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## **MARKET COMPETITION AND CONCENTRATION IN THE GLOBAL MARKET OF APPLE JUICE CONCENTRATE CONCERNING HUNGARY, POLAND AND CHINA**

### *KONCENTRACJA I KONKURENCJA NA GLOBALNYM RYNKU KONCENTRATU JABŁKOWEGO W ODNIESIENIU DO WĘGIER, POLSKI I CHINY*

**Key words: competition, concentration, apple juice concentrate, Hungary, Poland, China**

*Słowa kluczowe: konkurencja, koncentracja, koncentrat soku jabłkowego, Węgry, Polska, Chiny*

*JEL codes: Q17, L66*

**Abstract.** This study examined the market competition and concentration in the global market of apple juice concentrate. To determine comparative advantages, RCA index was used. Among the three studied countries, China is the most competitive, Hungary is in the second place, and Poland has the lowest relative competitiveness. To determine market concentration, Herfindahl-Hirschman-index was applied. Based on it – excluding the high Chinese market share between 2006 and 2010 – the global market of apple juice concentrate can be considered as a market with moderate concentration. Based on the secondary research the study has a detailed examination of cause and effect relationships behind the RCA and HHI index results.

### **Introduction**

The main reason for choosing this topic is the fact that apple concentrate is an important processed product, it is the second most important product in the juice market after orange juice concentrate. AJC (*Apple Juice Concentrate*), as raw material, is mostly purchased by beverage companies, but it can be used for cosmetics and medicine production also. During the manufacturing process beside the AJP, there are two different types of by-products: apple pomace, which is marketable as animal feeds in the form of dried apple pomace, and apple aroma, which is usually used to produce essential oils.

Globally, AJC production is between 1.4-2.1 million tonnes. In 2014 1.8 million tonnes of AJC were produced worldwide. 50-60% of AJC production belongs to China and Oceania, 30% to Europe, 11% to North and South America, 2% to the Middle East and only 1-2% of AJC production is produced in Russia, Japan, Australia and Africa. The EU-28 countries produce 350,000-400,000 tonnes of AJC, also Ukraine, produces 70,000-90,000 tonnes and Turkey produces 35,000-55,000 tonnes [Heillinger 2013], so all in all 500,000 tonnes of AJC are produced in Europe annually. Poland is the EU's leading producer (150,000-220,000 tonnes), followed by Germany, Italy and Hungary (50,000-50,000 tonnes).

The 40% of globally produced AJC is sold on the European market; this is the largest consumption. North America, which produces only a small amount, purchases 30% of the globally produced AJC that is 470,000 tonnes. Russia and China have an average 100,000 tonnes AJC consumption annually. China exports annually 70,000 tonnes of AJC to the world market; the largest part is exported to North America, to the US, the smallest part, which is a significant amount also, to Japan, Russia and the Netherlands. Europe and South America export their AJC mostly to North America. The EU-28 on average imports 570,000 tonnes AJC the largest buyers are Germany, the United Kingdom, the Netherlands and Austria. The Member States cover 75% of this consumption, and only 25% is brought from other countries, mainly from China (10,000-100,000 tonnes) and Turkey (40,000-50,000 tonnes). The one-third of the import is from Poland

Table 1. The market share of countries with comparative advantages in the global market of AJC (2002-2015) 100%=1,1-1,9 million tonnes

*Tabela 1. Udział w rynku krajów o przewadze komparatywnej w globalnym rynku koncentratu soku jabłkowego (2002-2015) 100%= 1,1-1,9 mln ton*

Countries/ <i>Kraje</i>	Udział w rynku /Share in the market [%]													
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
China/ <i>CN</i>	24	31	31	37	42	56	45	49	46	41	39	38	31	36
Poland/ <i>PL</i>	16	16	14	11	13	8	14	13	11	11	15	17	18	22
Ukraine/ <i>UA</i>	< 1	< 1	< 1	< 1	< 1	< 1	2	3	3	2	5	7	7	< 1
Chile/ <i>CL</i>	4	4	3	3	4	2	2	2	2	4	4	3	6	5
Turkey/ <i>TR</i>	2	3	3	3	2	2	1	2	3	4	3	4	4	5
Hungary/ <i>HU</i>	7	3	4	3	2	2	3	4	2	2	3	3	4	4
Moldova/ <i>MD</i>	< 1	< 1	1	1	1	1	1	1	1	1	1	2	3	< 1
Others/ <i>Inne</i>	47	43	44	42	36	29	32	26	32	35	30	26	27	28

Source: own edition based on COMTRADE data [2016]

*Źródło: opracowanie własne na podstawie danych COMTRADE [2016]*

(130,000-200,000 tones), 15% is from Austria, and 9% is from Turkey. Table 1 summarises the market shares of the most important AJC exporter countries. China and Poland together account nearly for 60% of AJC export while they had 40% market share in 2002, yet the market size has not changed substantially since then.

The aim of this paper is to explore the global market of AJC in particular to Hungarian, Polish and Chinese AJC market. To explore the market three objectives were determined:

- identifying comparative advantages of Hungary, Poland and China on AJC global market;
- determining the volume of market concentration by consulting tentative statistic data;
- exploring the cause and effect relationships behind the market concentration, in line with the objectives above.

## Material and methods

To determine comparative advantage, RCA-index was applied (Revealed Comparative Advantage). Firstly, Béla Balassa determined RCA index [1965]. Despite, the Balassa-index has been regularly questioned in recent years the original index is the most usually used analysis tool in empirical research [Fertő 2003]. Ricardo David developed the theory of comparative advantage [1965]. The theory highlights the case when two countries are capable of producing the same two goods, but one of them is more efficient at producing both goods than the other country. In this case, maximum output can be realised if the country, which is more efficient at producing, produces the product with higher production advantage.

Several studies have used Balassa-index to evaluate international trade performance. Imre Fertő and Lionel J. Hubbard [2001] evaluated competitiveness and comparative advantage of the Hungarian agriculture. They analyzed 21 product groups and according to it in Hungary, the „vegetables and fruits” product group had a comparative advantage in the period from 1992 to 1998 in Europe. I. Fertő [2006] also evaluated the volume of comparative advantages in his research but at detailed product groups level. He concluded that Hungarian fresh fruits did not have comparative advantage globally and at the EU level, but processed fruits had comparative advantage globally and at the EU level between 1992 and 2002. Atilla Jámor [2008] in his doctoral thesis examined the competitiveness of cereals at the product level. In his dissertation, he evaluated the comparative advantage of 21 products in a manner that particular products were examined inside the cereal product group. The research covered the EU15 countries during the period from 1995 to 2006.

The comparative advantage of AJC, which belongs to the group of processed vegetables and fruits, have been examined in several studies and closely related to the study mentioned above. Du

Juan in conjunction with his colleagues [2012] studied the Chinese, Poland and German market share and comparative advantage of AJC applying RCA index. According to his statement China has a significant market share in the global AJC market (above 70%) and by RCA index, China has a high comparative advantage and at the national level, AJC is an outstanding product. Mehmet Arif Sahinli [2013] analysed revealed comparative advantages in the agricultural sector between Turkey and the EU where AJC takes place separately among the different examined products. According to his study, both countries have comparative advantage in the AJC export, but the EU's comparative advantage is significantly higher. Tebogo Edwin Mashabela and Nick Vink [2008] analyzed the comparative advantage of fresh and processed fruits in Chile and South-Africa using product line view. According to their results, it can be stated that the comparative advantage of both countries decreased during the period from 1995 to 2005, Chile has comparative advantage, but South Africa has comparative disadvantage.

Viktória Kurmai [2015] in her study of the global market situation of AJC according to RCA index stated that China has the strongest comparative advantage since the millennium, and it was the strongest during the period from 2010 to 2011. While China, Poland, Hungary and Chile had strong comparative advantages after the millennium, nowadays besides these four countries Austria, Turkey and Moldova also have a strong comparative advantage. Austria and Turkey had an ordinary comparative advantage during the period from 2002 to 2006 but from 2010 to 2014 Turkey acquired a stronger comparative advantage. Since the millennium, Argentina's comparative advantage is weak while Italy has now lost even its weak comparative advantage. By the newest data Germany, Italy, Spain, the Netherlands and the US have comparative disadvantage in the world market of AJC trade.

RCA index is the so-called indicator of revealed comparative advantages and with the application of this index international specialization of countries can be described. The index is based on the examined trade construction; it compares the ratio of a certain product in the overall export to the market share related to the trade of this product in the determined country groups. RCA index can be defined as follows [Balassa 1965]:

$$RCA = \frac{\frac{X_{ij}}{X_{it}}}{\frac{X_{nj}}{X_{nt}}}$$

where:  $X$  – stands for the export,  $i$  – country,  $j$  – product,  $t$  – product group,  $n$  – group of countries.

The index of revealed comparative advantage or disadvantage of the product export to the reference area is defined with the comparison of the market share of given product group in the countries overall export with the market share of reference countries in the overall export. The higher the index value is then zero the comparative advantage of the sector is stronger in the comparison to other sectors; in the case of lower index values the country has comparative disadvantage. Jeroen Hinloopen and Charles van Marrewijk [2001] worked out the ranking for distribution of RCA index, to the index become more precise:

- A-category:  $0 < RCA \leq 1$  no comparative advantage,
- B-category:  $1 < RCA \leq 2$  weak comparative advantage,
- C-category:  $2 < RCA \leq 4$  medium comparative advantage,
- D-category:  $4 < RCA$  strong comparative advantage.

Arye Hillman stated in his analysis [1980] that RCA index is adequate to compare comparative advantage of a product between countries but to compare products is inadequate. Vollrath suggested three different specifications for more realistic measurement of revealed comparative advantage [Fertó 2004]: relative trade advantage (RTA), the logarithm of relative export advantage ( $\ln RXA$ ) and the third measure is revealed competitiveness (RC). The relative trade advantage index takes into account exports as well as imports, and it is the difference between relative export

advantage (RXA) and relative import advantage (RMA). If  $RTA > 0$ , then the given country has trade advantage compared to the reference countries, otherwise it has disadvantage. The higher is the index the most competitive is the given country. The relative competitiveness is the difference between the logarithm of the relative export advantage ( $\ln RXA$ ) and the logarithm of relative import advantage ( $\ln RMA$ ). The positive value of  $\ln RXA$  and RC indexes means competitive advantage while the negative value means competitive disadvantage.

The international COMTRADE database provided the data for RCA index calculation. In this database, the data related to AJC export has been noted since 2002. The examination of revealed comparative advantages of AJC export in the three countries covers the period after the millennium. In the line with the objective, countries all over the world were chosen as reference country group, and the selected product group is 'not fermented vegetable and fruit juices'. According to the Nomenclature classification, its code is HS 2009. Combined Nomenclature classification for the product group mentioned above distinguishes 15 products. AJC (HS 200979), which is the subject of this study, is one of the greatest product in that product group.

The most common method for determining the volume of market concentration is the Herfindahl-Hirschman Index (HHI). The Herfindahl-Hirschman Index is widely applied. The index is defined as the sum of the squares of the relative market shares [Rhoades 1993]. The index reaches its maximum at the level of 10,000. HHI values above 2,500 indicate high market concentration, values between 1,500 and 2,500 indicate moderate market concentration, values below 1,500 indicate an unconcentrated market [Naldi, Flamini 2010].

$$HHI = \sum \left( \frac{x_i}{\sum_{i=1}^n x_i} \right)^2$$

where:  $X_i$  – characteristic expressed in natural measurement in  $i$ -th unit,  $n$  – item number.

Some research institutions apply this method, for instance, to determine the concentration of given market regarding the market share of different market actors. With other words, HHI indicates the volume of market concentration in the given market. Different state supervisory authorities frequently use HHI to establish whether market competition is in danger or not.

Many studies have applied Hirshman-Index to determine the market concentration of country groups related to certain products in the food sector. Attila Jámor [2009] by HHI determined that the EU15's cereal trading is a stable concentrated market. Gábor Harsányi [2007], in his doctoral thesis, applied HHI in the EU's wine market and stated that the EU's wine trading is moderately concentrated, and the most important country is Spain. Krisztina Pocsai [2014] in his doctoral dissertation examined the distribution of Mangalica stock at the county level and concluded that the Mangalica stock in Hungary has moderate concentration. COMTRADE provided the required database for HHI calculations in which to determine HHI harmonised nomenclature was used. The index can be interpreted on the global market; the examination included every country in the world that is not necessary because smaller market actors do not entail any substantive changes in the index. The index has been determined for the period from 2002 to 2015.

The RCA index group, i.e. determining comparative advantages in certain product groups, can be useful to explore the most important export products of a country. However, in this study, the author would like to determine the market relations of one product that needs the interpretation of findings related to comparative advantage and market concentration analysis. Since the indexes were calculated for several years – the third objective – there is a need for exploration the causes of changes. For that reason, the available technical literature related to the three examined countries was consulted. Based on it, some tendencies and cause and effect relationships related to AJC market were successfully identified.

## Results

The first objective of this study is to determine revealed comparative advantages of Hungary, Poland and China on the AJC global market. RCA index group was calculated for the period from 2002 to 2015 (Tab. 2). The examined countries have strong comparative advantage in the global market of AJC. Where countries are ranked by RCA values China has the strongest comparative advantage, Hungary is the second in the row and Poland has the smallest relative competitiveness. Although Poland has larger market share than Hungary, its relative competitiveness remains below the Hungarian level. The reason for this is the fact that besides the great exports Poland performs significant imports also. Based on the RCA index group it can be concluded that Hungarian and Chinese indexes for the period 2002-2008 have improved and nowadays the two countries have higher comparative advantage while relative competitiveness in Poland shows deterioration.

To answer the second research objective Figure 1. demonstrates the evolution of the global market concentration of AJC from 2002 to 2015. It can be seen that the HHI of the global market has not been below 1,500 since 2002 that indicates a highly concentrated market. From 2006 to 2010 the global market was highly concentrated but before and after this period as well as nowadays the global market of AJC shows a moderate concentration.

Table 2. Revealed comparative advantage or disadvantage of global AJC's external trade

*Tabela 2. Ujawniona przewaga komparatywna lub wada globalnego AJC handlu zagranicznego*

Index/ <i>Współczynnik</i>	RCA comparative advantage/ <i>ujawnione przewagi komparatywne</i>			RTA trade advantage/ <i>relatywne przewagi handlowe</i>			Ln RXA logarithm of export advantage/ <i>ln przewag eksportowych</i>			RC Competitiveness/ <i>Konkurencyjność</i>		
Value/ <i>Wartość</i>	> 1			> 0			> 0			> 0		
Countries/ <i>Kraje</i>	HU	PL	CH	HU	PL	CH	HU	PL	CH	HU	PL	CH
Mean/ <i>Średnia</i> (2002-2015)	4,77	4,01	5,95	3,81	2,62	5,92	1,55	1,38	1,78	1,73	1,27	6,19
Standard deviation/ <i>Odchylenie standardowe</i>	0,78	0,64	0,68	1,07	1,16	0,70	0,16	0,17	0,11	0,61	0,93	1,40
Mean/ <i>Średnia</i> (2012-2015)	4,63	4,16	5,94	4,01	2,33	5,93	1,53	1,42	1,78	2,07	0,82	6,44
Mean/ <i>Średnia</i> (2009-2015)	4,78	4,03	6,08	3,99	2,17	6,07	1,56	1,39	1,80	1,88	0,78	6,74
Mean/ <i>Średnia</i> (2002-2008)	4,76	4,00	5,82	3,62	3,07	5,77	1,54	1,36	1,75	1,58	1,75	5,65

Source: own calculation based on COMTRADE data [2016]

*Źródło: opracowanie własne na podstawie danych COMTRADE [2016]*

The high concentration of HHI from 2006 to 2010 can be explained with the large Chinese export share because during this period merely the half of importer countries brought AJC from China. After 2011 an increase in the Polish exports ratio can be seen and by the year of 2015, it reached 22%. The Hungarian market share is about 2-7% and regarding this amount Hungary was the 7th on the list of global ranking by exports amount in 2014.

Following the third objective, a secondary research was undertaken to provide an explanation for the results and tendencies related to RCA-index and Herfindahl-Hirshman-Index. These findings are discussed further below, sorted by countries.

The most important event is the Chinese boom in the 1990s when based on the government robust decision apple with higher income received a privileged role instead of traditional arable crops [Gale et al. 2010]. During the 90s China was producing the similar amount of apple like the US, approximately the one-fifth of global apple production. Today China accounts for half

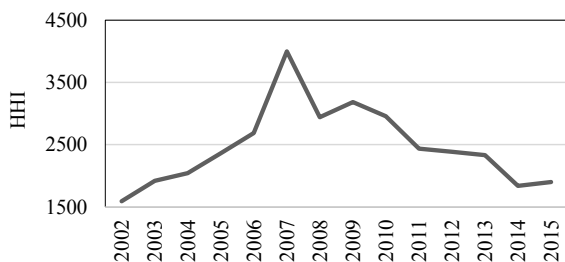


Figure 1. Market concentration of AJC (HHI) (2002-2015)

*Rysunek 1. Koncentracja rynku koncentratu soku jabłkowego na podstawie indeksu Hirschmanna-Herfindala w latach 2002-2015*

Source: own calculation based on COMTRADE data [2016]

*Źródło: opracowanie własne na podstawie danych COMTRADE [2016]*

of the 70-75 million tonnes global apple production (that is seven times higher than the USA) [Schwartau 2012]. The huge apple surplus primarily was intended to use as consumer products and to encourage apple consumption a marketing campaign was launched, in addition, the Japanese region was considered to be a driver. However, the significant apple surplus caused price depression, led to processing and nowadays in China some kinds of apples are deliberately produced for the processing industry. In the 90s in China only 5% of the apple production had been processed, nowadays 10-20% of the production belongs to processing industry, and the annual AJC production is 600-800 thousands of tonnes. The other 80-90% is marketed at the market in fresh products, and its 90-95% remains in Chinese markets. The domestic consumption has increased (25 kg/capita/year) but it hasn't reached the planned level yet. The continuously growing apple production do not have adverse effects on the global market [Schwartau 2012] because the high transportation costs the Chinese apple barely traded at the European fresh market. From 2000 to 2002 China was characterised by low production cost and during that time the American and European market were the largest buyers of Chinese AJC, however, nowadays production cost are high.

One of the reasons why the Chinese RCA index and market share was lower after the millennium is that the US in 2000 introduced 9-52% anti-dumping tariffs on Chinese AJC than in 2005 these customs duties were abolished and the biggest increase in Chinese AJC exports was observed in this year. The Chinese RCA and HHI indexes have been decreasing since 2013; this decline may have caused by the Polish expansion of AJC production. In 2012 Poland was planning expansion, which was implemented and by 2013 Poland was able to realize higher exports to the EU's AJC market [Murray 2013], in addition, 2013 was a productive year for Polish apple production. Currently, the 25.5% customs duty displaces the Chinese AJC from the European markets, whereas its price surely higher than European AJC prices. In Europe, there is no possibility of buying Chinese AJC since other European products are available at lower prices [Ferencz 2014]. Extreme weather conditions triggered the low market share of European countries, and the Chinese remarkable performance in 2007, and slight apple production was obtained throughout Europe.

The fact that China uses only the 40-50% of its production capacity remains a matter of concern that the problem arises but provides an opportunity for a significant expansion [Schwartau 2012]. The current situation can be traced to the Chinese previous forecast that the demand for Chinese AJC will remain stable on the international market. But the US and Europe bought the Chinese AJC until its price was low, with other words, they did not need namely that amount it was only bought because of its price.

The degree of acidity determines price and quality of the concentrate: if acidity is higher price will be higher and the product will be more valuable. Apple concentrates producing countries can be divided into three groups based on the different degrees of acidity [Hegedűs 2005]:

- low acidity (China, Turkey, Iran, Brazil, Spain);
- medium acidity (Hungary, Italy, Austria, Germany, Serbia, Moldova, Chile, Argentina);
- high acidity (Poland, Ukraine, the Baltics).

Among the processed vegetables and fruits, apple concentrate is the third leading exports product in Hungary, following frozen and canned corn and peas. Hungary is the 17th largest apple producer and the 10th AJC producer country globally [Maier, Cissowski 2015]. Hungary

produces 20,000-60,000 tonnes of apple concentrate it is an average of 50,000 tonnes. In Poland there are 4-5 major AJC producers while in Hungary “Agrana-Juice Magyarorszag” and “Rauch Hungária Kft” account for more than the two-thirds of apple concentrate production [Harcz 2008]. In the last five years, an average of 65% of the Hungarian exports was brought to Austria and Germany. Therefore, the Hungarian apple juice is processed by German and Austrian companies to produce food ingredients to the national food industry (concentrate) – so Hungary’s comparative advantage is the safe market [Hegedűs 2006]. Poland is the EU’s largest apple exporter and the 4th largest apple producer in the world, following China, the US and Iran [Belaya 2013]. The overall AJC production is marketed at external markets, the largest buyer from 2000 to 2004 was Russia when merely the half of the stocks was brought to the Russian market. The experienced lower market share, and comparative advantage from 2005 to 2007 was triggered by the extreme weather conditions that resulted in output droop, of the one part, and by the loss of market share on the American and German market, of the other part [Hegedűs 2005]. Improvements in apple producing technologies in Poland will result in an increase in the producing amount, and it will lead to the growth of AJC production also [Belaya 2014]. According to the forecasts, Europe will be more competitive than China and South America because there is a growing demand for AJC with low acidity. Furthermore, the good European apple output will lead to decreasing prices [Ferencz 2014] and the European product will be cheaper than AJC with high transportation costs where low labour costs will lose its significance.

## Conclusions

China is the world’s leading apple producer, apple juice concentrate producer and exporter. China has strong – the most influential in the world – comparative advantage and it has a significant impact on the market concentration. Among the European countries Poland has the largest market share, however, Hungary has higher market competitiveness. The US and Europe use different trade barriers to make the Chinese AJC inflow harder in favour of neighbouring countries. In that way, the EU offers a fixed market for Poland and at the same time supports the sector’s growth. German and Austrian companies process the Hungarian apple juice to produce food ingredients to the national food industry (concentrate) – so Hungary’s comparative advantage is the safe market.

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### **Streszczenie**

*Celem artykułu jest próba oceny koncentracji i konkurencji na globalnym rynku produktów koncentratu jabłkowego pochodzącego z trzech krajów: Węgier, Polski i Chin. W celu określenia przewagi komparatywnej użyto wskaźnika RCA. Spośród trzech badanych krajów, najbardziej konkurencyjne były Chiny, a Polska miała najniższą względną konkurencyjność. W celu określenia koncentracji rynku zastosowano indeks Herfindahla. Stwierdzono, że rynek na ten produkt jest umiarkowanie skoncentrowany.*

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