fertö (2016a) presented a more comprehensive analysis covering 27 EU member states. The investigators in all of those studies analysed a relatively large and internally diversified aggregate of agri-food products. In contradistinction, Qasmi and Fausti (2001) assessed the intensity of IIT for 23 specific agri-food product groups; however, they did not separate IIT into HIIT and VIIT. Hoang (2019) took a similar approach. Several studies were also focused on the nature of trade specialisation in selected processed products. Sharma (2002) analysed processed fruits, and Onogwu (2014) analysed cereal and miscellaneous edible preparations. Both authors looked for the determinants of intra-industry specialisation while at the same time neglecting the division into HIIT and VIIT. To date, there has been very little research on products with specific quality characteristics, but at lower processing stages, which motivated us to examine the intra-industry pattern of world trade in citrus fruits. Our paper fills the gap in the existing research and contributes to a better understanding of the role of quality characteristics in gaining a comparative advantage in the agri-food trade.

Results from the literature on the subject indicate that intra-industry specialisation can boost the level of international competitiveness measured at the meso- and micro-economic levels, as producers are able to increase sales and gain from economies of scale (Helpman and Krugman 1985; Rasekhi and Shojaee 2012). At the same time, consumers are able to meet their 'demand for variety' or find their 'favourite variety' (Krugman 1979; Lancaster 1979). It is also important to remember that greater adaptability of the trade structure to the system of comparative advantages is found with IIT than with inter-industry trade (Brülhart and Elliott 1998). Bojnec and Fertö (2012) investigated the agri-food trade of five Central European countries with the EU-15 and confirmed that a relative trade advantage is consistent with successful quality competition in two-way trade, whereas unsuccessful quality competition brings a relative trade disadvantage. Their research referred to four groups of agri-food products, including bulk raw commodities, processed intermediates, consumer-ready food and horticultural produce. We followed that idea, except that we attempted to verify whether such a relationship is also observed in trade in agri-food products at a lower processing stage.

According to United Nations Comtrade data (Comtrade 2022), growing trade flows of citrus fruits were observed in 2010 and 2020. Considering their importance to the human diet and the increasing demand for high-quality fresh fruit, citrus fruits are considered

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to be the most economically important fruit crop in the world. They are grown in both developed and developing countries, and a tropical climate is an obligatory condition for their production, so the world production and trade in citrus fruits are highly concentrated within a relatively narrow group of countries (Comtrade 2022; FAOSTAT 2022). In this paper, we aimed to identify the intensity and nature of intra-industry specialisation in the world trade in citrus fruits. Moreover, the study results verified the relationship between changes in the pattern of IIT and the level of comparative advantage gained by the largest producers and exporters of citrus fruits in the world.

MATERIAL AND METHODS

The analysis of the nature of intra-industry specialisation in the world trade in citrus fruits covered four stages: *i*) static and dynamic assessment of the intensity of IIT; *ii*) separation of IIT into horizontal and vertical trade; *iii*) calculation of the revealed symmetric comparative advantage (*RSCA*) index; and *iv*) construction of a matrix mapping the analysed countries on the basis of the level of comparative advantages (*RSCA*) and either the intensity of IIT or the structure of the change in trade flows according to the concept of marginal IIT (MIIT).

We measured the intensity of IIT by using the traditional Grubel-Lloyd index, expressed as follows (Grubel and Lloyd 1975):

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

where: X_{ik}, M_{ik} – export and import, respectively, of a given category of products i from or to country k (overall or bilateral).

The *IIT* index assumes values between 0 and 1; the higher the values, the more strongly the flows of export and import overlap (Hoang 2019). Following Qasmi and Fausti (2001), we can distinguish four classes of products differing in their *IIT* values: *i*) $0.00 < IIT \leq 0.25$ (strong inter-industry trade), *ii*) $0.25 < IIT \leq 0.50$ (weak inter-industry trade), *iii*) $0.50 < IIT \leq 0.75$ (weak IIT), and *iv*) $0.75 < IIT \leq 1.00$ (strong IIT).

The Grubel-Lloyd index is a static measure in the sense that it refers to trade values for one time period. If the objective is to quantify the pattern of specialisation (inter- or intra-industry) at a specific time point, it is sufficient to use such a measure. However, using this measure may not allow determination of whether adjustment processes to the comparative advantage system ever take place within the assortment structure of trade over a longer period. Therefore, we complemented the analysis of static IIT measures with a survey of the MIIT patterns as introduced by Hamilton and Kniest (1991). In this study, we used the *MIIT* index in the following formula:

$$MIIT_{ik} = 1 - \frac{\left|\Delta X_{ik} - \Delta M_{ik}\right|}{\left|\Delta X_{ik}\right| + \left|\Delta M_{ik}\right|} \quad (2)$$

where: ΔX_{ik}, ΔM_{ik} – changes in the values of export and import, respectively, in two investigated years or periods.

Similarly, as does *IIT*, *MIIT* ranges from 0 to 1. Values close to these extremes correspond to the observed change in the character of trade toward strongly inter-industry trade (0) or *IIT* (1), respectively (Greenaway and Milner 1983).

To divide IIT into its horizontal and vertical components and thus measure quality differences in trade, we used the approach based on relative unit values (*UVs*) presented by Abd-el-Rahman (1991) and Greenaway et al. (1994). HIIT occurs when the ratio of the *UVs* of export (UV^X) and import (UV^M) is within the following range:

$$1 - \alpha \leq \frac{UV_{ik}^X}{UV_{ik}^M} \leq 1 + \alpha \quad (3)$$

where: $\alpha = 0.15$ (Greenaway et al. 1994).

If *IIT* values are outside this range, trade is classified as VIIT. According to the definition given by Greenaway et al. (1994), we made the distinction between high- and low-quality VIIT by using the conditions specified here:

$$\frac{UV_{ik}^X}{UV_{ik}^M} > 1 + \alpha \text{ or } \frac{UV_{ik}^X}{UV_{ik}^M} < 1 - \alpha \quad (4)$$

If the ratio of export prices to import prices exceeds 1.15, we observe high-quality VIIT ($VIIT_{high}$), which means that a country sells higher-quality goods abroad and imports lower-quality products from abroad. In turn, if this ratio is lower than 0.85, it is low-quality VIIT ($VIIT_{low}$), and such a country exports goods of relatively lower quality than it imports. Taking into account the distinction between HIIT and VIIT, we re-estimated the *IIT* index as follows (Greenaway et al. 1994):

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$$IIT_{ik} = 1 - \left(\frac{\left| X_{ik}^{HIIT} - M_{ik}^{HIIT} \right| + \left| X_{ik}^{VIITlow} - M_{ik}^{VIITlow} \right| + \left| X_{ik}^{VIIThigh} - M_{ik}^{VIIThigh} \right|}{X_{ik} + M_{ik}} \right) \quad (5)$$

In the next step, we calculated the *RSCA* index to evaluate the level of international competitiveness of key players in the world citrus fruit market. Such an indicator has already been used, for example, by Widodo (2009), Jing (2018) and Smutka et al. (2018). We calculated the *RSCA* index from the formula given by Laursen (1998), $RSCA_{ij} = (RCA_{ij} - 1)/(RCA_{ij} + 1)$, using Balassa's revealed comparative advantage (RCA): $RCA_{ij} = (X_{ij}/X_{ik})/(X_{nj}/X_{nk})$ (where: X – export; i – analysed country; j – analysed product or group of products; k – all commodities; n – reference country or countries) (Balassa 1965). The advantage of the *RSCA* over the RCA index is that the former has a symmetric distribution and may be within the interval of [–1; 1], with values lesser than zero denoting a comparative disadvantage and those greater showing a comparative advantage. This makes it possible to build a matrix mapping the countries analysed by the level of comparative advantages (*RSCA*) and the level of IIT measured with either *IIT* or *MIIT*. Thus, we verified whether the adjustments in export and import are made to achieve a strong competitive position and reduce trade imbalance.

In this study, we used data from the United Nations Comtrade database (Comtrade 2022), aggregated at the four-digit or six-digit level of the Harmonised Commodity Description and Coding System (HS) nomenclature. We analysed the *IIT* and *MIIT* indexes by using the data for the four-digit subgroup of citrus fruits, fresh or dried (HS 0805), and we separated IIT into horizontal and vertical trade at the six-digit HS level. The analysis covered five six-digit items included in the HS 0805 subgroup. These were oranges (HS 080510); mandarins, clementines and tangelos (HS 080520 or, since 2017, HS 080521, HS 080522, and HS 080529); grapefruits and pomelos (HS 080540); lemons and limes (HS 080550); and other citrus fruits (HS 080590). Such an approach is a type of sensitivity analysis and shows possible differences in the values of intra-industry measures, depending on the degree of data aggregation. Trade values were expressed in current USD.

The time scope of the study was determined by the availability of comprehensive and internationally comparable data, and it covered the years of 2010 and 2020. The starting year of the analysis was also when strong imbalances were overcome between demand and supply and the slowdown in the agri-food sector from the 2007–2009 recession; 2020 is the last year for which a complete data set is available. We investigated the largest producers and exporters of citrus fruits with a minimum 5% share in the global volume of either production or export in both analysed years, and these were China, the Netherlands, the US, India, Brazil, Mexico, Spain, South Africa, and Turkey (Comtrade 2022; FAOSTAT 2022).

RESULTS AND DISCUSSION

A characteristic feature of the world citrus fruit market is the high degree of concentration of production and export in a relatively small group of countries, which tropical climate predestines to grow such fruits. In 2010 and 2020, approximately 70% of world production and export of these fruits came from ten countries, of which five accounted for almost 60%, and the three greatest producers and exporters accounted for close to 50% (Table 1). China was the leading citrus fruit producer worldwide, as in 2020 its production amounting to 44.6 million tonnes accounted for more than 28% of the total volume of global citrus fruit production. Almost 20 million tonnes, amounting to 12.5% of the global production of citrus fruits, were grown in Brazil, and 14 million tonnes and 9% of global production came from India. China and India were also the countries in which the volume of citrus fruit production in the years 2010 and 2020 increased dynamically, thus indicating the strengthening of this direction of production specialisation. Among these three countries, only China specialised in the export of the analysed assortment group, providing 10% of global citrus fruit exports in 2020. Spain accounted for almost 26% of the global export of citrus fruits, 11% was provided by South Africa and 6% was provided by the Netherlands, where citrus fruits are not grown and the relatively high contribution of that country to the world export was the consequence of re-exportation.

The unique character of the Netherlands' share in the world citrus fruit trade was confirmed by values of the Grubel-Lloyd indexes of IIT (0.8 in 2010 and 0.92 in 2020), showing a high degree of overlapping between the export and import flows, noted in the Netherlands being the re-exporter of citrus fruits (Table 2). In 2010, IIT was still partly trade in horizontally diver-

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Table 1. World production and export of citrus fruits in 2010 and 2020

Countries	Production					Export				
	2010		2020			2010		2020		
	(million tonnes)	structure (%)	(million tonnes)	structure (%)	2010 = 100	(million USD, current)	structure (%)	(million USD, current)	structure (%)	2010 = 100
Spain	6.1	4.7	6.7	4.2	109.8	3 396.6	30.0	4 191.0	25.9	123.4
South Africa	2.1	1.6	2.8	1.8	133.3	917.6	8.1	1 712.2	10.6	186.6
China	26.5	20.5	44.6	28.2	168.3	615.8	5.4	1 577.7	9.8	256.2
Netherlands	0.0	0.0	0.0	0.0	–	630.9	5.6	996.5	6.2	158.0
Turkey	3.6	2.8	4.3	2.7	119.4	860.0	7.6	941.0	5.8	109.4
US	10.0	7.8	7.1	4.5	71.0	956.6	8.5	931.8	5.8	97.4
Egypt	3.5	2.7	4.5	2.8	128.6	518.4	4.6	802.4	5.0	154.8
Mexico	6.9	5.3	8.9	5.6	129.0	258.8	2.3	555.2	3.4	214.5
Brazil	20.7	16.0	19.4	12.3	93.7	68.8	0.6	106.8	0.7	155.1
India	9.6	7.4	14.0	8.9	145.8	14.6	0.1	67.4	0.4	461.4
World	129.0	100.0	158.0	100.0	122.5	11 317.2	100.0	16 169.7	100.0	142.9

Source: Authors' calculations based on FAOSTAT (2022) and Comtrade (2022)

sified products of negligible differences in UVs of export and import (*HIIT* = 0.16), but in 2020 the total turnover was $VIIT_{high}$ (0.92) (Table 3). This difference could indicate a change in the pattern of trade from direct re-export consisting in the export of previously imported fruit in an unchanged form into re-export of co-packaged and refined commodities, increasing the UV of exported goods in relation to imported commodities. Moreover, re-exports from the Netherlands were predominantly fruits with relatively high unit prices, such as lemons, limes and oranges, and the other imported fruits were used to a greater extent on the domestic market.

We also observed a strong citrus fruit IIT in the US, a country with a relatively high share both in the world production and export of citrus fruits. However, it was the only one of the countries analysed for which during the period from 2010 to 2020 a significant, almost 30%, decrease was recorded in the volume of citrus fruit production (Table 1), along with an adjustment in the assortment structure of trade, aiming at a change in the character of specialisation toward IIT (*MIIT* = 0). Such a trend was probably a manifestation of the US striving to reduce the negative balance of trade in citrus fruits (USD 620 million in 2020) and to return to the net exporter position for this assortment group,

Table 2. Trade balance and intensity of IIT in citrus fruits in 2010 and 2020

Countries	Trade balance (million USD, current)		*IIT*		*MIIT*
	2010	2020	2010	2020	
China	509.7	1 086.1	0.29	0.48	0.57
Netherlands	–314.2	–170.3	0.80	0.92	0.76
US	345.5	–620.2	0.78	0.75	0.00
India	6.2	37.6	0.73	0.61	0.58
Brazil	58.8	74.9	0.26	0.46	0.73
Mexico	250.1	524.9	0.07	0.09	0.10
Spain	3 190.1	3 902.3	0.11	0.13	0.19
South Africa	915.8	1 706.5	0.00	0.01	0.01
Turkey	846.9	908.3	0.03	0.07	0.39

IIT – intra-industry trade; *MIIT* – marginal IIT

Source: Authors' calculations based on Comtrade (2022)

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Table 3. IIT in citrus fruits in 2010 and 2020 by types

Countries	2010					2020				
	IIT[a]	*HIIT*	*VIIT*			*IIT*[a]	*HIIT*	*VIIT*		
			total[b]	$VIIT_{low}$	$VIIT_{high}$			total[b]	$VIIT_{low}$	$VIIT_{high}$
China	0.29	0.00	0.29	0.29	0.00	0.43	0.09	0.35	0.08	0.27
Netherlands	0.79	0.16	0.63	0.00	0.63	0.92	0.00	0.92	0.00	0.92
US	0.78	0.00	0.78	0.48	0.30	0.75	0.53	0.22	0.00	0.22
India	0.50	0.00	0.49	0.49	0.00	0.61	0.00	0.61	0.61	0.00
Brazil	0.22	0.05	0.18	0.18	0.00	0.33	0.00	0.33	0.33	0.00
Mexico	0.07	0.01	0.06	0.01	0.05	0.09	0.06	0.03	0.03	0.00
Spain	0.11	0.07	0.04	0.04	0.00	0.13	0.13	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Turkey	0.03	0.00	0.03	0.00	0.03	0.06	0.00	0.06	0.00	0.06

[a]Weighted *IIT* calculated based on the transformation proposed by Greenaway et al. (1994); [b]total vertical intra-industry trade (*VIIT*) (the sum of *VIIT* in high and low quality products); *IIT* – intra-industry trade; *HIIT* – horizontal IIT; *VIIT* – vertical IIT

Source: Authors' calculations based on Comtrade (2022)

which the US occupied in 2010 (Table 2). At the same time, IIT was transformed from vertical trade both in high-quality products ($VIIT_{high}$ = 0.30 in 2010) and low-quality products ($VIIT_{low}$ = 0.48 in 2010) into horizontal trade (*HIIT* = 0.53 in 2020) (Table 3). In view of the increasing trade deficit (Table 2) and the fact that products of relatively low quality may be relatively easily substituted with products from other countries, such a direction of specialisation over a longer time perspective may lead to an accelerated reduction of the share in trade and a weakening of the exporter's competitive position.

Opportunities for the development of export may be connected with diverse, high-quality products distinguished by unique quality attributes, making them difficult to replace or substitute with other assortments. In the years 2010 and 2020, such a type of intra-industry specialisation occurred in China, which, like the two other leading citrus fruit producers, India and Brazil, had a low intensity of IIT or a predominance of inter-industry trade ($0.26 < IIT < 0.73$) (Table 2) and strove to enhance the intensity of IIT (*MIIT* = 0.57 in China, *MIIT* = 0.58 in India, and *MIIT* = 0.73 in Brazil). What is essential is that the change in the trade model was accompanied by an improvement in trade balance, with all three countries strengthening their position of net citrus fruit exporters. Whereas in China's citrus fruit trade diverse high-quality products were gaining in importance ($VIIT_{high}$ = 0.27 in 2020), the citrus fruit trade in India and Brazil as a whole was a $VIIT_{low}$ of 0.61 and 0.33, respectively (Table 3).

To a lesser extent, adjustments in the trade structure aiming at increasing the degree of overlapping between export and import flows occurred in Turkey's citrus fruit trade, with a strong inter-industry trade (0.03 in 2010 and 0.07 in 2020). Thanks to its high degree of food self-sufficiency in relation to citrus fruits, Turkey is a large citrus fruit exporter, with domestic production supplemented with imported citrus fruits only to a very limited extent. The citrus fruit trade in South Africa, Mexico and Spain was also characterised by inter-industry specialisation determined by excess supply over domestic demand, which became even more evident in the period from 2010 to 2020 and resulted in an increasing trade balance surplus.

Except for the Netherlands and the US, the intensity of IIT in citrus fruits in the countries analysed was relatively low. This finding is consistent with the results of earlier studies indicating a higher degree of intra-industry specialisation in the case of processed agri-food products (Qasmi and Fausti 2001; Dadakas 2019; Pawlak 2019). In the analysis of the IIT model, except for the US in 2020, VIIT dominated over HIIT. Jambor et al. (2016), Jambor and Leitão (2016), Dadakas (2019) and Pawlak (2019) made similar observations concerning the agri-food trade in EU countries, and Rasekhi and Shojaee (2012) confirmed them for Iran.

Although fruit and vegetable value chains have played an increasingly important role in the nutrition of developed countries, analyses concerning their international competitiveness are scarce. Bojnec and Fertö (2016b) used the RCA indicator to evaluate the

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level of competitiveness of the EU in the global market of fruit and vegetables considered jointly, and Jing (2018) used the RSCA index to assess the competitiveness of China in the world fruit market. However, none of those studies referred solely to citrus fruits.

On the basis of the *RSCA* values, five of the nine countries analysed had an RCA in the global trade in citrus fruits (*RSCA* > 0), including Spain, South Africa and Turkey showing the strongest competitive position (0.71 < *RSCA* < 0.90) (Figure 1). Those three countries were self-sufficient, global leading exporters of citrus fruits (FAOSTAT 2022) with a strong inter-industry trade specialisation and a positive trade balance (Table 1, Figure 1). Similarly to the analysis of the RCA indexes for the fruit and vegetable products of the EU conducted by Bojnec and Fertö (2016b), an advantageous competitive position in the world citrus fruit trade can be a result of the favourable natural and climatic conditions, cheaper labour force, or advanced technologies for competitive fruit production, harvesting, transportation and marketing. At the same time, the comparative advantage is associated with the rising demand for citrus fruits both in the economically developed countries and some emerging markets. In this case, the health-promoting and quality properties of the products exported, as well as the restrictiveness of non-tariff measures imposed by importers, are decisive to the growth of trade (Rickard and Lei 2011; Garcia Álvarez-Coque et al. 2012; Melo et al. 2014; Grant et al. 2015).

Apart from rich soil and a favourable climate, Turkey's competitive position relies on its geographical position allowing access to large markets in Europe, the Middle East, and North Africa (Camanzi et al. 2003; Crescimanno et al. 2014). However, the shift toward the IIT pattern in Turkey resulted in a decreased level of comparative advantages in the period from 2010 to 2020 (Table 2, Figure 2). No similar trend was observed in the other countries with high *MIIT* indexes, showing adjustments in the trade structure to increase intra-industry specialisation, such as the Netherlands, Brazil, India, and China (Figure 2). Except for the Netherlands as a re-exporter, the three other countries were the largest producers of citrus fruits deprived of a comparative advantage and specialising in IIT in vertically differentiated products, while at the same time having a positive trade balance. Trade surplus values in Brazil and India were relatively low, as VIIT in low-quality products, easily substituted with products coming from other countries, was dominant in those countries. China made the adjustments in trade pattern and strove to attain trade specialisation in high-quality differentiated products, which are not easy to replace with standard products. On the one hand, this facilitates a significant improvement of a positive trade balance; the value of trade surplus in 2020 was twice as high as in 2010 (Table 2). On the other hand, this trend did not allow China to achieve a strong competitive advantage. Such a result is in line with the findings reported by Jing (2018).

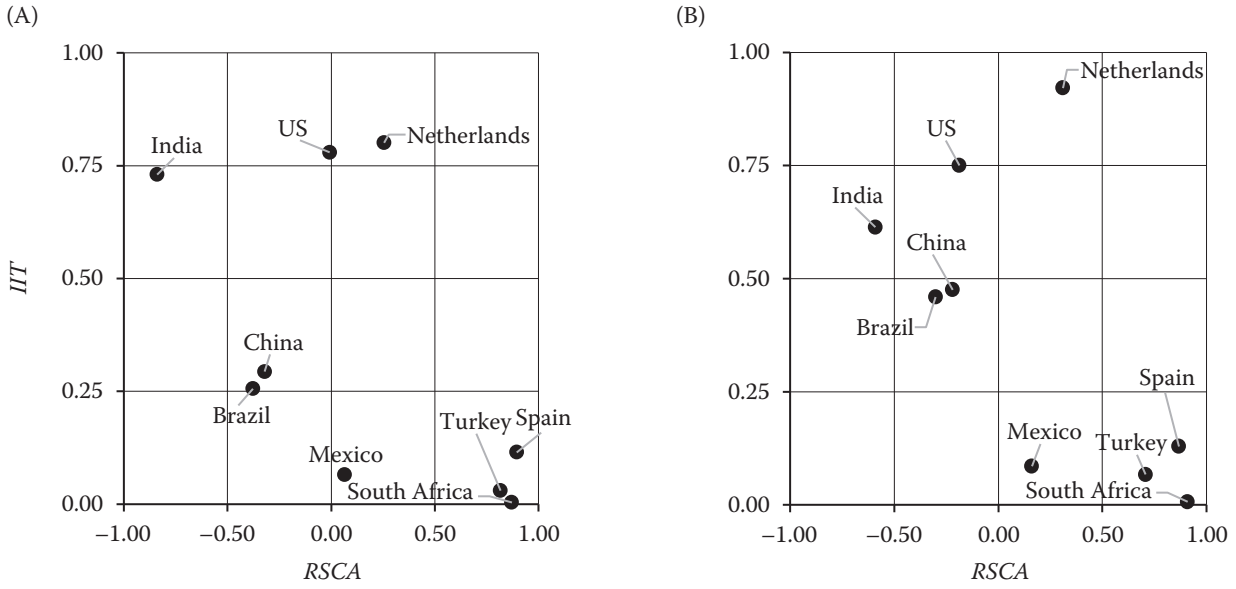

Figure 1. Revealed symmetric comparative advantage (*RSCA*) *versus* intensity of intra-industry trade (*IIT*) in citrus fruits in (A) 2010 and (B) 2020

Source: Authors' calculations based on Comtrade (2022)

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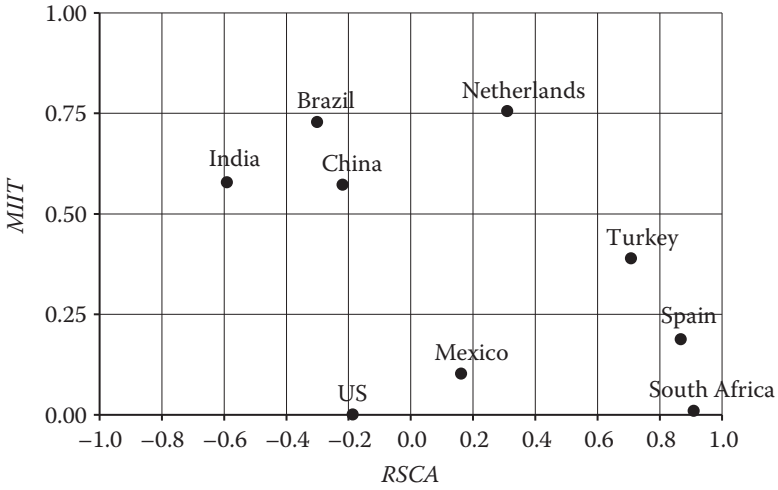

Figure 2. Revealed symmetric comparative advantage (*RSCA*) *versus* marginal intra-industry trade (*MIIT*) in citrus fruits in 2020

Source: Authors' calculations based on Comtrade (2022)

A favourable competitive position, but weaker compared with that gained by the largest world exporters of citrus fruits, was enjoyed only by the Netherlands being a re-exporter of higher-quality products than those imported to the country. Bojnec and Fertö (2016b) previously showed the relatively strong competitive advantages of the Netherlands in the global market of fruits and vegetables. Because of the typically intra-industry nature of the Dutch trade in citrus fruits, the comparative advantage was not accompanied by a positive trade balance, although the value of a trade deficit noted by that country decreased by approximately 45% in the period from 2010 to 2020. A clear relationship between a strong IIT and lack of comparative advantage in the world market, along with the transition in the trade position from being a net exporter to a net importer of citrus fruits, occurred in the US. This finding is in line with observations by Bojnec and Fertö (2012) that unsuccessful quality competition in two-way trade leads to a relative trade disadvantage. As mentioned earlier, the trade in horizontally diversified citrus fruits of relatively low quality, which can be relatively easily substituted with other products, was dominant in the US.

CONCLUSION

IIT is a factor determining the level of comparative advantages reached by key players in the global citrus fruit market. Our study results indicate that the stronger the IIT or the more intensive shifts toward enhancing intra-industry specialisation, the lower the comparative advantage of a country in the global export of citrus fruits. However, increasing the intensity of intra-industry specialisation does not always mean a deterioration in the value of the trade balance. Moreover, an intensive IIT contributes to a greater diversity of citrus fruits available for domestic consumers, resulting in a maximised utility function, while at the same time producers are able to take advantage of economies of scale and diversify destination markets for their products.

In general, the intensity of citrus fruit IIT in the countries analysed was relatively low, which to a considerable extent results from strong concentration of production and export for this assortment group within a relatively small group of countries with the tropical climate required for their production. These countries are self-sufficient in terms of this fruit assortment and only to a limited extent supplement supply on the domestic market with imported commodities to meet consumers' demand for variety or to allow them to find their favourite variety. When analysing the model of IIT in citrus fruits, we found that trade in vertically diversified products was dominant in IIT. It should be stressed here that in terms of export development and geographical diversification of target markets, facilitation of an increased share in world trade requires intra-industry specialisation to consist in the trade of high-quality diversified products, exhibiting unique quality attributes, thanks to which they cannot easily be substituted with other assortments. Hence, the more utilitarian value of this study may be related to encouraging policies aiming at enhancing the scale of VIIT in high-quality products. Specific implications for agri-business actors and policymakers can include promoting activities focused on quality upgrades of the products sold abroad at higher export prices and trade liberalisation improving access to global markets, including those with a high growth rate of demand for citrus fruits.

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The analyses we conducted allowed us to fill the existing research gap in the field of identifying the nature of IIT in products with specific quality characteristics, but a lower processing level. To be able to generalise the conclusions drawn, we investigated a group of leading producers and exporters that did not come from a single country or selected bilateral relations of a given country or countries, as is typically done. It was also possible to verify the relationship between changes in the pattern of IIT and the level of comparative advantage gained by the largest producers and exporters of citrus fruit in the world. However, the evolution of the IIT pattern should be explained in more detail by identifying the most important factors affecting such a specialisation. Considering this aspect as a limitation of this study, in the course of further research, it would be advisable to investigate the determinants of IIT in citrus fruits, including in the scope of the research their largest producers, exporters and importers. Potential analogies with other raw agricultural commodities would also provide valuable insights.

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