TRANSFORMATION OF POLISH SUGAR MARKET

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Abstract

Poland and its sugar market represents very specific phenomenon among countries producing beet sugar. Polish sugar industry, as one of the few in the former Eastern bloc, survived its own clinical death. Despite significant reduction in the number of sugar factories from 76 (2001) to only 18 (2017), Polish sugar industry kept considerable production capacity. Main aim of presented contribution is to identify main trends and important specifics connected to Polish sugar industry development between 2000 and 2017. Polish market underwent significant restructuring that on one side resulted in significant reduction of amount of sugar refineries and sugar beet producers. On the other hand, it resulted in considerable concentration of production capacities among subjects that successfully passed the transformation phase. Total amount of farmers producing sugar beet decreased from about 112 thousand in 2000 to just 34 thousand in 2017. Although this reduction seems to be very drastic, in reality, sugar sector was able to absorb successfully this change and finally the sector became much stronger. Between 2000 and 2017, total sugar beet production is almost unchanged at the level of 12 million tonnes. The decline in sugar beet harvested area was substituted by a significant increase in yields and by an increase in average sugar content. Also, sugar production remained almost unchanged and during the period oscillated around the level of 2 million tonnes. Only four players (Krajowa Spolka Cukrowa S.A., Nordzucker Polska S.A., Pfeifer & Langen, Südzucker Polska S.A.) control all production capacities. The market is highly oligopolistic. Results of the competitiveness analysis of sugar foreign trade concluded, that Polish sugar exports have a considerable potential. But extreme territorial concentration is seen as weak point.

Keywords: Market, production, capacities, trade, transformation, process, Poland, Krajowa Spolka Cukrowa S.A., Nordzucker Polska S.A., Pfeifer & Langen, Südzucker Polska S.A., sugar
JEL Classification: Q02, Q13, Q17

1 Introduction

Poland and its sugar market represents very specific phenomenon among countries producing beet sugar. Polish sugar industry, as one of the few in the former Eastern bloc, survived its own clinical death. Despite significant reduction in the number of sugar factories from 76 (2001) to only 18 (2017), Polish sugar industry kept considerable production capacity (Jagiełło, 2009). Current installed capacity of all sugar refineries can process approximately 114 thousand tonnes of sugar beet per one day. Refineries employ about 3,300 people. Annual sugar beet production reaches about 12.3 million tonnes and annual sugar production approaches 2.3 million tonnes. Polish sugar industry produces about 1.3% of world sugar production and 12% of EU sugar. Polish share on global production of sugar from sugar beet oscillates around 5.6%. Local production exceeds local consumption of sugar by almost 600 thousand tonnes annually. Surplus in production creates appreciable export potential. Annually about 500 thousand tonnes of sugar is being exported, it represents a considerable share particularly on the European market or in the perspective of global trade with beet sugar. Polish market underwent significant restructuring that on one side resulted in significant reduction of number of sugar refineries and sugar beet producers (Molas et al., 2017). On the other hand, it resulted in considerable concentration of production capacities among subjects that successfully passed the transformation phase (Artyszak, 2009). Observed concentration is a general characteristic of the whole EU sugar industry (Benešová et al., 2015; Řezbova et al., 2013). Although many improvements were implemented by Polish sugar industry, still there are problems to be solved – for example logistics (Polowczyk and Baum, 2016) or observed slowdown in investments (Szajner, 2016). In addition, it is important to mention, that during the transformation significant production capacities were acquired by foreign, predominantly German, capital. Foreign capital is represented by following companies: Südzucker; Nordzucker; Pfeifer&Langen. Position of the Polish state is also a specific feature of local sugar industry. The state still controls one of the largest sugar production corporations operating on Polish territory - Krajowa Spółka Cukrowa S.A..

2 Data and methodology

Main aim of presented contribution is to identify main trends and important specifics connected to Polish sugar industry development between 2000 and 2017.
Own analyses is based on comparison of secondary data sourced from Polish national sources (National Research Institute, Agricultural Market Agency, Ministry of Agriculture and Rural Development, Central Statistical Office of Poland), Eurostat and F.O.Licht database.

For the purpose of own analyses, the following categories of data are observed: sugar beet yields, harvested area and total production; sugar production and trade (H4-1701); number and specifics of farms linked to beet production; number and specifics of sugar refineries; sugar consumption and its structure; sugar prices. Also, selected economic and financial indicators of individual actors are specified.

Individual data are analysed in usual metric units; prices are expressed in euros in nominal expression. The development over time is analysed by using simple statistical indicators such as average, geometric mean and base index (2017/2000).

Attention is paid to the competitiveness of Polish sugar industry and its ability to gain comparative advantage (measured by LFI and TBI index).

The LFI (Lafay, 1992) index tries to identify whether a country has a "bilateral" comparative advantage. Using this index (LFI) we consider the difference between each item's normalized trade balance and the overall normalized trade balance. Using the LFI index we can focus on the bilateral trade relations between the countries and regions. For a given country \((i, i)\) and for any given product \((j)\), the Lafay index is defined as:

\[
LFI_j^i = 100 \frac{x_j^i - m_j^i}{x_j^i + m_j^i} \frac{\sum_{j=1}^{N}(x_j^i - m_j^i)}{\sum_{j=1}^{N}(x_j^i + m_j^i)} \frac{x_j^i + m_j^i}{\sum_{j=1}^{N}(x_j^i + m_j^i)}
\]

where \(x_{ij}\) and \(m_{ij}\) are exports and imports of product \(j\) of country \(i\), towards and from the particular region or the rest of the world, respectively, and \(N\) is the number of items. Positive values of the Lafay index indicate the existence of comparative advantages in each item; the larger the value the higher the degree of specialisation. (Zaghini, 2003)

Trade Balance Index (TBI) is employed to analyse whether a country has specialization in export (as net-exporter) or in import (as net-importer) for a specific group of products. TBI is simply formulated as follows:

\[
TBI_{ij} = \frac{x_{ij} - m_{ij}}{x_{ij} + m_{ij}}
\]

where \(TBI_{ij}\) denotes trade balance index of country \(i\) for product \(j\); \(x_{ij}\) and \(m_{ij}\) represent exports and imports of group of products \(j\) by country \(i\), respectively (Lafay, 1992). A country is referred to as a “net-importer” in a specific group of products if the value of TBI is negative, and as a “net-exporter” if the value of TBI is positive (Widodo, 2009).
Finally, the concentration of production capacities (the participation of individual companies operating within Polish sugar market) and trade territorial structure (the participation of individual partner countries in Polish sugar exports) is analysed from the point of view of the most important Polish sugar industry players. This analysis is based on application of Herfindahl-Hirschmanov index (further referred as HHI) and “Four-firm concentration ratio” (further referred as CR4). HHI is able to measure the market concentration of the industry; therefore, it is used by competition authorities to secure antitrust policy. HHI is characterized as the sum of the market shares of each trader in the sector and it is calculated as a sum of squared market share values of investigated entities in the industry:

\[
HHI = \sum_{i=1}^{N} s_i^2 = s_1^2 + s_2^2 + s_3^2 + \ldots + s_n^2
\]  

(4)

where \( s_i \) stands for market share of corporation “\( i \)” in the sugar production, \( N \) denotes total amount of corporations operating on the relevant market in the given country. According to Hirschman (1964), HHI ranges between 0 and 10,000, while 0 indicates no concentration and high competitiveness of the market and 10,000 indicates low level of competition and signalise monopoly. In this contribution classification of concentration is based on methodology used by U. S. Department of Justice and Federal Trade Commission. Their methodology indicates highly competitive environment for values below 100. Values below 1,500 indicates non-concentrated environment where operates number of important sugar companies. Values above 2,500 usually indicates market with monopolistic competition where exists significant concentration. The more HHI approaches 10,000, the more monopoly characteristics are evinced by the market.

The "Four-actors concentration ratio" (CR5) indicator is used to identify the main actors participating Polish sugar exports within the monitored group of countries. It assesses the share of the five largest countries participating in Polish \( S_i \) sugar trade. This indicator is calculated as ( representing the share of every single actor/country in total Polish sugar exports).

\[
CR_n = \sum_{i=1}^{n} s_i = s_1 + s_2 + s_3 + \ldots + s_n
\]  

(5)

For the CR4 evaluation, interpretation of DG Compete was used (London Economics, 2007). The values between 0 and 50% indicate perfect competition directing towards oligopoly. The range from 50 to 80% is a clear oligopoly and the results above 80% express the direction of the oligopoly towards the monopoly.
3 Results and discussion

Polish sugar market was developing itself in a very specific way during last 17 years. Significant changes influenced not only sugar-producing entities, but also agricultural producers who supply a key input for sugar production in Poland – sugar beet. Between 2000 and 2017, the situation in the sugar beet production sector changed significantly. While in 2000 sugar beet was harvested from 318 ths. hectares, between 2015 and 2017 beet was harvested only from 202 ths. hectares. Although the area shrank by about 34%, total sugar beet production was not limited. Annual production oscillated around 10 and 12 million tonnes. Decrease of harvested area was by improving situation in yield (as also described by Řezbová et al., 2013); between 2000 and 2017 yield increased by 60% from 40 t/ha up to more than 60t/ha. Also, number of farmers changed. While in 2000 about 112 ths. farms were producing sugar beet, in 2017 only 34 ths. farms continued with sugar beet production.

There was observed increase in the average number of farms supplying one refinery. In 2000, about 1,500 sugar beet producers supplied one refinery, while in 2017 this value already exceeded 1,900 farms. Also, average harvested area per one farm increased. While in 2000 average farm harvested beet from 3ha, in 2017 average area approached 6.5 ha. Significance of this change was also confirmed by research conducted on the level of the EU (Eurostat, 2017) as it concluded that share of small scale farers (up to 5 hectares) on sugar beet production was reduced from 90 to 7.3%. As small farms produced almost 50% of total sugar beet in 2000, in 2013 their share was only 1.2%. At present, nearly 50% of beet growing areas are under the control of farms with a size exceeding 50 hectares, growing sugar beet on more than fifty hectares. As a result, significant restructuring of sugar beet production was observed, this resulted in a reduction in the number of growers and greater concentration of production capacities. Undoubtedly, this trend has also been accompanied by a significantly higher efficiency of beet production, which subsequently allowed a significant increase in yield. Over the period, sugar beet price oscillated between 25 and 40 EUR per tonne, however in terms of the long-term average, price ranged between 25 and 30 EUR/tonne.

Stable production of sugar beet logically resulted also in relatively stable production of sugar. Between 2000 and 2017, total sugar production oscillated close to 2 million tonnes of raw sugar equivalent. Sugar production was also significantly increased in relation to one harvested hectare. Original value of year 2000 (production of 6.56 tonnes of sugar per one hectare) almost doubled (to 11.2 tonnes per hectare).
Table 1 Development of raw sugar production

| Sugar production (raw sugar equivalent) | Poland |
|----------------------------------------|--------|
|                                        | thous. tonnes | tonnes per ha |
| 2000/2001                              | 2.013   | 6.56          |
| 2002/2003                              | 2.193   | 7.24          |
| 2004/2005                              | 2.176   | 7.45          |
| 2006/2007                              | 1.873   | 7.94          |
| 2008/2009                              | 1.411   | 8.02          |
| 2010/2011                              | 1.556   | 7.33          |
| 2012/2013                              | 2.025   | 9.82          |
| 2014/2015                              | 2.156   | 11.20         |
| 2016/2017                              | 2.283   | 11.20         |
| **Growth rate /GEOMEAN**               | 1.008   | 1.034         |
| **BASIC INDEX 2017/2000**              | 1.134   | 1.707         |

Source: Sugar market - the state and prospects. No. 20-44. Institute of Agricultural and Food Economics. Agricultural Market Agency. Ministry of Agriculture and Rural Development.

Number of companies operating on the market and the development of the number of sugar refineries are another specific feature of the Polish sugar industry. Between 2001 and 2017, the number of sugar refineries was reduced by more than 70%. Most of the sugar refineries was closed by Krajowa Spółka Cukrowa S.A (20 refineries); Śląska Spółka Cukrowa (16 refineries); Südzucker S.A. (12 refineries) and British Sugar Overseas - Poland (10 refineries). Śląska Spółka Cukrowa and British Sugar Overseas closed all their sugar production activities and since then they are not active on the market. Pfeiffer&Langen closed 7 and Nordzucker S.A. closed 6 sugar refineries. It is important to mention that the reduction in the number of sugar refineries has not been reflected significantly in sugar production. Despite the decreasing number of sugar refineries (-58), the volume of sugar production has not been significantly affected. Even the production loss caused by closure of two groups was completely compensated. Producers who remained on the market increased production. In particular, Südzucker S.A. increased sugar production capacity from 105 ths. to 523 ths. tonnes; Pfeiffer&Langen increased production from 273 ths. to 550 ths. tonnes. Also, campaign length was extended, and it resulted in improved efficiency. In average, Polish sugar campaign prolonged from 51 (2001) to 112 days (2016); Krajowa Spółka Cukrowa S.A increased the average number of campaign days from 51 to 102; Südzucker
S.A. from 40 to 127 days; Pfeiffer&Langen from 51 to 120 days and Nordzucker S.A. from 55 to 103 days.

Speaking about sugar-producing groups, it is worth mentioning, that mainly Südzucker and Pfeiffer&Langen required more sugar beet due to longer campaign increased production. Therefore, they increased their share on purchased beet measured by share on contracted beet production area. Their share rose from 8.3 to 22.4% and 15.6 to 26.3% respectively. In the case of other producers, their shares on the contracted production areas remained preserved. On the other hand, all companies evince significant reduction in the number of contracted farms. But this reduction was fully compensated by the fact, that an average contracted farm intensified its production. Installed daily capacity for sugar beet processing among individual refineries is another characteristic feature of polish sugar industry. Based on the available data it can be concluded, that Polish sugar refineries can be considered relatively large. Their daily beet processing capacity ranges from 3,500 and 12,200 tonnes, average capacity per one sugar refinery reaches about 6,351 tonnes per day. With only two exceptions, all refineries produce sugar from sugar beet; only refineries in Glinojeck and Chelmza have limited capacity (1,200 t/day and 800 t/day respectively) to process also imported raw sugar. During the transformation period, average annual sugar production capacity was increased significantly. Between 2001 and 2006, average production of each refinery increased from 20 ths. to 116 ths. tonnes per annum. An important indicator is also the increase of annual average sales per one sugar refinery. In 2016, average refinery evinced sales of about 70 million EUR. Total turnover of all polish refineries was about 1.153 billion EUR. Labour productivity development was also observed as in 2016 sugar production per one employee reached approximately 630 tonnes, and turnover was about 380 ths. EUR per person employed. Also, economic indicators of the whole sugar industry improved. Indicators changed as follow between 2000 and 2016: total revenues (+17%), net income (+198%), return on sales (from 6.7 to 17%), liquidity (from 1.1 to 4.0). Also a continuous transfer of investments was reflected in the Polish sugar industry, as cumulated investments reached a total of 4.115 billion PLN (1.016 billion EUR) between 2000 and 2016. Similarly to Szajner (2016), it can be concluded that investments are being slowed down. Investment peak is observed in 2006 (93.6 million EUR), since than investments have been falling to 49.4 million EUR in 2016.

Table 2 Selected Economic Characteristics of Polish Sugar Industry

| Specification                        | 2007    | 2009    | 2011    | 2013    | 2015    | 2016    |
|--------------------------------------|---------|---------|---------|---------|---------|---------|
| Sales. in total (million EUR)        | 1,155   | 1,039   | 1,540   | 1,477   | 1,031   | 1,253   |
| Sales. per 1 enterprise (million EUR)| 40      | 58      | 86      | 82      | 57      | 70      |
| Specification                           | 2007 | 2009 | 2011 | 2013 | 2015 | 2016 |
|----------------------------------------|------|------|------|------|------|------|
| Labour productivity (tonnes per employee) | 263  | 342  | 531  | 518  | 444  | 630  |
| Labour productivity (thous. EUR per employee) | 157  | 221  | 440  | 434  | 312  | 380  |

*Source: Sugar market - the state and prospects. No. 20-44. Institute of Agricultural and Food Economics. Agricultural Market Agency. Ministry of Agriculture and Rural Development.*

**Table 3 Selected Economic Characteristics of Polish Sugar Industry**

| Specification                           | 2008 | 2010 | 2012 | 2014 | 2016 |
|----------------------------------------|------|------|------|------|------|
| Net revenue. current prices (million EUR) | 1,175.1 | 1,148.2 | 1,820.2 | 1,255.0 | 1,290.3 |
| Net profit (million EUR)               | -88.1 | 164.2 | 398.3 | 134.3 | 218.9 |
| Return on sales (%)                    | -7.5 | 14.3 | 21.9 | 10.7 | 17.0 |
| Current liquidity ratio                | 2.6 | 3.3 | 3.4 | 3.3 | 4.0 |
| Investment. current prices (million EUR) | 87.5 | 72.4 | 69.4 | 52.5 | 49.4 |

*Source: Sugar market - the state and prospects. No. 20-44. Institute of Agricultural and Food Economics. Agricultural Market Agency. Ministry of Agriculture and Rural Development.*

The economic performance of the sector was largely reflected in relatively stable sugar market. The average price, with some exceptions, fluctuated between 0.5 and 0.6 EUR/kg. Polish market was also stabilised by slowly increasing consumption as it rose from 1.6 to 1.72 million tonnes. Increase in consumption was not pushed by change in consumption among Polish households, but it was pushed by food industry. While consumption of households decreased from 780 to 550 ths. tonnes between 2000 and 2017 (-30%), consumption of food industry increased from 770 ths. to 1,1 million tonnes (+42%). Decreasing consumption of Polish households was fully compensated by the growing consumption of food industry, which increased consumption by more than 300,000 tons a year. Per capita sugar consumption remained relatively stable throughout the monitored period. It remained at a level exceeding 40 kg per year.

It is necessary to mention, considering sugar production and installed production capacities, that polish market evince relatively high concentration rate.
According to the HH index (2,944 points), Polish sugar market operates under monopolistic competition with significant concentration.

Polish sugar industry is strongly influenced by international trade. Between 2000 and 2017, the volume of sugar exports oscillated between 350 and 700 thousand tonnes. The peak (702 ths. tonnes) was reached in 2006, the minimum (335 ths. tonnes) was realized in 2011. In average, total annual exports amounted to 430 ths. tonnes and increased in average by 0.9% per annum. Polish exports can be characterized by relatively significant year-on-year fluctuations. Its standard deviation from the average was about 30%. On contrary to volumes, value of exports evinced annual growth of about 5.3% as the value increased from approx. 100 million to 240 million EUR. Lowest value of exports is observed in 2002 (51 million EUR), while maximum (377 mil. EUR) occurred in 2012. Also export values were highly volatile. This statement is supported by the standard deviation of mean that reached 45%. The value and volume of exports was influenced by the development of unit prices as they increased from 0.23 in 2002 to 0.48 EUR/Kg in 2017, instability of export price is supported by standard deviation of mean at the level of 33%. Value and volume of imports rose more dynamically compared to exports. Between 2000 and 2017, volume of imports increased from 55 to 210 ths. tonnes; value of imports rose from 16 to 90 million EUR. While value and volume of exports gained in average 5.3%, respectively 0.9% per annum, import values and volumes gained in average 8.2% and 10.8%. However, it must be noted, that import was even more unstable than exports; standard deviation from mean are 59% (for volumes) and 69% (for values). Although the growth rate of imports outperformed the of exports (with only exception of kilogram price: 4.3% per annum for export vs. 2.4% for import), Poland managed to maintain a positive trade balance in the analysed period, both in value and volume terms. At present (2016/2017), the surplus of the trade balance is estimated to be about 150 million EUR and 290 ths. tonnes of sugar.

A particular feature of the Polish sugar market is its trade orientation primarily to the EU countries. Poland export significant share of its production in the EU. However, the EU market has not always been a key sugar destination. In the pre-accession period, particularly in year 2000, Poland only exported 1.85% of its exported volumes (i.e. around 2.51% of exported value) to the EU. Subsequently, as the accession was approaching, share of Polish exports to the EU increased. In 2003, EU received about 24.98% and 26.09% of exported volume and value respectively. Entry into the EU was a turning point from the perspectives of Polish agrarian foreign trade. In 2004, as much as 48.56% and 73.53% of Polish export directed to the EU countries measured in volume and value. This situation was affected by change in export price, related to higher price of sugar in the EU. The
export price, after Poland became EU member and accessed the single market, grew from an average 0.21 to 0.57 EUR/kg between 2003 and 2004. Exports to the EU single market grew from 100 ths. tonnes (23 million EUR) in the period immediately before the accession to less than 300 ths. tonnes (150 million EUR) in 2016. The export maximum was reached in 2013, when the total volume of exports amounted to approximately 365 ths. tonnes (about 250 million EUR). The share of EU countries in sugar exports reached its peak in 2009, when about 88.52% (in volume terms) and 91.94% (in value terms) of exports directed to single market. After 2013, export to EU evinced further decrease. In 2016, 61.37 percent of trade volume finished in EU (66.37 of trade value). Above stated information indicates, that between 2004 and 2016 the exports to the EU underwent turbulent changes and fluctuations, as volume and kilogram export prices strongly oscillated. The average year-on-year change can serve as an evidence of this turbulent development, it achieved in value and volume terms 30.8 and 27.6 percent respectively. High fluctuation can be also indicated by a high percentage rate of standard deviation from the mean reaching 57.52% and 65.92% percent in volume and value respectively. Unit export price showed in average standard deviation from the mean of about 28.13 percent. Among relatively volatile exports, similar market behaviour can be observed in relation to imports. Import volumes and values evince relatively high average annual rate of change. Through the observed period, annual average rate of change reached in value and volume 9.4 and 12.3 percent respectively. Observed export growth rate outperformed import growth rate. On the other hand, import deviations were much more intensive than export annual deviations as it could be observed in the values of average standard deviation from mean of sugar import volumes (64.13%) and values (78.16%). Even growth rate of kilogram import prices (2.6% per annum) grew little bit faster than export prices (2.5% per annum). Import prices has higher standard deviation from the mean (37.70%), comparing to export price (28.13%). Generally, volumes of imports from EU countries fluctuated over time. At the beginning of the analysed period, the share of imports from the EU countries was very significant, both in the case of import volumes (about 45 ths. tonnes, share 82.7%) as well as in the case of import values (12.5 million EUR, share 79.6%). Prior to the EU accession (2003), imports amounted to 74 ths. tonnes, respectively it amounted to less than 20 million EUR and the share of imports from EU countries accounted for 96.86% and 98.93% respectively. In the period after the accession, share of EU countries on Polish sugar imports was gradually reduced. A minimum was reached in 2012, when EU accounted only for 18.13% of imported volume and 23.58% of imported value. Imports from the EU reached its maximum in terms of volumes in 2009 (223 ths. tonnes) and in terms of value in 2011
EU sugar market regulations supported import fluctuations, as they significantly affected Polish production capacities as well as capacities in other countries. In addition, the Common Commercial Policy and Common Agriculture Policy influenced performance of agrarian foreign trade, as both policies isolated the EU internal sugar market from the rest of the world. The sugar price and supplied quantity were not determined by demand, but their development was largely determined by subsidies, production and import regulations. Present Polish sugar market is characterised by positive trade balance expressed both in trade volume and value. Negative trade balance was only observed prior to Polish EU accession and in year 2009. Internationalization of its production capacities was very important aspect that has significantly influenced the character of Polish foreign trade. Majority of production is no longer under the control of primarily Polish capital, but they are under the control of international capital. A significant part of Polish production and export capacities are controlled mainly by German companies such as Nordzucker, Südzucker and Pfeifer&Langen. Polish sugar industry was significantly affected by applied sugar production quotas. For a long time, they limited production at the level of 1.4 million tonnes of sugar a year. On one hand, quotas greatly reduced the export ambitions of Polish sugar industry; however, on the other hand quota system generally protected the Polish market from competition from other EU countries.

The territorial structure of the Polish sugar trade is very concentrated. The top five export destinations (Germany, Israel, Lithuania, Italy and Latvia) accounted for approximately 52.6 percent of Polish sugar exports in value. Russian Federation, Czechia, Georgia, Greece and Hungary belong together with above mentioned countries, to the TOP10 export partners. The share of TOP10 trading partners in total sugar exports reached approximately 72.56% in 2016. An even higher degree of concentration is observed by the territorial structure of Polish imports. TOP5 (Sudan, Zimbabwe, Mozambique, Germany, Lithuania) and TOP10 (TOP5 Sweden, Mauritius, Czechia, Denmark, Ukraine) import destinations accounted for 71.4 and 92.94 percent of sugar imports to Poland. The HH Index analysis shows the high level of concentration of the territorial structure of the sugar foreign trade, both from the export and import perspective. The HHI value for the export reaches 965 points and the HHI value of imports reaches about 1228 points. Also, CR4 confirms high level of territorial concentration. CR4 ratio calculated for four main export destinations (Germany, Lithuania, Israel, Latvia and Italy) reached the value 52% - it means the character of export structure is close to oligopoly.
Table 4 Comparative advantages of Polish sugar exports toward EU countries

| Country (2016) | LFI  | Country  | TBI  |
|---------------|------|----------|------|
| Austria       | -0.123 | Austria  | -0.48 |
| Belgium       | 0.487  | Belgium  | 0.913 |
| Bulgaria      | 0.18   | Bulgaria | 1    |
| Croatia       | 0.001  | Croatia  | 1    |
| Cyprus        | 0.169  | Cyprus   | 1    |
| Czechia       | -0.085 | Czechia  | 0.388 |
| Denmark       | 0.027  | Denmark  | -0.149 |
| Estonia       | 0.175  | Estonia  | 0.987 |
| Finland       | 0.007  | Finland  | 1    |
| France        | -0.083 | France   | -0.438 |
| Germany       | 0.343  | Germany  | 0.634 |
| Greece        | 2.12   | Greece   | 0.997 |
| Hungary       | 0.793  | Hungary  | 0.992 |
| Ireland       | 0.054  | Ireland  | 0.993 |
| Italy         | 0.449  | Italy    | 0.98 |
| Latvia        | 1.456  | Latvia   | 1    |
| Lithuania     | -0.415 | Lithuania| 0.247 |
| Luxembourg    | 0.703  | Luxembourg| 1    |
| Malta         | 0      | Malta    | 1    |
| Netherlands   | 0.039  | Netherlands| 0.326 |
| Portugal      | 0      | Portugal | 1    |
| Romania       | 0.055  | Romania  | 1    |
| Slovakia      | 0.145  | Slovakia | 0.794 |
| Slovenia      | -0.005 | Slovenia | -0.515 |
| Spain         | 0.026  | Spain    | 0.98 |
| Sweden        | -1.374 | Sweden   | -0.516 |
| United Kingdom| -0.023 | United Kingdom| 0.242 |

*Source:* UN Comtrade, own processing, 2017.
Table 5  **Comparative advantages of Polish sugar exports toward non-EU countries**

| Country (2016) | LFI  | Country       | TBI  |
|---------------|------|---------------|------|
| Algeria       | 0.002| Algeria       | 1    |
| Argentina     | 0    | Argentina     | -0.998|
| Armenia       | 0    | Armenia       | 1    |
| Australia     | 0.007| Australia     | 1    |
| Azerbaijan    | 0.003| Azerbaijan    | 1    |
| Bahrain       | 0.002| Bahrain       | 1    |
| Barbados      | -0.02| Barbados      | -1   |
| Belarus       | -0.031| Belarus     | -0.169|
| Belize        | -11.836| Belize       | -1   |
| Bosnia 
Hersegovina | -0.252| Bosnia 
Hersegovina | -1   |
| Brazil        | -0.039| Brazil        | -1   |
| Bunkers       | 0    | Bunkers       | 1    |
| Cambodia      | -0.817| Cambodia      | -1   |
| Cameroon      | 8.41 | Cameroon      | 1    |
| Canada        | 0.015| Canada        | 1    |
| Colombia      | -0.151| Colombia      | -1   |
| Cook Isds     | 0    | Cook Isds     | 1    |
| Cuba          | -0.027| Cuba          | -1   |
| Egypt         | 0.48 | Egypt         | 1    |
| Georgia       | 9.382| Georgia       | 1    |
| Ghana         | 0.234| Ghana         | 1    |
| China         | 0.074| China         | 0.984|
| Iceland       | 0.012| Iceland       | 1    |
| India         | 0.002| India         | 1    |
| Indonesia     | -0.036| Indonesia     | -1   |
| Israel        | 2.961| Israel        | 1    |
| Jordan        | 0    | Jordan        | 1    |
| Kazakhstan    | 5.228| Kazakhstan    | 1    |
| Kuwait        | 0    | Kuwait        | 1    |
| Kyrgyzstan    | 0.062| Kyrgyzstan    | 1    |
| Lebanon       | 5.845| Lebanon       | 1    |
| Country (2016)        | LFI | Country        | TBI |
|----------------------|-----|----------------|-----|
| Libya                | 0   | Libya          | 1   |
| Malawi               | -0.011 | Malawi        | -1  |
| Malaysia             | 0.002 | Malaysia       | 1   |
| Mauritius            | -20.721 | Mauritius    | -1  |
| Mongolia             | 0.05 | Mongolia       | 1   |
| Mozambique           | -11.495 | Mozambique    | -1  |
| Myanmar              | 9.452 | Myanmar        | 1   |
| Norway               | 0   | Norway         | 1   |
| Oman                 | 0.005 | Oman          | 1   |
| Pakistan             | 0.001 | Pakistan       | 1   |
| Paraguay             | 0   | Paraguay       | -1  |
| Qatar                | 0.026 | Qatar         | 1   |
| Rep. of Korea        | 0.033 | Rep. of Korea | 1   |
| Rep. of Moldova      | 5.298 | Rep. of Moldova | 0.895 |
| Russian Federation   | 0.982 | Russian Federation | 1 |
| Saudi Arabia         | 0.001 | Saudi Arabia  | 1   |
| Senegal              | 0   | Senegal        | 1   |
| Singapore            | 1.558 | Singapore     | 1   |
| South Africa         | 0.474 | South Africa  | 1   |
| Sri Lanka            | 29.112 | Sri Lanka    | 1   |
| Sudan                | -7.441 | Sudan        | -0.672 |
| Swaziland            | -0.002 | Swaziland   | -1  |
| Sweden               | -1.374 | Sweden       | -0.516 |
| Switzerland          | -0.006 | Switzerland  | -0.809 |
| Syria                | 4.065 | Syria         | 1   |
| Thailand             | 0   | Thailand      | -1  |
| Turkey               | 0.347 | Turkey        | 1   |
| Turkmenistan         | 0   | Turkmenistan  | 1   |
| Ukraine              | -0.188 | Ukraine       | -0.987 |
| United Arab Emirates | 0.046 | United Arab Emirates | 0.925 |
| USA                  | -0.001 | USA          | 0.118 |
| World                | 0.157 | World         | 0.369 |

*Source: UN Comtrade, own processing, 2017.*
Existing comparative advantage in relation to partner countries is another specific feature of Polish sugar industry. Based on the results of the LFI analyses, it is possible to prove that Poland achieved bilateral comparative advantage of its exports with about 50 countries (more than 90 countries are involved into Polish sugar trade activities). Poland also achieved positive trade balance to most of its trade partners. From the perspective of comparative advantages, it is crucial that Poland achieved comparative advantages over most of the EU member states (18 EU countries: Belgium, Bulgaria, Croatia, Cyprus, Denmark, Estonia, Finland, Germany, Greece, Hungary, Latvia, Luxembourg, the Netherlands, Romania, Slovakia, Spain). Poland also reached positive trade balance in relation to 22 EU member countries (Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Finland, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Romania, Slovakia, Spain, United Kingdom). As far as third countries are concerned, Poland exhibit bilateral comparative advantage toward 32 non-EU countries (Azerbaijan, Bahrain, Cameroon, Canada, Egypt, Georgia, Ghana, China, Iceland, India, Israel, Kazakhstan, Kyrgyzstan, Lebanon, Malaysia, Mongolia, Myanmar, Saudi Arabia, Singapore, South Africa, Sri Lanka, Syria, Turkey, United Arab Emirates).

4 Conclusion

The analysis shows the following findings in relation to Polish sugar production and sugar markets. Polish market underwent significant restructuring that on one side resulted in significant reduction of amount of sugar refineries and sugar beet producers. On the other hand, it resulted in considerable concentration of production capacities among subjects that successfully passed the transformation phase. Total amount of farmers producing sugar beet decreased from about 112 thousand in 2000 to just 34 thousand in 2017. At the same time, the number of sugar refineries decreased from 76 to 18. Although this reduction seems to be very drastic, in reality, sugar sector was able to absorb successfully this change and finally the sector became much stronger. Between 2000 and 2017, total sugar beet production is almost unchanged at the level of 12 million tonnes. The decline in sugar beet harvested area was substituted by a significant increase in yields and by an increase in average sugar content. Also, raw sugar production remained almost unchanged and during the period oscillated around the level of 2 million tonnes. On contrary, production of white sugar increased significantly from 1.54 in 2001 to almost 2.1 million tonnes in 2016. Reduction of sugar refineries was in this perspective compensated by the modernisation of those production facilities that were able to survive. Investments totalled about 1billion EUR. At the same time,
refineries increased their processing capacities. Between 2001 and 2016 length of sugar campaign increased from average 51 days to about 112 days. The average processing capacity of one sugar refinery grew by tens of percent and reached 6,351 tonnes a day (installed processing capacity of the smallest refinery is 3,500 and the capacity of the biggest refinery is 12,200 tonnes per day). The general stability of the Polish market has one forfeit – extreme concentration. Only four players (Krajowa Spolka Cukrowa S.A., Nordzucker Polska S.A., Pfeifer&Langen, Südzucker Polska S.A.) control all production capacities. The market is highly oligopolistic, dominated by three subjects: state-owned Krajowa Spolka Cukrowa, Südzucker and Pfeifer&Langen (both owned by German capital). Polish market is highly dominated by German influence, since companies controlled by German capital control approximately 56 percent of installed production capacities and produce more than 60 percent of white sugar.

The transformation process of Polish sugar industry did not significantly damaged sugar exports. Although volume of export significantly fluctuated, from the long-term perspective it oscillates around 0.5 million tonnes annually. Increasing unit price per kilogram of exported sugar is considered as a positive and important factor that pushed total value of exports to approximately 240 million EUR in 2017. Opposite to exports, volume of imports rose dynamically from 55 ths. tonnes in 2000 to more than 200 ths. tonnes in 2017. The total value of imports grew much slower than value of exports. Imports oscillates around 100 million EUR and makes sugar trade balance positive in the long-run. Polish sugar export is strongly oriented toward EU countries, while significant portion of imports originate in non-EU countries, in particular in countries with preferential access to EU markets under General System of Preferences. It is also important to mention that Poland has a considerable export potential and its exports are very competitive especially in comparison to other EU countries. However, more dynamic production development was disabled by system of production quotas (valid until 10/2017) that limited production of Polish sugar at the level of 1.4 million tonnes a year.

Results of the competitiveness analysis of sugar foreign trade concluded, that Polish sugar exports have a considerable potential. But extreme territorial concentration is seen as weak point. Top 10 countries participate on Polish exports and imports with sugar approximately by 72.56% and 92.94% respectively (2016). The main partners of Polish exports are Germany, Israel, Lithuania, Italy and Latvia, while main importers are Sudan, Zimbabwe, Mozambique, Germany and Lithuania. At present, significant restructuring in the Polish sugar industry can be observed because of changes in EU’s sugar policy (abolition of sugar quotas). General changes in EU legislative environment raise a question, whether Poland
will further strengthen its position on the European sugar market or whether the sugar market will suffer as a result of the restructuring of the sugar market, which is expected to be run by multinational actors in the European sugar market.

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