

Changes in sugar beet production in the Czech Republic and Poland after the year 2000

Změny v produkci cukrové řepy v Česku a Polsku po roce 2000

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ABSTRACT

After the EU 2006 policy reform, EU sugar industry was undergoing fascinating development. The main aim of the contribution was to compare, how changes influenced sugar beet producers in the Czech Republic and Poland. In Poland, farmers were able to increase the average size of cultivated land while number of farmers decreased by 70%, yields and sugar content improved. In the Czech Republic, no significant improvement in average area per grower and sugar content was noticed, improvement was observed in the yield and total production. Most of the beet production is located close to sugar refineries, due to logistics constraints. Czech farms operate under higher costs and lower per hectare profit margin. Producers are operating under almost perfect competition, as Herfindahl-Hirschman index for producers is equal to 29.96 and 3.12 for the Czech Republic and Poland respectively. Distribution of sugar beet area among farmers, measured by the Gini coefficient, is qualified as very highly unequal. In both markets, differences in market powers exist. Dominance of Retail and Sugar producers over sugar-beet growers exists. Average price of beet has an increasing trend, although share of beet price on sugar price stagnated. After the end of the sugar quota system in 2017, growers will face pressure to further decrease the price of beet, as the price of sugar is expected to be down due to higher sugar supply. Improving production efficiency will be required.

Keywords: Czech Republic, Gini, Herfindahl-Hirschman Index, Lorenz curve, market concentration, Poland, price, production, region, sugar beet

ABSTRAKT

Po reformě Evropské politiky prošel cukrovarnický průmysl v EU fascinujícím vývojem. Hlavním cílem příspěvku bylo porovnat, jak změny ovlivňovaly producenty cukrové řepy v České republice a Polsku. V Polsku byli zemědělci schopni zvýšit vlastní průměrnou výměru pěstované řepy, zatímco počet pěstitelů klesl o 70%. Hektarové výnosy a obsah cukru se v Polsku kontinuálně zlepšují. V České republice nebylo zaznamenáno výrazné zlepšení v průměrné ploše na jednoho pěstitel a cukernatosti, bylo ovšem zaznamenáno zlepšení ve výnosu a celkové produkci. Většina výroby cukrové řepy se nachází v blízkosti cukrovaru s ohledem na logistická omezení. České farmy vykazují vyšší náklady a nižší ziskovou marži na hektar. Producenti pracují pod téměř dokonalou konkurencí, jelikož Herfindahl-Hirschman

Index se rovná 29.96 pro Českou republiku a 3.12 pro Polsko. Rozložení plochy cukrové řepy mezi zemědělce, měřeno Giniho koeficientem, je kvalifikováno jako velmi nerovnoměrné. Na obou trzích existují rozdíly v tržních silách. Existuje dominance maloobchodníků a výrobců cukru nad pěstiteli cukrové řepy. Průměrná cena cukrové řepy má rostoucí trend, i když její podíl na ceně cukru má stagnující charakter. Po ukončení systému cukerných kvót v roce 2017 je očekáváno, že pěstitelé budou čelit tlaku na další snížení ceny cukrové řepy, protože se očekává pokles ceny cukru z důvodu vyšší nabídky na trhu. Je očekáváno, že producenti budou muset dále zlepšovat produkční charakteristiky.

Klíčová slova: cena, cukrová řepa, Česká republika, Gini, Herfindahl-Hirschmanův index, Lorenzova křivka, koncentrace trhu, Polsko, produkce, region

INTRODUCTION

Sugar belongs to one of the mostly grown arable crops in Central Europe (Potori et al., 2017), while the whole industry was facing significant changes. As sugar market was characterised as one of the most distorted and protected (Marks and Maskus, 1993; Ryden, 2013), after the EU 2006 policy reform, EU sugar industry is undergoing fascinating development – increasing productivity, rising concentration as well as changes in the market and regulated environment. In addition, since 2017 sugar production quotas were abolished sugar market can develop its own direction on the Single European Market. End of quotas was expected to result into optimisation of production by saturating available sugar production capacities. As a result, higher production appeared and correlation between world and European sugar price was observed (Heno et al., 2018). Impacts of policy changes are also visible out of the EU. Most of the sugar imported (more than 60% of imports) comes from African, Caribbean and Pacific countries (ACP) and Least developed countries (LDCs) under Economic Partnership Agreements; Everything But Arms regime. Elimination of quotas led to increased EU production resulting in the fact, that EU became a net exporter (U.S. Department of Agriculture, 2018). To help 18 traditional supplying countries, EU provides significant financial assistance to strengthen sugar sector competitiveness or supporting diversification of activities (Blanco, 2018). Sugar is considered a sensitive commodity, therefore within liberalisation process with third countries, special attention is paid to sugar trade regime. Therefore, in some trade agreements tariffs are not eliminated, in some cases, preferential quotas are being applied (Ministry of

Agriculture of the Czech Republic, 2017). After the 2017 policy reform, EU still plans to support and protect its sugar industry mainly by substantial import tariff and private storage aid (European Commission, 2017).

Volume and value of the sugar crops production and trade have risen unusually quickly in recent years (Svatoš et al., 2013). Nevertheless, the development in the industry had to accept many challenges after European sugar reform from 2006. Large portions of production capacities (more than 50% of sugar factories; Řezbová et al., 2013) of predominantly uncompetitive sugar producers were destroyed and in addition, some countries lost all its sugar production facilities. Those were Bulgaria, Ireland, Latvia, mainland Portugal and Slovenia. Finally, EU sugar production was concentrated in 18 EU countries, while before the reform sugar was produced in 23 member states. Overall reduction of production quota was 28% from 18.5 million to 13.3 million tonnes (European Commission, 2009). Applied changes had an impact on market concentration in the sugar industry (ARETÉ, 2012; Řezbová et al., 2015; Maitah et al., 2016) which led to increased efficiency in the sector while opportunities were taken to promote economies of scale (Organisation for Economic Cooperation and Development, 2007). As in other sectors (Clarke et al, 2002; Dobson et al., 2003) concentration in the sugar sector took place mainly through mergers and acquisitions, while large European sugar groups/alliances used the opportunity to increase their power outside their home country, in the case of the EU, mainly in the new EU members. Not only in the EU, but concentration in the sugar market also occurs as a general trend worldwide (Wiltgen, 2007; Breguet, 2011; Maitah and Smutka, 2016; Siqueira et al., 2017).

Having all above-mentioned facts in mind, the question is how changes influenced sugar beet producers in the Czech Republic and Poland belonging to the Top EU beet-sugar producing countries. The main aim of presented contribution is to identify main differences in the production of sugar beet in the Czech Republic and Poland and assess production development changes that occurred between 2000 and 2017. The following questions are answered in the following paper: 1) While consolidation of sugar industry took place, does average beet grower of the year 2000 differ from an average grower in the year 2017; 2) Have producers improved yields, extended cultivated area, improved their financial situation and share on final sugar price; 3) What are the trends, sugar beet production faces?

MATERIALS AND METHODS

Own analyses is based on a comparison of secondary data sourced from Czech and Polish institutions and organizations: (i) Institute of Agricultural and Food Economics - National Research Institute (IAFE-NRI) in Poland; (ii) Institute of Agricultural Economics and Information (IAEI) in the Czech Republic; (iii) Polish Agricultural Market Agency - ARiMR; (iv) Czech Paying Agency - SZIF; (v) Ministry of Agriculture and Rural Development in Poland; (vi) Central Statistical Office of Poland - GUS; (vii) Czech Statistical Office - CZSO; (viii) MZe - Czech Ministry of Agriculture; (ix) Eurostat; and (x) European Association of Sugar Manufacturers (CEFS).

For the purpose of own analyses, the following categories of data are observed: (i) sugar beet production characteristics (area, yield, total production); (ii) cultivated area of each sugar beet producing farm; prices in the sugar value chain (price of sugar beet, producer and price in retail).

The development over time is analysed by using a simple statistical indicator such as Average Annual Growth Rate (AAGR) based on geometric mean. This means, AAGR is a geometric average of an individual growth rates (x_n/x_{n-1}). Following formula was used for the calculation:

$$AAGR = \sqrt[n-1]{\frac{x_2}{x_1} * \frac{x_3}{x_2} * \frac{x_4}{x_3} * \dots * \frac{x_n}{x_{n-1}}} \quad (1)$$

The concentration of production capacities is analysed from the point of view of all Czech and Polish sugar producers. This analysis is based on the application of Herfindahl-Hirschman index (further referred as HHI). The index is able to measure the market concentration of the industry. According to Hirschman (1964), HHI is calculated as follows:

$$HHI = \sum_{i=1}^n P_i^2 \quad (2)$$

where P_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.

HHI ranges between 0 and 10,000, while values close to 0 indicates no concentration and high competitiveness of the market; while 10,000 indicates low level of competition signalling monopoly. Naldi and Flamini (2014) defined following thresholds: (i) highly competitive industry has values below 1,000; (ii) values 1,000 - 1,500 signalise unconcentrated markets; (iii) values 1,500 - 2,500 indicate moderately concentrated markets; (iv) values above 2,500 indicates highly concentrated markets. The more HHI approaches 10,000, the more concentrated and monopolistic the market is.

Distribution of production at the level of beet growers, from the harvested area point of view, is assessed by Lorenz curve and Gini concentration analyses. Both measures are used in a wide variety of areas (Lyon et al., 2016), but originally developed to measure inequality of income and wealth. Gini indexes of less than 0.3; 0.3-0.399; 0.4-0.499; and 0.5 or greater correspond to low, medium, high, and very high-income inequality, respectively (Conference Board of Canada, 2018). Lorenz curve represents the share of the total held by the lowest x% of the distribution. Area between the Lorenz curve and the line of equality is marked as "Area A", while area below the Lorenz curve is marked as "Area B". The whole area below equality line (i.e. A+B) is equal to $n/2$, where n was equal to 838 for Czech Republic and equal to 36,014

for Poland. Both values correspond with the amount of farmers. For the purpose of the analyses, Area B is calculated as follow:

$$\text{Area B} = \sum_{i=1}^n (S_n * 1) \quad (3)$$

where S_1 means a cumulative share of a smallest farmer on the total harvested area, S_n indicates the cumulative share of all farmers on the harvested area.

The Gini index was calculated as follow (Food and Agriculture Organization of United Nations, 2006):

$$\text{GINI} = \frac{\text{Area (A+B)} - \text{Area B}}{\text{Area (A+B)}} \quad (4)$$

Among above-stated methods, authors also used basic indicators of financial analyses. Those are: (i) Return on costs = income (with subsidies)/total costs and (ii) Profit margin = income (without subsidies and with subsidies)/revenues. Formulas are based on Homolka et al. (2014); Špička and Kontsevaya (2016) and adjusted for the purpose of the study and data available.

RESULTS AND DISCUSSION

Both Czech Republic and Poland belong to the Top EU beet-sugar producing countries. Among those, France, Germany, United Kingdom, Netherlands, Belgium and Austria are considered TOP 10 EU sugar beet producers. In these countries, sugar beet is harvested from more than 40 thousand hectares (see Table 1). However, European agriculture is differentiated toward small and big farms, also in the production of beet. Significant differences are observed. Highest yields are reached among Spanish (93.3 t/ha), French (87.5 t/ha) and Dutch (83.3 t/ha) farmers. As observed from Table 1, in countries with relatively large beet-growing farms, lower hectare yield occurs. For example, in the Czech Republic, where farms are the largest, average yield in 2016 was in comparison to abovementioned countries only 63.1 t/ha. Yield close to 65 t/ha was reached only in Poland and Italy. In other countries reached yield was 70 t/ha and more.

From the European point of view, it needs to be mentioned, how important was the improvement in the sugar beet production in the Czech Republic and Poland. As noted before (Table 1), in both countries only below average hectare yields was reached in 2016 in comparison

to other EU beet growers. However, as seen from the long-term perspective, it can be observed how total area utilised for beet production changed, and how beet yield and sugar content improved. In Poland, total utilised area of beet (Table 2) was reduced from 333 thousand hectares in 2000 to nearly 200 thousand hectares in 2017. In addition, share on total agricultural land went down, while in 2000 sugar beet covered 2.3% of arable land, in 2016 beet covered less than 1.9%. However, loss of 130 thousand hectares of land (-39%) does not mean loss of 40% of production. It can be observed (Table 2) that from a long-term perspective there is a slight annual increase in total beet production even if annually over 2.4% of land is lost. But, as observing individual annual values, between 2007 and 2008 total harvested area decreased by 60 ha, just after sugar EU reform. That decrease resulted in 30% decrease in the beet production (-3.96 million tonnes) even though average yield was up by 4 t/ha. After the consolidation, total production of beet went up back to production values of year 2000. Intensification led to stabilizing beet production. Average yield of sugar beet increased from 39.4 up to 68.3 t/ha between 2000 and 2014. Improvements in sugar yield are caused by: (i) new agronomic techniques and technologies; (ii) quality of seed material; (iii) favourable climatic conditions; (iv) as well as the concentration of production at the farm level (Golinowska and Zimny, 2015). These improvements were also mirrored in yield quality, defined by beet sugar content of roots when delivered to the sugar refinery. Average sugar content of beet (Table 3) improved in Poland from 15.89% to 17.67% between 2001 and 2015, which means that sugar content increased by almost 0.8% p.a.

When comparing Czech and Polish sugar production development, there are some significant differences. (i) Due to EU sugar reform, total harvested area in the Czech Republic fell only slightly (-7%) comparable to Poland (-40%) between 2007 and 2008. (ii) Total land utilised for sugar beet production in 2017 (66 thousand hectares) exceeded values of 2000 by 4.8 thousand hectares. (iii) Share on arable land has an increasing trend as increased from 1.98% to 2.43% between 2000 and 2016. (iv) As

Table 1. Average sugar beet production indicators in selected EU countries

Country	Area (thous. ha) ¹	Yield (100 kg) ¹	Production (thous. tones) ¹	Cultivated area per one grower ²
France	421.06	874.98	36,901.89	13.86
Germany	351.33	741.93	24,034.6	10.7
Poland	202.16	604.83	12,309.43	5.3
United Kingdom	95.67	720.99	6,968.33	28.22
Netherlands	71.5	832.62	5,979.35	4.51
Belgium	56.77	787.6	4,238.61	7.69
Czech Republic	61.48	630.5	3,878.4	77.4
Spain	35.66	932.88	3,329.82	5.43
Italy	36.18	603.21	2,115.09	5.09
Austria	43.91	707.99	3,104.19	6.84

¹ 2015-2017 average; ² 2014-2016 average. Source: CEFS (2016), Eurostat (2018).

Table 2. Average sugar beet production indicators in selected EU countries

Area (thous. ha)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Poland	333	317	303	286	297	286	262	247	187	200
Share on arable land	2.37%	2.26%	2.32%	2.28%	2.36%	2.37%	2.12%	2.1%	1.56%	1.67%
Czech Republic	61.3	77.7	77.5	77.3	71.1	65.6	61	54.3	50.4	52.5
Share on arable land	1.98%	2.52%	2.79%	2.81%	2.61%	2.42%	2.31%	2.07%	1.94%	2.03%
	2010	2011	2012	2013	2014	2015	2016	2017	AAGR	
Poland	206	203	212	194	198	180	206	220	-2.41%	
Share on arable land	1.89%	1.84%	1.95%	1.8%	1.82%	1.65%	1.91%	1.61%	-2.25%	
Czech Republic	56.39	58.33	61.16	62.4	62.96	57.61	60.74	66.1	0.44%	
Share on arable land	2.21%	2.31%	2.43%	2.49%	2.53%	2.31%	2.43%	2.23%	0.71%	

Source: Czech Statistical Office (2018), Statistics Poland (2018).

land utilisation was not reduced, total production of beet was higher by 56% to base year reaching almost 4.4 million tonnes. Comparing to Poland, total Czech beet production was about 30% of Polish beet harvest quantity while utilising 30% of Polish area. (v) This leads to the conclusion, that in fact yields are very much comparable (Table 3). Although Czech yields are statistically and historically higher, in last 3 years the difference was only +6% comparing to -48% to Spain; -36% to France

and -32% to the Netherlands (see Table 1). Czech yield evinces a slower rate of improvement. Sugar content is not changing significantly. In 2001 the average sugar content of beet when delivered reached 17.6% while average of last 5 years (2013 – 2017) was only 17.2%. Poland beet production follows intensification of production through increasing yields and quality, the situation in the Czech Republic is opposite, rather extensive approach is applied as illustrated in Table 3.

Table 3. Production characteristics of beet production in CZ, PL

Years	Beet production		Yield (dt/ha)		Sugar content (%) when delivered		Number of farms		Average area per farm (ha)	
	PL	CZ	PL	CZ	PL	CZ	PL	CZ	PL	CZ
2000	13,134	2,809	394	458	n/a	n/a	111,900	n/a	2.98	n/a
2001	11,364	3,529	358	454	15.89	17.6	99,400	1,002	3.19	77.69
2002	13,432	3,833	443	495	16.42	15.35	91,500	1,087	3.31	71.3
2003	11,739	3,495	410	452	18	16.19	85,900	1,045	3.33	74
2004	12,730	3,579	428	503	17.67	18.21	77,900	935	3.81	76.04
2005	11,912	3,496	416	533	19.06	18.53	70,700	901	4.05	72.77
2006	11,475	3,138	438	514	16.8	18.7	63,200	866	4.15	70.39
2007	12,682	2,890	513	532	17.1	18.41	60,700	767	4.07	70.76
2008	8,715	2,885	465	572	17.03	16.47	40,900	718	4.57	70.17
2009	10,849	3,038	543	579	16.8	18.04	40,000	711	5	73.79
2010	9,973	3,065	483	544	16.4	16.85	38,200	730	5.39	77.24
2011	11,674	3,899	574	668	18	16.65	37,000	712	5.49	81.92
2012	12,350	3,869	582	633	17.3	17.32	35,800	723	5.92	84.59
2013	11,234	3,744	580	600	17.6	17	35,700	758	5.43	82.32
2014	13,489	4,425	683	703	17.1	17.59	35,000	746	5.66	84.4
2015	9,364	3,421	520	594	17.67	15.91	34,000	843	5.29	68.34
2016	13,500	4,118	655	678	17.32	18.2	34,000	867	6.06	70.05
2017	13,900	4,399	630	666	16.49	17.5	34,000 (36,014) ¹	838	6.47	78.88
AAGR	0.33%	2.67%	2.8%	2.23%	0.23%	-0.04%	-6.77%	-1.11%	4.67%	0.1%

¹ Number of farms in 2017 was according to ARiMR data on provided coupled payments (36,014). Source: IAFE-NRI (2001-2018), Czech Statistical Office (2018).

Table 3 supports the idea of intensification and extensification of sugar beet production in Poland and the Czech Republic respectively. In Poland, the number of farmers dealing with sugar-beet production decreased from almost 112 to 34 thousand. In 2000, average farmer cultivated about 3 ha of beet. As the number of farmers were reduced by 60%, area per farmer more than doubled. Unfortunately, data from 2000 to 2004 are not

available for the Czech Republic. According to average annual growth rate, the number of farmers (-0.6%) and their area (-0.7%) are more or less constant in long-term perspective. Some important changes need to be commented. EU Sugar regime changes of 2006 resulted in reduction of farmers. Between 2007 and 2010, 155 farmers resigned on beet production. Between 2011 and 2015, farmers amounted to about 730, but in 2016 and

2017 another 121 farms started with beet production. New farms can be identified as rather smaller one, therefore the fact resulted in decrease in average beet area (2017; 70 ha). End of quotas motivated refineries to contract more beet, therefore an additional increase in average area per farm is observed in 2017.

Anyway, as seen in Table 4, average Czech farms are much bigger than other average farms in the rest of the EU. From the most important beet-growers, UK is the closest with respect to farm size. However, UK farmers, still, are by 60% smaller. After Brexit (March, 2019), the situation of Czech farmers will change significantly. The closest "size competitor" will be probably France with only about 13 – 15 ha of beet per one farm. Farmers needs to take in consideration the fact, that intensity is important for farmers rather than size. The same volume of production Czech average farmer were able to reach in 2016 on 77 hectares, Spanish farmers would reach on 52 hectares, French on hectares and Dutch on 59 hectares (Table 4).

From the perspective of production distribution among individual regions, in both countries exist regions where beet is produced the most. It means, beet production is not equally distributed among the whole country, but rather concentrated close to milling and refinery facilities due to costly transportation. In the Czech Republic, there are three regions (Karlovarský, Plzeňský, and Jihočeský) without any beet production. In Poland, there is only one region, where beet was almost not harvested in 2017

(Podlaskie; the one farmer cultivating four ha). In the Czech Republic, the largest share of beet production is produced in Středočeský (no. 8; 26.5%), Olomoucký (no. 5; 18.6%) and Královehradecký region (no. 6; 17.6%). In those regions, 505 farmers grown beet on total 42,395 hectares. In Poland, most significant regions are Wielkopolski (no. 15; 20.8%); Kujawsko-Pomorski region (2; 19%) in the western part of Poland and Lubelski region (no. 4; 17.5%) in the eastern part of Poland. In these three regions, 57.3% of the land is located which is devoted to beet production.

In Table 5 and 7 regional characteristics of beet production are presented and Figure 1 provides graphical illustration of regional specifics. Data were received from Czech (SZIF) and Polish (ARiMR) paying agency. Both agencies provided data on received sugar payments by individual farmers. Based on per hectare 2017 payment (EUR 363 in Poland; EUR 262 in the Czech Republic), individual regional characterisations were calculated. In the Czech Republic, the highest number of farmers is located in Středočeský region, where the biggest refinery is located (Tereos TTD - Dobruška); followed by Královehradecký region (Tereos TTD – Ceske Mezirici) and Olomoucký region, where 3 smaller refineries are located (Cukrovar Vrbátky; Litovelská cukrovarna; Hanácká potravinářská společnost). In the Ustecký region; region without any refinery, the largest beet-specialised farmers were located. Average farm size in that region equalised to 106.6 ha per entity, mainly due to the fact, that 16

Table 4. Intensity comparison with selected EU countries (average for 2015-2017)

Country	Average yield (t/ha)	Average farm size (ha)	Average farm production (t)	Size to reach Czech farm produce (ha; %)	
France	87.5	13.86	1,213	56 ha	72%
United Kingdom	72.1	28.22	2,035	68 ha	88%
Netherlands	83.26	4.51	376	59 ha	77%
Czech Republic	63.05	77.4	4,880	77 ha	100%
Spain	93.29	5.43	507	52 ha	68%
Poland	60.48	5.3	321	81 ha	105%

Source: Eurostat, 2018.

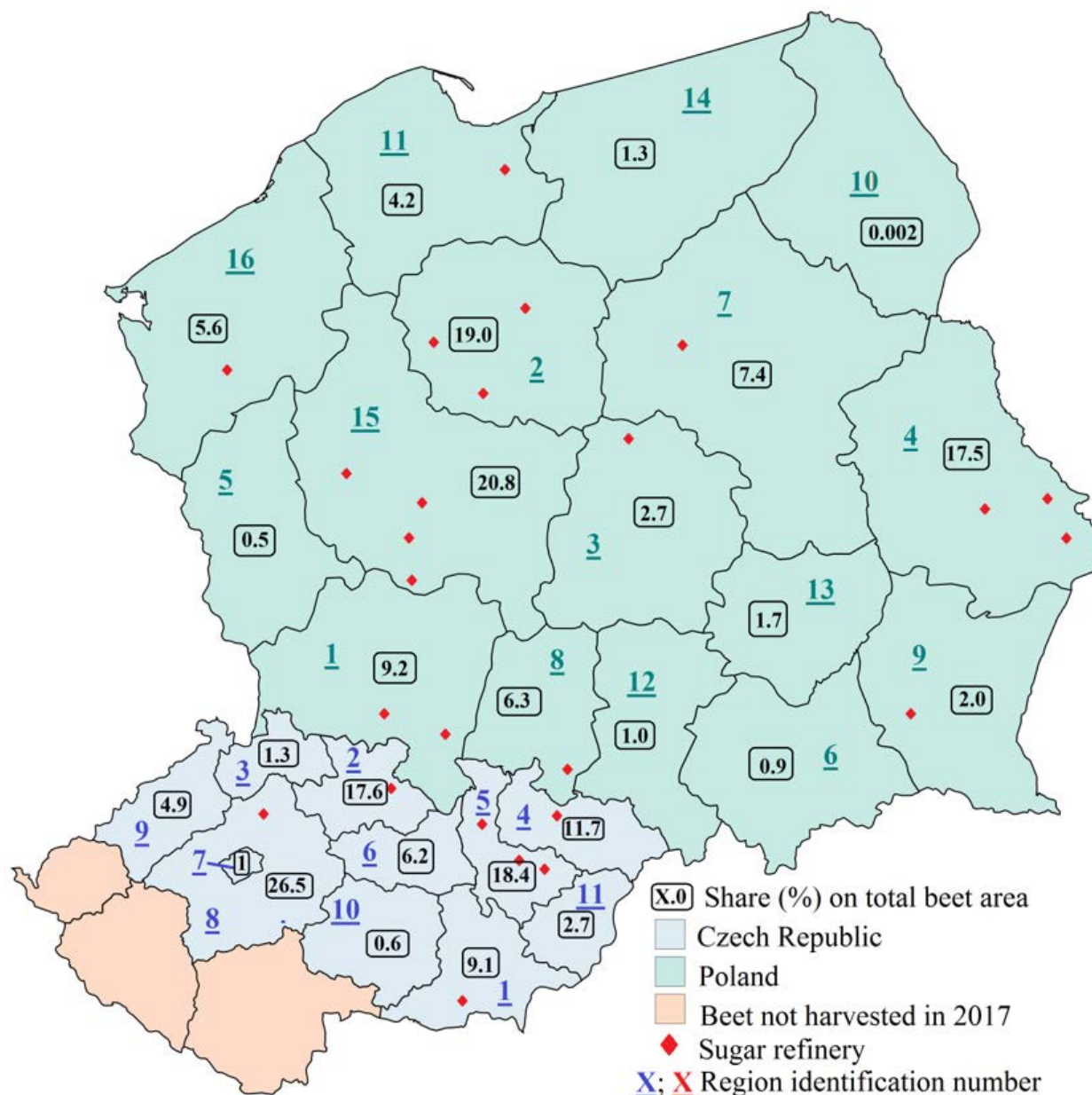


Figure 1. Regional share on total beet harvested area (2017) (Source: author based on SZIF (2018) and ARiMR (2018), own processing by use mapchart.net)

out of 31 farmers harvest beet on more than 100 ha, with maximum 417 ha of beet per entity. However, such a big entity is not an exception in the Czech Republic. 571 farms harvest beet on less than 80.9 hectares (below average), while 267 farms cultivate beet on more than 80.9 hectares (above average). Among those, (i) 214 farms cultivated more than 100 ha; (ii) 82 farms more than 200 ha; (iii) 35 farms more than 300 ha; (iv) 8 farms more than 500 ha and (v) only 1 farm cultivated more than 1,000 ha of sugar beet in 2017.

Significant differences are also evident among legal (corporate) and individual farms (Table 6). 457 farms of individual farmers shared only 23% on beet production fields (15,708 ha in 2017). Average size of a corporate farm is significantly larger. While average individual farmer cultivated about 34 ha of beet, legal farm reached almost 137 hectares. Concerning smallest farmers, only 28 farms (individual only) cultivated beet on less than 5.81 ha, which was Polish average for 2017 according to ARiMR data (Table 7). Generally, in Poland strong position

Table 5. Regional characteristics of sugar beet production, Czech Republic (2017)

RID	Region	Area (ha)	Average size (ha)	Number of farmers
1	Jihomoravský	6,190.5	83.7	74
2	Královehradecký	11,918.2	80	149
3	Liberecký	885.9	63.3	14
4	Moravskoslezský	7,959.9	70.4	113
5	Olomoucký	12,500.9	88	142
6	Pardubický	4,179	70.8	59
7	Praha	708.3	59	12
8	Středočeský	17,976.4	84	214
9	Ústecký	3,303.7	106.6	31
10	Vysočina	420.3	84.1	5
11	Zlínský	1,834.4	73.4	25
	Total	67,877	80.9	838

RID – regional identification number used in Figure 1. Source: own processing based on data from SZIF (2018).

Table 6. Corporate and individual farms – size characteristics, Czech Republic (2017)

Size (ha)	Count	Average	Max.	Min.	Total	Share
Legal farms	381	136.93	1,084.36	10.44	52,169.01	76.86%
Individual farmers	457	34.37	261.42	1.97	15,708.46	23.14%

Source: own processing based on data from SZIF (2018).

holds individual farmers, as out of 36,014 entities only 537 farms have corporate status (1.5%) mentioned Malgorzata Sztoldman (Director of Department of Analysis and Reporting; Agency for Restructuring and Modernisation of Agriculture) in email communication from July, 13, 2018. Unfortunately, more detailed data about Polish legal and corporate entities (similar to Table 6), were not available to the time being.

The regional characteristics, as described in Table 7, differ among individual regions. Strong beet production regions are those located close to large refineries, as the input beet is needed. The largest cultivated area is located in Wielkopolski region (43.5 thousand hectares), where 4 refineries are located (Pfeifer&Langen – Sroda, Gostyn, Miejska Gorka; Nordzucker – Opalenica); followed by

Kujawsko-Pomorski region with 3 refineries (Krajowa Spolka Cukrowa – Naklo, Kruszwica; Nordzucker – Chelmza) and Lubelski region with 3 refineries (Krajowa Spolka Cukrowa – Krasnystaw, Werbkowice; Südzucker – Strzyzow). In these three regions, 23,482 farmers (65%) on 119,896 hectares (57%) produce beet. Although these regions are dominant in sugar production (see below, mentioned refineries represent about 54% of Polish daily processing capacity), specialisation of farmers is not as dominant as in the Czech Republic or other European countries. Average farmer cultivates in mentioned regions about five hectares. On contrary, in regions where production is not as significant, average farm size is bigger - Warmińsko-Mazurski region (22.4 ha; 121 growers), Zachodniopomorski region (16.2 ha;

Table 7. Regional characteristics of sugar beet production, Poland (2017)

RID	Region	Area (ha)	Average size (ha)	Number of farmers
1	Dolnośląski	19,296.4	10.2	1,900
2	Kujawsko-Pomorski	39,786.5	5.1	7,776
3	Łódzki	5,671.3	3.1	1,831
4	Lubelski	36,585.1	4.5	8,066
5	Lubuski	1,110.6	11.4	97
6	Małopolski	1,833.8	8.2	223
7	Mazowiecki	15,523.4	5.4	2,900
8	Opolski	13,095.9	7.4	1,781
9	Podkarpacki	4,116.3	6.2	669
10	Podlaski	4	4.0	1
11	Pomorski	8,776.9	9.5	922
12	Śląski	2,011.9	8.0	252
13	Świętokrzyski	3,652	3.3	1,113
14	Warmińsko-Mazurski	2,710.8	22.4	121
15	Wielkopolski	43,524.3	5.7	7,640
16	Zachodniopomorski	11,667.6	16.2	722
	Total	209,367	5.81	36,014

RID – regional identification number used in Figure 1. Source: own processing based on data from ARiMR (2018).

722 growers) and Lubuski region (11.4 ha, 97 growers). In 2017, according to ARiMR data, average Polish farmer cultivate 5.8 ha of sugar beet. However, it needs to be mentioned, that 28,395 farmers (78.8%) do not reach average plot. On contrary, the largest farm cultivated 1,221.41 ha of beet, which is by 137 hectares more than the largest farm cultivated in the Czech Republic in a given year.

Characterisation of beet producers could be easily assessed by Lorenz curve (Figure 2). Based on its shape, it can be assumed, that distribution of cultivated land among growers evince higher equality in the Czech Republic in comparison to Poland. In Poland, the curve is more distant from the 45° line, which characterises the perfect distribution of cultivated land among individual farmers. Gini coefficient, calculated from the Lorenz

curve, is equal to 0.611 for Poland and 0.544 for the Czech Republic (Table 8). Anyway, according to classification of inequality by The Conference Board of Canada (2018), in both countries production of beet is distributed “very highly” unequally. Polish line is located below the Czech curve. Mainly in Poland, the smallest farmers contribute only limitedly to total production. Farmers, who do not reach average, cultivate beet on 69,417 hectares (33% of area); while farmers with more than average area cover

Table 8. H-H Index of the sugar beet producers based on cultivated area (2017)

Country	Gini coefficient	Herfindahl-Hirschman Index
Czech Republic	0.544	29.96
Poland	0.611	3.12

Source: Own data information based on own calculation.

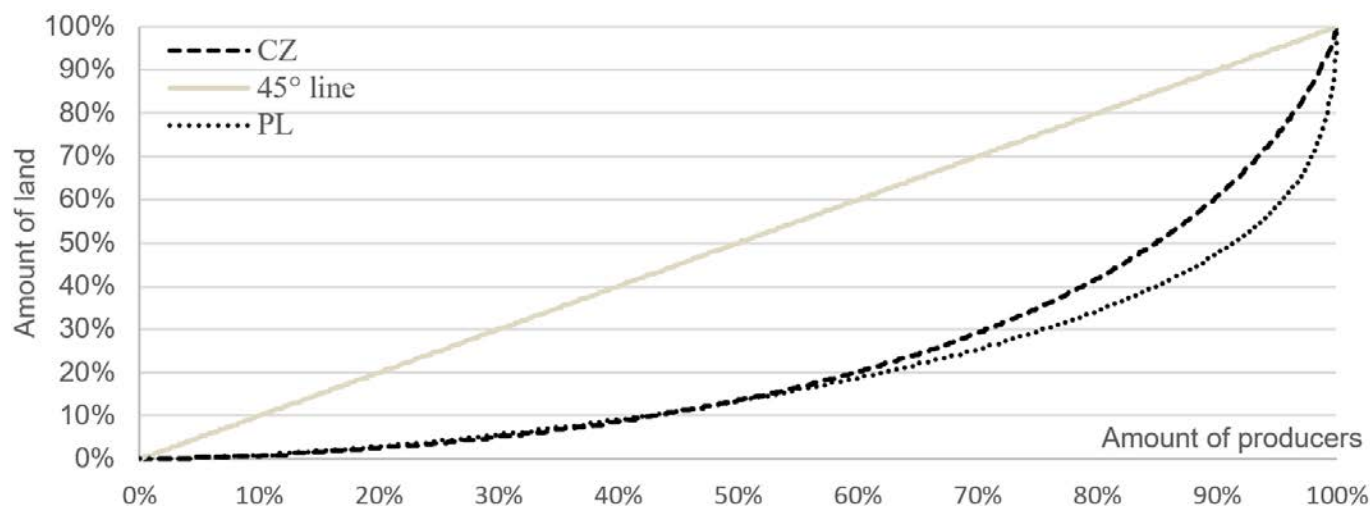


Figure 2. Distribution of land among Czech and Polish beet producers (Lorenz) (Source: own processing based on data from SZIF (2018) and ARiMR (2018))

66.8% of beet grown area. Among others, top 10% of agricultural enterprises (size above 10.12 ha) occupy 52% of beet grown area, while in the Czech Republic top 10% of farms (with coverage higher than 195 ha) occupy 39.2% of cultivating land. Concentration of farmers, according to HHI, was in both countries very limited. Therefore, at the level of production, perfect competition with a large amount of players was observed. HHI for Poland was almost 10 times smaller than Czech HHI.

As indicated above, there is a big difference in size of beet farms. Average Czech entities are more than 14 times bigger than average Polish beet grower, which one could expect could lead to economies of scale. Bigger farmers should be able to negotiate better conditions for agricultural inputs, are able to utilise machinery more efficiently, as well as overheads are divided into more production units. However, literature reflects the fact, that small farms could be operated more efficiently than large-scale farms - Inverse Relationship theory mainly studied in developing countries (Schneider and Lenzelbauer, 1993; Heltberg, 1998). To study differences in scale economies, financial aspects of beet production were considered. Note, the data prepared by Czech and Polish institutions consider different yields than average ones prepared by Czech and Polish Central Statistical Offices. These cost data are prepared based on a collection of documents from a certain poll of farmers, which were down with

their yields in comparison to national average. In the sample of Polish farms, yield was between 53.3 (2015) and 70.1 t/ha (2014), while among Czech farms it ranged from 62 to 77 t/ha

As it is obvious from Table 9 (PL) and Table 10 (CZ), Czech production costs per one hectare were by EUR 805 higher than in Poland in 2017. In observed years, total Polish production costs ranged from 1,349 (2016) to 1,397 (2014) EUR per hectare, which resulted in costs from 19.8 up to 25 EUR per tonne of sugar beet produced. Czech farmers deal with costs of about 2,300 EUR per hectare, i.e. 29.7 – 36.4 EUR/tonne. Calculated four-year average was 32.3 EUR/t for the Czech Republic, and it was by more than EUR 10 lower for Poland. In Poland, total value of direct costs ranged between 617 and 646 EUR/ha, which means direct costs represents 46% of total costs. In the Czech Republic, direct costs reached 4-year average of 1,284 EUR/ha, creating 57% of total costs. More detailed study of available cost calculations pointed out opposite position of direct and indirect costs. Differences are observed mainly in expenditures on seeds and plant protection. According to Řezbová et al. (2013) Czech variable costs were 30% lower to Polish variable costs based on data from Agribenchmark, the international network of agricultural economists, advisors, producers and specialists in agricultural and horticultural value chains. Similarly to costs, also revenues

are bigger in the Czech Republic. Czech four-year average of revenues reached 2,298 EUR/ha, while in Poland farmer four-year average value of production was 1,697 EUR/ha. In Poland, even without subsidies, income was positive in observed years. In the Czech Republic, farmers without the subsidies would reach loss in 2014, as well as in 2015. When comparing profit margins (see Table 13) Polish farmers outperformed Czech beet growers in observed years. In 2017, while Czech farms reached 24% profit margin with subsidies, in Poland that value was 47%. In average, over four years, Polish farmers reached by 34% higher profit margin although their size of beet area (farmers considered for calculation of costs) is way below Czech farms. Polish average for costs calculation is 9.31 ha of beet area per farm.

As already mentioned, after EU accession both Czech Republic and Poland were included in Common Agricultural Policy, which resulted in introduction of specific supporting measures. Since 2004 both countries have applied Single Area Payment Scheme (SAPS), which distributed support according to farm size. Due to the fact, that price level in new EU member states was lower, support did not equal to original EU15 members. But SAPS payments were increased continually. Simultaneously national governments were given the opportunity to provide national based per hectare payments (TOP-UPs) which decreased as EU per hectare support rose. As seen from the Tables 11 and 12, total SAPS payments rose up to 2014 as they reached EUR 218 in both countries. In 2015, changes connected with the new financial programming period (2014 - 2020) occurred as CAP payments underwent reform. EU follows the idea, that agriculture has not only production function, but also provide public goods and environmental services (Cooper et al., 2009). Based on this approach, SAPS payments were divided into smaller "envelopes". The Czech Republic introduced basic payment (SAPS) and Greening payments. In Poland, in addition, also redistributive payment for smaller farms (called additional payment) was introduced. In Poland, from SAPS (107), Greening (72) and redistributive payment for small (42) a farm can receive up to EUR 221 per hectare. Decoupled EU per hectare contribution to

Czech farm is only EUR 207 (133 + 74 in 2018). Even after 2011, Czech Republic continues to provide additional per hectare payments granted from national resources. For 2016 and 2017, national decoupled payment was equal to EUR 6. Above-mentioned payments are the same for all agricultural commodities. However, special attention is paid to coupled payments to sugar beet industry. First part of support is almost comparable; the second part differs significantly.

After EU accession, sugar beet production was supported by two basic measures (i) Separate Sugar Payments (SSP) applied between 2006 and 2014; and (ii) Voluntary Coupled Support (VCS) applied from 2015 on. Among the EU countries VCS ranges from EUR 100 to 600 according to Blanco (2018). This makes sugar beet one of the most supported sectors together with dairy products, fruits and vegetable, beef and veal, etc. (Blanco, 2018). For the SSP, the payments per tonne of harvested beet were provided, while under VCS per hectare payments are granted. In both countries, similarity in per tonne payments were observed (SSP, EUR 13 - 14). Values presented in the Tables 11 and 12 (line "payment per hectare") reflect average yield in a given country for a given year. Higher average yield in the Czech Republic resulted in higher separate sugar payment per hectare. Difference in per hectare SSP in the Czech Republic and Poland oscillated between EUR 89 (2008) and EUR 203 (2011). However, in 2015, significant change occurred. As per-tonne based system was replaced by per hectare payment (VCS), the situation changed. In Poland, payment over EUR 800 per hectare decreased to EUR 504 in 2015 and later to EUR 350 (-60%). In the Czech Republic, total decrease was more drastic; payments decreased from EUR 977 (2014) to EUR 257 in 2018 (-74%). Only for comparison, sugar VCS in Hungary and Slovakia reached 421.1 EUR/ha and 393 EUR/ha respectively (Vásáry et al., 2017). Between 2005 and 2014, Czech farmers reached higher per hectare payments due to higher yields, between 2015 and 2017 higher payments were provided to Polish beet growers. Also, it is worth mentioning, that Polish farmers has access to significant pallet of indirect support tools, which improve general economy of beet

Table 9. Costs of beet production in Poland

	Unit	2014	2015	2016	2017	4Y average
Yield	t/ha	70.1	53.3	67.5	65.2	64.03
Selling price of beet root	EUR/t	29.3	27.34	26.15	22.82	26.4
Selling price of beet leaves	EUR/t	6.14	5.31	5.98	6.33	5.94
Total value of production	EUR/ha	2,058	1,463	1,788	1,479	1,697
Total direct cost, including:	EUR/ha	646	636	623	617	631
- Seeds	EUR/ha	156	155	151	150	153
- Fertilisers	EUR/ha	288	277	269	259	273
- Plant protection	EUR/ha	189	192	190	195	192
Gross margin without subsidies	EUR/ha	1,413	826	1,165	862	1,066
Indirect costs (without external factors of production)	EUR/ha	384	362	355	386	372
Gross value added	EUR/ha	1,029	464	810	476	695
Depreciation	EUR/ha	228	231	233	224	229
Net value added	EUR/ha	801	233	577	251	465
Cost of external factors of production	EUR/ha	140	140	138	140	139
Total costs	EUR/ha	1,397	1,370	1,349	1,368	1,371
- Costs of 1 t	EUR/t	19.9	25.7	19.8	21.2	21.6
Income without subsidies	EUR/ha	661	93	439	111	326
Subsidies, including:	EUR/ha	1,115	723	671	585	774
- Sugar beet payment (SSP ¹ , VCS)	EUR/ha	897	504	452	363	554
- Single Area Payment	EUR/ha	218	107	107	109	135
- Greening	EUR/ha	-	72	72	72	72
- Additional payment	EUR/ha	-	40	40	41	40
Total income	EUR/ha	1,777	816	1,110	696	1,100

¹ The value of Separate Sugar Payment (SSP for 2014) was 12.8 EUR/tonne. Mentioned value of 2014 is based on per tonne support and average yield (70.1) of sample farms (149). Farm average beet area was 9.31 ha per farm. Source: Żekało (2016); Augustyńska (2018).

production and later on also the whole sugar value chain. Government enables farmers to pay lower social and health insurance, income tax, etc. (Pawłowska-Tyszko et al., 2015).

Concentration and intensification may determine the final profitability of farm. Even though Czech farms cultivate more sugar beet, operate under economies of scale, reached conclusions did not indicate higher

negotiation power. In comparison to Polish colleagues, Czech farmers were not able to reach higher prices. In 17-year average, Polish beet price was by 4% higher. In most of the years, average Polish beet farm-gate price was higher (in 11 out of 17 observations; mostly until 2009). Only between 2010 and 2014, Czech price was more beneficial. Table 14 also presents changes in distribution of margins in sugar value chain when comparing price

Table 10. Costs of beet production in the Czech Republic, per hectare, EUR

	Unit	2014	2015	2016	2017	4y average
Number of observations	no.	32	38	34	39	36
Average yield (t/ha)	t/ha	76.88	63.09	72.84	69.26	70.5
Average selling price of root (EUR/t)	EUR/t	31.42	32.62	31.07	30.92	31.5
Revenues	EUR/ha	2,246	2,236	2,430	2,279	2,298
Direct costs	EUR/ha	1,254	1,307	1,289	1,285	1,284
- Seeds	EUR/ha	244	251	240	242	244
- Fertilisers	EUR/ha	297	304	268	228	274
- Plant protection	EUR/ha	296	327	337	323	321
- Other direct material costs	EUR/ha	43	39	46	85	53
- Other direct costs and services	EUR/ha	358	366	388	390	376
- Depreciation (direct)	EUR/ha	17	20	11	16	16
Indirect costs	EUR/ha	1,031	993	1,021	888	983
- Overheads	EUR/ha	267	261	286	268	271
- Costs of ancillary activities	EUR/ha	373	368	336	275	338
- Wage and personnel costs	EUR/ha	391	363	399	345	374
Total costs	EUR/ha	2,285	2,300	2,310	2,173	2,267
- costs of 1t	EUR/t	29.72	36.46	31.71	31.37	32.3
Income without subsidies	EUR/ha	-40	-65	120	106	31
Subsidies	EUR/ha	1,294	499	483	441	679
- Direct payments	EUR/ha	225	209	208	199	210
- Sugar beet payments (SSP ¹ , VCS)	EUR/ha	1,069	290	275	242	469
Total income	EUR/ha	1,254	434	603	548	710

¹ The value of Separate Sugar Payment (SSP) was 13.9 EUR/tonne. Value of 2014 is based on per tonne support and average yield (76.88) of sample farms (32). Source: IAEI (2019).

of beet at farm-gate, sugar price at producer level and retail consumer price. Based on own calculations and observations, it can be concluded, that margin between beet producer and sugar refinery has been decreasing in long-term by 1.49% annually in Poland and 0.6% in the Czech Republic. The fact can be explained by increasing price of beet (faster in Poland: +0.9%/annum; while +0.3% in the Czech Republic) and falling wholesale price of sugar (faster in Poland: -0.5%/annum; while -0.25% in

the Czech Republic). As seen in Figure 3, share of beet price on the final retail price is decreasing in the long term, however, oscillates around 4% of the retail price in both markets.

Intensification of Polish sugar industry (Smutka et al., 2018) and concentration of Czech retail market (Špička, 2016) could play a significant role in different direction of retail prices (-0.75% per annum in Poland; +0.6% in the Czech Republic). Higher concentration of Czech retail

Table 11. Subsidies for sugar beet production, Poland, per hectare, EUR

Measure	2004	2005	2006	2007	2008	2009	2010	2011
SAPS	48	57	70	80	100	120	141	161
Greening	-	-	-	-	-	-	-	-
Additional payment ¹	-	-	-	-	-	-	-	-
TOP-UP	67	72	79	78	79	64	82	62
Separate Sugar Payment (t) ²	-	-	8.5	9.9	11.6	12.6	12.7	12.6
- payment per ha ³	-	-	374	507	540	686	611	725
Sugar payment (VCS)	-	-	-	-	-	-	-	-
Measure	2012	2013	2014	2015	2016	2017	2018	4Y mean ⁴
SAPS	178	196	218	107	107	109	107	107.5
Greening	-	-	-	72	72	72	72	72
Additional payment ¹	-	-	-	40	40	41	42	40.8
TOP-UP	52	33	-	-	-	-	-	-
Separate Sugar Payment (t) ²	12.8	12.8	12.8	-	-	-	-	-
- payment per ha ³	744	742	876	-	-	-	-	-
Sugar payment (VCS)	-	-	-	504	452	363	350	439.7

¹ For farms up to 30 ha; ² Separate Sugar Payment in operation up to 2014 - payments based on historical contracts with working sugar refineries (2006/2007) or closed refineries that sold quotas (2005/2006), ³ Value of payment per hectare is based on average national per hectare yield (Table 3), ⁴ 2015-2018 average. Source: Polish Ministry of Agriculture.

(Špička, 2016), may play significant role in consumer price determination, as lower competition does not drive prices down. Even though producer prices go down, the Czech retail sugar margin has an increasing trend. Retail sugar margin has been increasing by 3.71% per annum. In Poland, observed situation differs. Retail market is less concentrated (Špička, 2016), retail prices move in the direction of producer prices (-0.5 and -0.75% per annum, respectively), the margin of sugar producers and retailers is decreased annually by similar intensity. In 2016, beet price was higher in Poland (+17%); while retail price was lower by 1% in comparison to the Czech market. Margins applied by retailers are since 2008 lower in Poland (in average 21% over the period) compared to Czech retailers (in average 28%). But, in comparison to other grocery products, the margin for sugar (as well as for products with relatively long shelf life) is relatively small (Foltýn et al., 2015) due to its long self-life which only rarely results

into a loss for retail chains.

Low concentration of beet growers, in both markets leads to a question, how efficiently are farmers able to negotiate with sugar manufactures. In the Czech Republic exist two main beet growers associations: (i) Bohemian Beet Grower Association and (ii) Association of sugar beet growers in Moravia and Silesia. They both represent beet growers during negotiations with producers, as well as legislators and policymakers. Bohemian association, for example, helps growers negotiate general sectoral terms of contracts, but as sale contract is an only two-sided agreement signed by grower and refinery, the association can only provide recommendations. From this perspective, the strong monopsonistic position of Tereos TTD in Bohemia (owns only two refineries in the region, Dobruška, and České Meziříčí) is slightly mitigated by associations' activities.

Table 12. Subsidies for sugar beet production, Czech Republic, per hectare, EUR

Measure	2004	2005	2006	2007	2008	2009	2010	2011
SAPS	57	71	89	101	125	147	165	189
Greening	-	-	-	-	-	-	-	-
TOP-UP	46	78	79	64	54	47	21	0
Separate Sugar Payment (t) ¹	-	-	6	7.7	11	13.9	13.9	13.9
- payment per ha ²	-	-	310	409	630	807	756	927
Sugar payment (VCS)	-	-	-	-	-	-	-	-
Measure	2012	2013	2014	2015	2016	2017	2018	4Y mean ³
SAPS	214	236	218	130	130	125	133	129.5
Greening	-	-	-	71	71	69	74	71.3
TOP-UP	20	11	7	7	7	6	6	6.5
Separate Sugar Payment (t) ¹	13.9	13.9	13.9	-	-	-	-	-
- payment per ha ²	879	833	977	-	-	-	-	-
Sugar payment (VCS)	-	-	-	290	275	242	257	269

¹ Separate Sugar Payment in operation up to 2014 - payments based on historical contracts with working sugar refineries (2006/2007) or closed refineries that sold quotas (2005/2006), ² Value of payment per hectare is based on average national per hectare yield (Table 3), ³ 2015-2018 average Source: Czech Ministry of Agriculture.

Table 13. Financial indicators – sugar beet producers

Return on costs	2014	2015	2016	2017	4Y average
CZ	55%	19%	26%	25%	31%
PL	127%	60%	82%	51%	80%
Profit margin without subsidies	2014	2015	2016	2017	4Y average
CZ	-2%	-3%	5%	5%	1%
PL	32%	6%	25%	8%	19%
Profit margin with subsidies	2014	2015	2016	2017	4Y average
CZ	56%	19%	25%	24%	31%
PL	86%	56%	62%	47%	65%

Source: own calculations based on Żekała (2016); Augustyńska (2018); IAEI (2019).

In Poland, Krajowy Związek Plantatorów Buraka Cukrowego (The National Union of Sugar Beet Growers) represents farmers on the European forum (CIBE) and takes part in the negotiation of industry agreements in which, for example, the ranges of transport cost are set. Krajowy Związek Plantatorów Buraka Cukrowego brings

together 32 regional associations supporting sugar beet growers. These regional associations do not enter the negotiation process for input prices (each sugar factory solves this problem on its own) but can support sugar beet growers in the negotiation process for beet price with individual sugar factories. However, a large amount

Table 14. Sugar value chain – prices (sugar beet price; price of sugar at producer level; consumer price)

Year	Beet price (EUR cents/kg)		White sugar				Price increase			
			Producer price (EUR cents/kg)		Consumer price (EUR cents/kg)		Beet => producer		Producer => consumer	
	PL	CZ	PL	CZ	PL	CZ	PL	CZ	PL	CZ
2000	2.72	2.54	58.88	48.32	74.1	59.24	2,063%	1,801%	26%	23%
2001	2.83	3.03	57.46	53.25	68.63	63.55	1,930%	1,658%	19%	19%
2002	3.15	2.91	54.44	56.97	59.11	65.93	1,630%	1,861%	9%	16%
2003	2.98	2.82	41.37	54.32	48.87	55.36	1,288%	1,825%	18%	2%
2004	4.77	4.13	57.88	64.53	69.36	69.55	1,114%	1,462%	20%	8%
2005	4.52	4.36	64.13	63.83	77.80	78.54	1,318%	1,365%	21%	23%
2006	3.74	3.31	67.76	67.89	80.34	76.6	1,712%	1,954%	19%	13%
2007	3.1	2.86	66.07	68.43	79.55	78.87	2,033%	2,292%	20%	15%
2008	3.23	2.95	62.36	64.54	77.16	84.34	1,830%	2,087%	24%	31%
2009	2.92	2.67	58.23	57.31	72.1	74.86	1,894%	2,044%	24%	31%
2010	2.81	2.83	53.82	51.77	68.28	71.98	1,817%	1,729%	27%	39%
2011	2.86	3.5	71.83	62.95	98.75	91.66	2,409%	1,701%	37%	46%
2012	3.23	3.28	77.66	75.87	94.71	96.5	2,305%	2,214%	22%	27%
2013	3.18	3.54	73.14	70.40	85.69	92.96	2,203%	1,886%	17%	32%
2014	2.97	3.01	49.71	56.69	59.71	79.9	1,573%	1,783%	20%	41%
2015	3.12	2.86	45.65	44.47	53.24	65.22	1,362%	1,457%	17%	47%
2016	3.15	2.67	54.32	46.39	65.74	65.18	1,623%	1,636%	21%	41%
2017	n/a	n/a	n/a	52.2	71.35	75.83	n/a	n/a	n/a	45%
Average	3.25	3.13	59.69	58.9	72.47	74.78	1,771%	1,809%	21%	28%
AAGR	0.92%	0.31%	-0.5%	-0.25%	-0.75%	0.6%	-1.49%	-0.60%	-1.28%	3.71%

Source: own calculations based on data from Ministry of Agriculture of the Czech Republic (2017), Statistics Poland (2018).

of beet growers in Poland and their small production, limited negotiation capacity of 32 local associations, leads to the assumption, that majority of Polish beet growers has only limited capacity to negotiate better price or conditions. Establishment of effective marketing organisation could be seen as a possible solution. They could improve the production economy at the site of input purchase and sugar beet sale and their negotiating position. In Poland, Ministry of Agriculture introduced supportive measure focused on the establishment of

producer groups marketing sugar beet supported from Polish Rural Development Programme of the European Union. It was applied in all financial perspectives 2004-06, 2007-12 and 2014-20. Based on available data (provided by ARiMR, 2017), until November 2017, there has been supported 19 groups which were established for sugar beet marketing. Nineteen (19) groups altogether organised 152 producers (out of 36,014 in 2017), which means only 0.4% of all Polish beet producers used this occasion for self-concentration. This means, however,

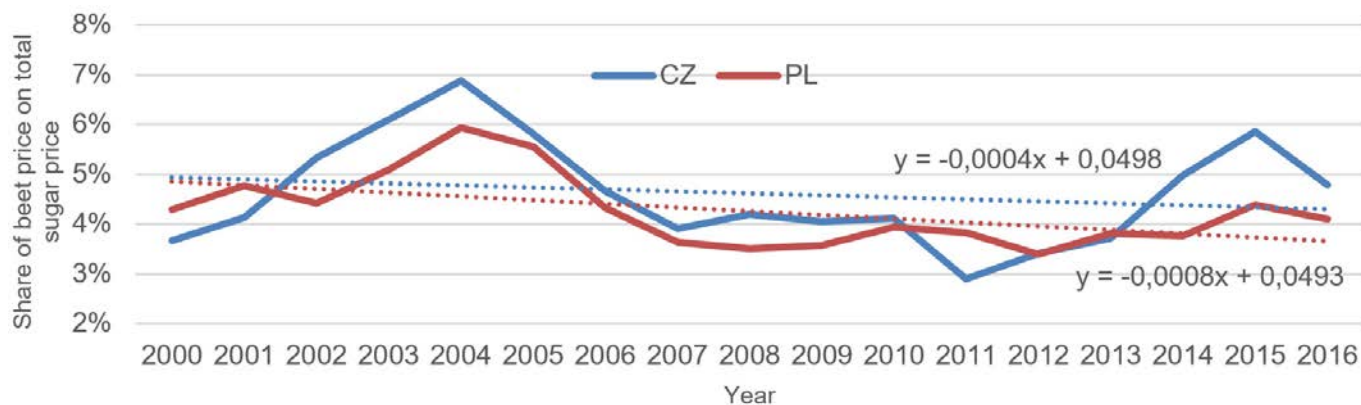


Figure 3. Share of beet price on total sugar price (Source: own calculations)

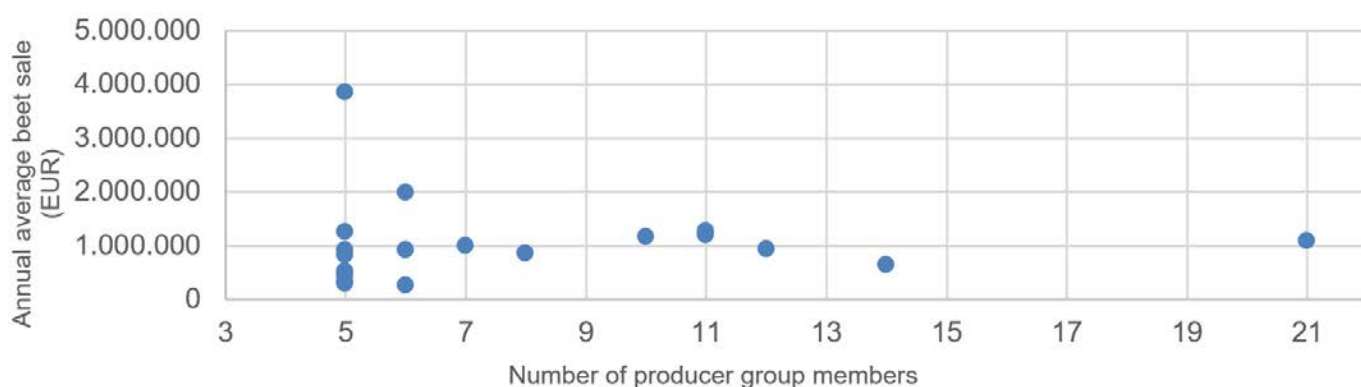


Figure 4. Producer groups, relation of number of members and average beet sale (EUR) (Source: main calculations based on ARiMR (2017) data)

Polish farmers are of below European average size, their intention to integrate and improve their position is not significant.

As indicated in Figure 4, there does not exist any relation between number of farmers integrated into producer group and their total amount of sales. Based on the available data, it was estimated, that producers integrated in groups covered about 5% of Polish production (cumulative annual sales could reach about 40 million EUR if all groups continue in its operations). Unfortunately, Polish groups evince about 40% fail rate (Kotyza, 2017), which further reduce importance and efficiency of provided financial support. Above stated facts indicate that Polish farmers agree with given market situation and, probably, only unfavourable market situation could motivate them to proceed with vertical integration on the level of marketing organisations.

CONCLUSIONS

The main aim of the contribution was to compare, how changes influenced sugar beet producers in the Czech Republic and Poland over a defined time. In Poland, farmers were able to increase the average size of cultivated land, a number of farmers is almost by 76 thousand below original level, and yields as well as sugar content improved. In the Czech Republic, no significant improvement in average area per grower and sugar content was noticed. The improvement was observed in the yield and total production. Amount of farmers is by about 150 below the 2001 situation. The decrease in a number of growers observed mainly after the year of 2006 due to consequences of EU sugar reform was compensated in last years when refineries prepared themselves for the end of the sugar quota system.

From the regional point of view, most of the beet production is located close to sugar refineries, due to logistics constraints. In the Czech Republic, most of the beet is produced in the Středočeský, Královehradecký and Olomoucký region. In Poland, most of the beet production is located in Wielkopolski, Kujawsko-pomorski and Lubelski region. Czech farms, according to findings of agricultural economy research institutes, operate under higher costs and lower per hectare profit margin.

Czech production is relatively more equally distributed among a smaller portion of farmers; last decile farm occupies about 40% of beet area. Polish distribution of cultivated beet among farmers is more unequal, the last decile of farms cultivate about 52% beet hectares. Nevertheless, distribution of sugar beet area among farmers, measured by the Gini coefficient, is qualified as very highly unequal. The Gini coefficient for the Czech Republic is equal to 0.544; in Poland the coefficient is equal to 0.611. On contrary, the concentration of farmers, measured by Herfindahl-Hirschman index, indicates that beet production is under perfect competition with a large amount of players. This negatively influences their positions in the sugar value chain. Over time, the share of beet price on sugar retail price has a decreasing trend; although it still oscillates close to 4 percent. In both markets, differences in market powers are observed. The average price of beet has an increasing trend. Czech farmers, who are in average 12 times larger compared to Polish farms and should operate under the economy of scale reached a lower price of beet. Price of sugar, at the level of a sugar refinery, has negative trend. At the level of retail, sugar prices are kept higher in the Czech Republic mainly due to the high concentration of retail market. All over, level of concentration of sugar refinery industry and retail markets influences the position of non-concentrated farmers. Therefore, farmers have only limited negotiation power. Over last 15 years, joint marketing groups or producer organisations were not developed. In Poland, a certain affords occurred to establish producer groups. Their share on the market is minor and their functionality is questioned, due to the high fail rate of supported groups in Poland. Unequal position of growers to refineries is

slightly mitigated by the existence of grower associations, but they do not directly enter negotiation procedure, they only provide certain framework and assistance, if needed.

After the end of the sugar quota system, growers will be under pressure to further decrease the price of beet, as the price of sugar will be down. Improving production efficiency, further improvements in yields, pressure on costs will be observed. On the other hand, producers will need to face further consolidation in the sugar production markets, as small uncompetitive refineries might be put out of operation and large might become larger. Elimination of quota will also increase market with sugar substitutes, mainly glucose-fructose syrup, which is produced mainly from cornstarch. Substitutes, mainly if the price of sugar was high, were very successful to replace sugar in many food products. In short-run, when low sugar prices are expected, competition from non-sugar sweeteners industry might not influence the position of farmers, but could significantly change the situation during sugar price increase and therefore in the long-run influence prices of beet negatively. After the EU is left by the UK, Czech farmers are about to be way the largest one among the TOP sugar producing countries, but lagging behind production efficiency of other farmers in mainly Wester Europe. Current negotiations about new EU financial perspective is making farmers concerned, whether also in the new financial scheme support for beet will be remained. If not, the whole sector would change significantly.

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REFERENCES

- Agency for Restructuring and Modernisation of Agriculture (ARiMR) (2017) Data on producer groups. Retrieved upon request, based on law on providing public information. [Accessed 7 December 2017].
- Agency for Restructuring and Modernisation of Agriculture (ARiMR) (2018) Data on beet growers and their support. Data retrieved upon request, based on law on providing public information. [Accessed 9 August 2018].

- ARETÉ (2012) Study on price transmission in the sugar sector - revised draft executive summary. [Online] Bologna: Arete srl. Available at: https://ec.europa.eu/agriculture/sites/agriculture/files/external-studies/2012/sugar-price-transmission/fulltext_en.pdf [Accessed 5 September 2018].
- Augustyńska, I. (2018) Produkcja, koszty i dochody z wybranych produktów rolniczych w latach 2016-2017 (wyniki rachunku symulacyjnego). Warszawa: IAFE-NRI.
- Blanco, M. (2018) The impact of the Common Agricultural Policy on developing countries. Brussels: European Parliament. DOI: <https://dx.doi.org/10.2861/953397>
- Breguet, P. (2011) Assessing the future of the Australian sugar industry. [Online] Brisbane: QSL. Available at: <http://www.qsl.com.au/sites/default/files/QSL%20FO%20Licht%20presentation%20China%20Sept%202011.pdf> [Accessed 5 September 2018].
- Clarke, R., Davies, S., Dobson, P. (2002) Buyer power and competition in European food retailing. Cheltenham: Edward Elgar Publishing.
- Conference Board of Canada (2018) World income inequality. Is the world becoming more unequal? [Online] Ottawa: Conference Board of Canada. Available at: <http://www.conferenceboard.ca/hcp/hot-topics/worldinequality.aspx> [Accessed 2 September 2018].
- Cooper, T., Hart, K., Baldock, D. (2009) The provision of public goods through agriculture in the European Union. London: Institute for European Environmental Policy.
- Czech Statistical Office (2018) Agriculture - time series. [Online] Prague: Czech Statistical Office. Available at: https://www.czso.cz/csu/czso/zem_ts [Accessed 29 July 2018].
- Dobson, P. W., Waterson, M., Davies, S. W. (2003) The patterns and implications of increasing concentration in European food retailing. *Journal of Agricultural Economics*, 54 (1), 111-125. DOI: <https://dx.doi.org/10.1111/j.1477-9552.2003.tb00053.x>
- European Association of Sugar Manufacturers (CEFS) (2016) CEFS Sugar Statistics 2016. [Online] Brussels: European Association of Sugar Manufacturers. Available at <http://g8fnp1kplyr33r3krz5b97d1.wpengine.netdna-cdn.com/wp-content/uploads/2017/06/CEFS-SUGAR-STATISTICS-2016.pdf> [Accessed 25 March 2018].
- European Commission (2009) CAP reform: Commission welcomes success of EU sugar reform as restructuring process concludes. [Online] Brussels: European Commission. Available at: http://europa.eu/rapid/press-release_IP-09-366_en.pdf [Accessed 29 July 2018].
- European Commission (2017) EU sugar quota system comes to an end. [Online]. Brussels: European Commission. Available at: http://europa.eu/rapid/press-release_IP-17-3487_en.htm [Accessed 12 September 2018].
- Eurostat (2018) Eurostat database. [Online] Luxembourg: Eurostat. Available at: <http://ec.europa.eu/eurostat/data/database> [Accessed 5 April 2018].
- Foltýn, I., Štiková, O., Mrhálková, I. (2015) Model AGRO 2014 and problem discrimination of Czech food producers. In: Smutka, L., Řezbová, H., *Agrarian Perspectives XXIV: Proceedings of the 24th International Scientific Conference*, Prague, Czech Republic, 16-18 September 2015, 126-134.
- Food and Agriculture Organization of United Nations (2006) Inequality analyses, Gini index. [Online] Rome: Food and Agriculture Organization of the United Nations. Available at: http://www.fao.org/docs/up/easypol/329/gini_index_040en.pdf [Accessed 2 September 2018].
- Golinowska, M., Zimny, L. (2015) Economic efficiency of sugar beet cultivation in the conditions of diversified mineral fertilization and in different systems of conservation tillage, *Polish Association of Agricultural Economists and Agribusiness - SERIA*, 17 (1), 55-61.
- Heltberg, R. (1998) Rural market imperfections and the farm size-productivity relationship: Evidence from Pakistan. *World Development*, 26 (10), 1807-1826.
- Heno, S., Viou, L., Khan, M. F. R. (2018) Sugar beet production in France. *Sugar Tech*, 20 (4), 392-395. DOI: <https://dx.doi.org/10.1007/s12355-017-0575-x>
- Hirschman, A. O. (1964) The paternity of an index. *The American Economic Review*, 54 (5), 761.
- Homolka, J., Slaboch, J., Švihlíková, A. (2014) Evaluation of effectiveness of investment projects of agricultural bio-gas stations. *AGRIIS on-line Papers in Economics and Informatics*, 6 (4), 45-57.
- Institute of Agricultural and Food Economics - National Research Institute (IAFE-NRI) (2001-2018) Rynek cukru: Stan i perspektywy, 20-45.
- Institute of Agricultural Economics and Information (IAEI) (2019) Nákladovost zemědělských výrobků. [Online] Prague: Institute of Agricultural Economics and Information. Available at: <https://www.uzei.cz/nakladovost-zemedelskych-vyrobu/> [Accessed 12 February 2019].
- Kotyza, P. (2017) Efekty podpor vzniku nových odbytových organizací v České, Slovenské a Polské republice, Prague: National Museum of Agriculture.
- Lyon, M., Cheung, L. C., Gastwirth J. L. (2016) The advantages of using group means in estimating the Lorenz curve and Gini index from grouped data. *The American Statistician*, 70 (1), 25-32. DOI: <https://dx.doi.org/10.1080/00031305.2015.1105152>
- Maitah, M., Řezbová, H., Smutka, L., Tomšík, K. (2016) European sugar production and its control in the world market. *Sugar Tech*, 18 (3), 236-241. DOI: <https://dx.doi.org/10.1007/s12355-016-0439-9>
- Maitah, M., Smutka, L. (2016) Restoration and growth of the Russian sugar market. *Sugar Tech*, 18 (2), 115-123. DOI: <https://dx.doi.org/10.1007/s12355-015-0383-0>
- Marks, C. V., Maskus, K. E. (1993) The economics and politics of world sugar policies. Ann Arbor: The University of Michigan Press. DOI: <https://dx.doi.org/10.3998/mpub.13297>
- Ministry of Agriculture of the Czech Republic (2017) Situační a výhledová zpráva. Cukr - cukrová řepa. Prague: Ministerstvo zemědělství.
- Naldi, M., Flamini, M. (2014) The CR4 Index and the Interval Estimation of the Herfindahl-Hirschman Index: An Empirical Comparison. [Online] Available at: <https://hal.archives-ouvertes.fr/hal-01008144> [Accessed 30 August 2018].
- Organisation for Economic Cooperation and Development (OECD) (2007) Sugar Policy Reform in the European Union and in World Sugar Markets. Paris: OECD Publishing. DOI: <https://dx.doi.org/10.1787/9789264040212-en>
- Pawłowska-Tyszko, J., Soliwoda, M., Pieńkowska-Kamieniecka, S., Walczak, D. (2015) Stan obecny i perspektywy rozwoju systemu podatkowego i ubezpieczeniowego polskiego rolnictwa. Warsaw: Institute of Agricultural and Food Economics - National Research Institute.
- Potori, N., Doucha, T., Medonos, T., Gálik, J., Jamborová, M., Čičová, T. (2017) Comparison of the Agro-food sectors from a macro perspective. In: Biro, S., *Structural changes in Agriculture since EU Accession in Slovakia, the Czech Republic and Hungary*. Budapest: Research Institute of Agricultural Economics, 9-34. DOI: <https://dx.doi.org/10.7896/ak1702>
- Ryden, L. (2013) The EU common agricultural policy and its effects on trade. [Online] Jönköping: Jönköping University. Available at: <http://www.diva-portal.org/smash/get/diva2:627041/FULLTEXT01.pdf> [Accessed 30 August 2018].

- Řezbová, H., Belova, A., Škubna, O. (2013) Sugar beet production in the European Union and their future trends. *AGRIS on-line Papers in Economics and Informatics*, 5 (4), 165 – 178.
- Řezbová, H., Maitah, M., Sergienko, O. I. (2015) EU quota sugar market concentration – the main drivers of EU sugar market. *AGRIS on-line Papers in Economics and Informatics*, 7 (4), 131 – 142.
- Schneider, F., Lenzelbauer, W. (1993) An inverse relationship between efficiency and profitability according to size of (Upper-)Austrian firms? Some further tentative results. *Small Business Economics*, 5 (1), 1-22
- Siqueira, P., Assis Shikida, P. F., Cardoso, B. F. (2017) Impact of mergers and acquisitions on the performance of the sugar and alcohol industry in Brazil. *Rivista di Economia Agraria*, 52 (2), 151-171. DOI: <https://dx.doi.org/10.13128/REA-22659>
- Smutka, L., Pawlak, K., Kotyza, P., Svatoš, M. (2018) Polish sugar industry development. *AGRIS on-line Papers in Economics and Informatics*, 10 (1), 71-90. DOI: <https://dx.doi.org/10.7160/aol.2018.100107>
- State Agricultural Intervention Fund (SZIF) (2018) Seznam příjemců dotací. [Online] Prague: State Agricultural Intervention Fund. Available at: https://www.szif.cz/en/list_of_beneficiaries [Accessed 25 June 2018].
- Statistics Poland (2018) Statistical Yearbook of Agriculture. [Online] Warsaw: Statistics Poland. Available at: <https://stat.gov.pl/en/topics/statistical-yearbooks/statistical-yearbooks/statistical-yearbook-of-agriculture-2017,6,12.html> [Accessed 25 June 2018].
- Svatoš, M., Maitah, M., Belova, A. (2013) World sugar market – basic development trends and tendencies. *AGRIS on-line Papers in Economics and Informatics*, 5 (2), 73-88.
- Špička, J. (2016) Market concentration and profitability of the grocery retailers in Central Europe. *Central European Business Review*, 5 (3), 5-24. DOI: <https://dx.doi.org/10.18267/j.cebr.155>
- Špička, J., Kontsevaya, S. R. (2016) Differences of financial management strategy of Central European and Russian milk processors. *AGRIS on-line Papers in Economics and Informatics*, 8 (1), 89-102. DOI: <https://dx.doi.org/10.7160/aol.2016.080109>
- U.S. Department of Agriculture (USDA) (2018) EU28 Sugar annual report. Post-Quota EU Back to Top 3 Sugar Export Position. [Online] Brussels: U.S. Mission to the European Union. Available at: https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Sugar%20Annual_Brussels%20USEU_EU-28_4-18-2018.pdf [Accessed 10 August 2018].
- Vásáry, V., Bartoň, P., Božik, M., Humpál, J. (2017) Implementation of the new CAP – a comparative analyses. In: Biro, S., Structural changes in agriculture since EU accession in Slovakia, the Czech Republic and Hungary. Budapest: Research Institute of Agricultural Economics, 35-50. DOI: <https://dx.doi.org/10.7896/ak1702>
- Wiltgen, T. J. (2007) An economic history of the United States sugar program. [Online] Bozeman: Montana State University. Available at: <https://scholarworks.montana.edu/xmlui/bitstream/handle/1/2554/WiltgenT1207.pdf> [Accessed 5 September 2018].
- Žekało, M. (2016) Produkcja, koszty i dochody z wybranych produktów rolniczych w latach 2014-2015 (wyniki rachunku symulacyjnego). Warsaw: IAFE-NRI.