STRUCTURAL CHANGES IN PRODUCTION OF ANIMALS FOR SLAUGHTER IN POLAND IN 2004–2014 ACROSS THE VOIVODESHIPS

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Abstract. The aim of this article is to analyze the changes in the structure of growth of animals for slaughter production in the Polish regions in the years 2004–2014, according to the sector of animals for slaughter using the classical shift share method. The study evaluates the rate of growth of volumes of animals for slaughter production. Furthermore, it identifies and estimates the share of structural and regional changes in the size of the effect of the global (total animals for slaughter production in Poland) in the regional breakdown.

Keywords: animals for slaughter, structural changes, Poland, voivodeship

INTRODUCTION

Agriculture is a specific economic sector where both the structure and volume of production strictly depend on natural conditions in the region concerned. The agricultural evolution is also largely affected by external determinants, specifically including those developed under the Common Agricultural Policy (CAP), findings of the World Trade Organization (WTO) and behavior of the raw material, product and capital markets (Kopiński, 2014).

The Polish meat market is heterogeneous and is among the key national agricultural markets. The production of slaughter livestock tends to fluctuate over time, depending on multiple factors, including meat consumption patterns and volumes, buying-in prices of slaughter livestock, and the level of retail prices for meat and meat products. In the slaughter livestock market, most of the processes are of periodical nature, mainly due to phases of the meat production cycle. For Poland, the last twenty-five years are a period of multiple changes resulting in a clear separation of the slaughter livestock market and the meat market which includes the pork livestock submarket, the bovine and veal livestock submarket and several other submarkets. The essential purpose of this paper is to analyze the changing volumes of slaughter livestock in Polish voivodeships from 2004 to 2014 by livestock species (bovine, poultry, pork) based on the classical shift share analysis. This paper evaluates the growth rate of slaughter livestock production volumes. Also, it identifies and estimates the share of structural and regional factors in the global effect by voivodeship.

MATERIAL AND METHODS

The slaughter livestock production structure was analyzed in all voivodeships and compared to the development of slaughter livestock production on a country-wide basis. Acquired from the Local Data Bank (Bank Danych Lokalnych, BDL) of the Central Statistical Office (Główny Urząd Statystyczny, GUS), data used in this study includes the slaughter livestock production

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volumes in specific voivodeships ($r = 1, \ldots, 16$) and the structural distribution thereof by slaughter livestock species ($i = 1, 2, 3$; bovine, pork and poultry livestock). The study is based on data from 2004 and 2014.

The shift share analysis (SSA) is a structural and geographical analysis introduced to the literature, in its classic form, by Dunn (1960) and Perloff et al. (1960). SSA allows to study and evaluate the development level of a specific region (voivodeship) compared to the development of a reference area (country). The evolution of the regional development of a specific aspect is assessed in the context of analyzed structural changes in the aspects concerned (Antczak, 2014; Grzybowska, 2013; Mayor and Lopez, 2008).

The classic shift share analysis evaluates the development of variable TX quantified as a compound of the absolute increment or development rate (Suchecki…, 2010; Trzpiot et al., 2013). The use of SSA in studying the development of a specific socio-economic aspect means decomposing the total change of the identified variable into three components (Tłuczak, 2015):

$$tx_{ri} = tx_{..} + \sum_i w_{r.(i)}\left(tx_{.i} - tx_{..}\right) + \sum_i w_{r.(i)}\left(tx_{ri} - tx_{.i}\right) (1)$$

with:

$$m = tx_{..} = \frac{\displaystyle\sum_{r=1}^{R}\sum_{i=1}^{S}\left(x_{ri}^{*} - x_{ri}\right)}{\displaystyle\sum_{r=1}^{R}\sum_{i=1}^{S} x_{ri}} - \text{national (global) share}$$

effect;

$$e_i = tx_{.i} - tx_{..} = \frac{\displaystyle\sum_{r=1}^{R}\left(x_{ri}^{*} - x_{ri}\right)}{\displaystyle\sum_{r=1}^{R} x_{ri}} - \frac{\displaystyle\sum_{r=1}^{R}\sum_{i=1}^{S}\left(x_{ri}^{*} - x_{ri}\right)}{\displaystyle\sum_{r=1}^{R}\sum_{i=1}^{S} x_{ri}} -$$

sectoral (structural) share effect;

$$u_{ri} = tx_{ri} - tx_{.i} = \frac{x_{ri}^{*} - x_{ri}}{x_{ri}} - \frac{\displaystyle\sum_{r=1}^{R}\left(x_{ri}^{*} - x_{ri}\right)}{\displaystyle\sum_{r=1}^{R} x_{ri}} - \text{local}$$

(geographic, competitive, differentiating) growth factor in sector i of region r;

$$w_{r.(i)} = \frac{x_{ri}}{x_{r.}} - \text{regional weights;}$$

x_{ri} – value of the analyzed variable in region r, in group i of the cross-sectional distribution in the initial period;

x^{*}_{ri} – value of the analyzed variable in region r, in group i of the cross-sectional distribution in the final period.

The result of rearranging equation (1) as follows (Szewczyk and Zygmunt, 2011):

$$tx_{ri} - tx_{..} = \sum_i w_{r.(i)}\left(tx_{.i} - tx_{..}\right) + \sum_i w_{r.(i)}\left(tx_{ri} - tx_{.i}\right) (2)$$

is the net regional growth ($tx_{ri} - t_{.}$) defined as the difference between the regional and the national growth rate.

The relationship expressed by equation (2) is referred to as structural and geographic equation, and the geographic distribution of the regional average growth rate's excess over national growth is decomposed into two effects:

- the structural effect: $s_r = \sum_i w_{r.(i)}\left(tx_{.i} - tx_{..}\right)$, which is the weighted arithmetic mean of deviations between the average growth rate in specific sectors and the national growth rate, and informs that the regions are differentiated by deviations in the distribution;

- the geographic effect: $g_r = \sum_i w_{r.(i)}\left(tx_{ri} - tx_{.i}\right)$, defined as the weighted arithmetic mean of regional deviations attributing the categories of the cross-sectional qualitative criterion to corresponding regions.

CHANGES TO THE SLAUGHTER LIVESTOCK PRODUCTION STRUCTURE IN POLAND

When comparing the growth/decline rates[1] of slaughter livestock production in specific voivodeships from 2004 to 2014 to the national average growth of livestock production (which is 40%), some regions may be identified that grew faster than the countrywide rate, namely the Lubuskie, Mazowieckie, Śląskie, Świętokrzyskie and Pomorskie voivodeships. In other voivodeships, the recorded development rates of slaughter livestock

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[1] The calculations were performed with the use of regional weights (meaning the share of the analyzed variable), individual cross-regional growth rates, and increments of livestock production volumes, in order to calculate the average values and to determine the total, structural and geographic effect.
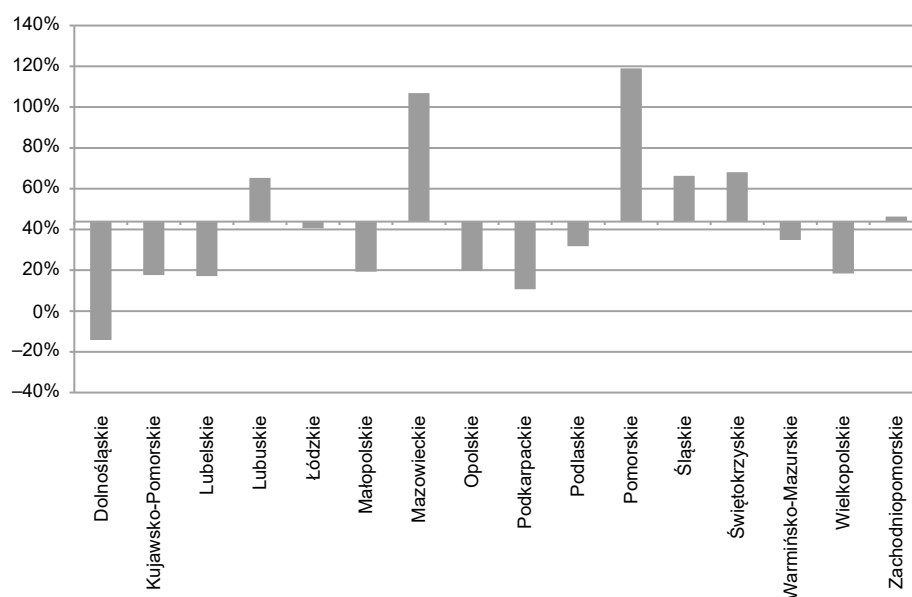
Fig. 1. The rate of changes in the value of animals for slaughter production in the Polish voivodeships in 2014 compared to 2004 (%)
Source: own elaboration.
Rys. 1. Tempo zmian wartości produkcji żywca rzeźnego w województwach Polski w 2014 r. w porównaniu z 2004 r. (%)
Źródło: opracowanie własne.

production were below the nationwide level (Fig. 1). The highest growth of slaughter livestock production was recorded in the Pomorskie voivodeship. In this case, the reason for the general growth was the more than three-fold increase in beef production and the poultry production volume which grew by as much as nine times (Fig. 1). On a countrywide basis, the poultry livestock production grew by around 73% from 2004 to 2014 as a consequence of favorable economic conditions and an assured outlet in EU countries[2]. The bovine livestock market turned out be the most stable one with a production development rate of 1.3%. In turn, the Dolnośląskie voivodeship recorded the biggest decline in livestock production volumes (–14.2%) among all regions due to decrease in pork production by nearly 71%.

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[2] Around 40% of the domestic poultry meat production is exported. The poultry sector has the greatest share in total exports of the food industry. Similarly, around 40% of egg production is exported. Poultry meat and eggs are exported mainly to EU countries, specifically including the Netherlands and Germany.

Table 1. The average rate of change in animals for slaughters production by sector in 2004–2014 (%)
Tabela 1. Przeciętne tempo zmian produkcji żywca rzeźnego według sektora w latach 2004–2014 (%)

Animals for slaughter Żywiec rzeźny	Rate of change Tempo zmian
Cattle – Wołowy	–1.3%
Pigs for slaughter – Wieprzowy	–39.7%
Poultry – Drobiowy	73.4%

Źródło: opracowanie własne.
Source: own elaboration.

In each voivodeship, the development of slaughter livestock production volumes could be caused by the changing production volumes of each livestock species and by the development of the internal competitive situation in the area concerned (geographic effects). In the Pomorskie voivodeship, the increase in slaughter

Table 2. Analysis of the structural and competitive changes in the size of production of the animals for slaughters in Poland by voivodeship in 2004–2014

Tabela 2. Analiza strukturalno-geograficzna zmian wielkości produkcji żywca rzeźnego w Polsce według województw w okresie 2004–2014

Voivodeship Województwo	Average rate Średnie tempo	Effect – Efekt		
		total całkowity	structural strukturalny	competitive geograficzny
Dolnośląskie	–14.2%	–75%	–14%	–61%
Kujawsko-Pomorskie	17.6%	6%	18%	–11%
Lubelskie	17.2%	5%	17%	–12%
Lubuskie	65.3%	60%	65%	–6%
Łódzkie	40.6%	45%	41%	4%
Małopolskie	19.2%	–3%	19%	–22%
Mazowieckie	106.8%	170%	107%	63%
Opolskie	19.7%	6%	20%	–14%
Podkarpackie	10.7%	–19%	11%	–30%
Podlaskie	31.7%	23%	32%	–9%
Pomorskie	119.0%	220%	119%	101%
Śląskie	66.3%	88%	66%	22%
Świętokrzyskie	68.0%	98%	68%	30%
Warmińsko-Mazurskie	34.9%	9%	35%	–26%
Wielkopolskie	18.4%	6%	18%	–12%
Zachodniopomorskie	46.3%	44%	46%	–2%

Source: own elaboration.
Źródło: opracowanie własne.

livestock production volume by 119% (i.e. around 220% above the national average growth rate) was caused by structural changes (with a share of 119%) and by internal developments related to competitiveness against other regions (with a share of 101%). In the Dolnośląskie voivodeship, the situation was reversed. The less-than-average (-75%) increase in slaughter livestock production volume was caused primarily by changes related to the competitiveness of livestock production. The Masovian voivodeship experienced substantial positive developments caused by favorable changes in the regional structure of slaughter livestock (107%). In that case, the geographic factor also played a major role (63%). All voivodeships, except for the Dolnośląskie voivodeship, experienced positive developments in livestock production volumes resulting from changes in the production structure. Meanwhile, the geographic (competitiveness) factor had the lowest impact in the Łódzkie voivodeship.

Table 3 and Figure 2 show the classification of Polish voivodeships by structural and geographic (competitive) effects. Three groups were identified because of the absence of negative structural effects and of positive competitive effects. The first group is composed of voivodeships where structural changes in slaughter livestock production had a positive effect on the increase of the total production volume of slaughter livestock (Pomorskie, Mazowieckie, Świętokrzyskie, Śląskie, Łódzkie). Compared to other regions, these voivodeships demonstrate higher growth dynamics of

Table 3. Classification of Polish voivodeships by positive and negative aggregated effects
Tabela 3. Klasyfikacja województw ze względu na pozytywne i negatywne efekty zmian

| Effects Efekty	Voivodeships Województwa	Number of voivodeships Liczba województw
Structural (+) competitive (+) Strukturalny (+) konkurencyjny (+)	Pomorskie, Mazowieckie, Świętokrzyskie, Śląskie, Łódzkie	5
Structural (+) competitive (–) Strukturalny (+) konkurencyjny (–)	Zachodniopomorskie, Lubuskie, Podlaskie, Kujawsko-Pomorskie, Wielkopolskie, Lubelskie, Małopolskie, Warmińsko-Mazurskie, Podkarpackie	10
Structural (–) competitive (–) Strukturalny (–) konkurencyjny (–)	Dolnośląskie	1

Source: own elaboration.
Źródło: opracowanie własne.
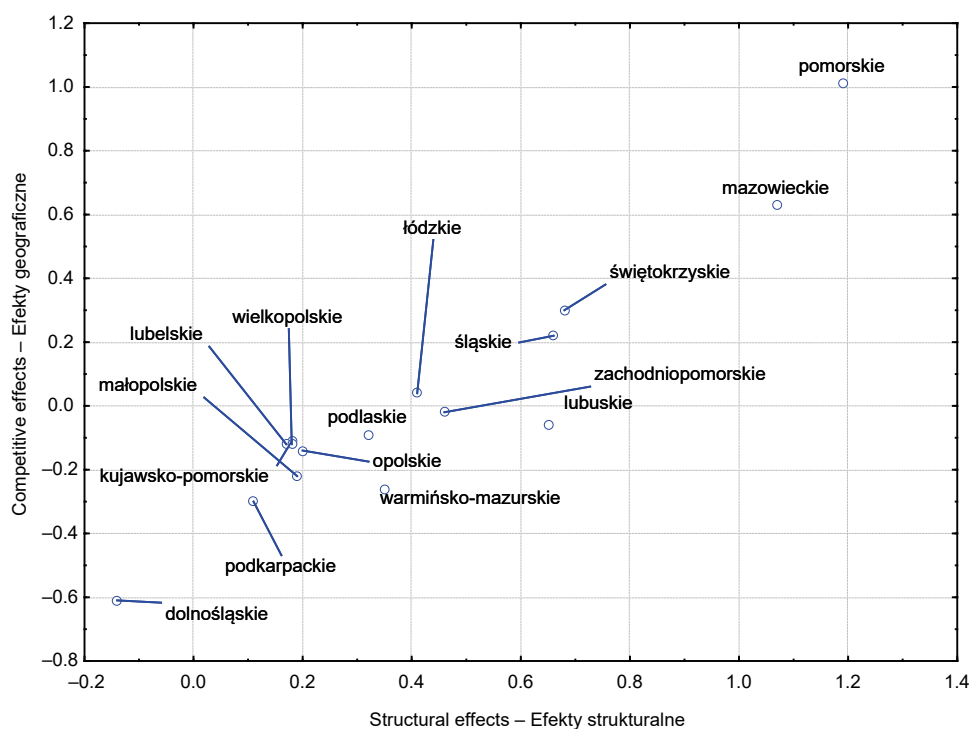
Fig. 2. The structural and competitive effects of the rate of production of animals for slaughter in Poland in 2004–2014
Source: own elaboration.
Rys. 2. Efekty strukturalne i geograficzne tempa zmian produkcji żywca rzeźnego w Polsce w latach 2004–2014
Źródło: opracowanie własne.

slaughter livestock production. The Pomorskie voivodeship stands out from this group as a region with extremely strong positive effects, both in structural and competitive terms. As regards the second group, all of the 10 included voivodeships demonstrate a positive value of the structural effect. Negative values of

competitive (geographic) effects indicate that changes inside the regions, related to gaining a competitive edge over other voivodeships, had an adverse impact on the development of slaughter livestock production volumes in these regions. In this group, the most beneficial developments took place in the Lubuskie voivodeship: the growth rate of slaughter livestock production was by 59.5% higher than the nationwide average, and was driven to a minimum extent by unfavorable changes in the regional structure of slaughter livestock production (−5.7%). This group also includes two other voivodeships (Małopolskie and Podkarpackie) where negative rates (compared to the nationwide average development rate) of slaughter livestock production growth were recorded. These changes were mainly caused by significant unfavorable internal developments related to competitiveness over other regions.

SUMMARY

This paper focused on analyzing the changes to the slaughter livestock production structure. As the analysis of slaughter livestock production presented in this paper is definitely not exhaustive, what also should be taken into account is the existence of multi-directional spatial relationships between the regions concerned. This is because each of the analyzed regions has specific features which, in turn, affect the regional potential and the nature of local agricultural activities. With the potential existing in the region, the right orientation of agricultural production may result in high incomes for farmers. Often costly, production reorientation could be a way to avoid additional expenditure.

According to studies, the differences in development rates of the analyzed slaughter livestock production (by species) in specific voivodeships are primarily caused by the competitive position of the region concerned, while the changes in the slaughter livestock production structure are a factor of minor importance. The Pomorskie and Dolnośląskie voivodeships clearly stand out from the group under consideration. The first one experienced a growth rate of slaughter livestock production above the average countrywide rate. This was caused by favorable changes in the slaughter livestock production structure and by the evolving competitive position of this voivodeship over other regions. Meanwhile, the Dolnośląskie voivodeship experienced the lowest

development rate compared to the countrywide average figures.

Based on the results, it may be concluded that the volume and nature of slaughter livestock production is largely affected by the general condition of the national agriculture sector. This situation broadly depends on the principles adopted under the Common Agricultural Policy which is applicable to all member countries.

REFERENCES

Antczak, E. (2014). Analiza zanieczyszczenia powietrza w Polsce z wykorzystaniem przestrzennej dynamicznej metody przesunięć udziałów. Ekon. Środ., 2(49), 191–209.

Dunn, E. S. (1960). A Statistical and Analytical Technique for Regional Analysis. Paper. Proceed. Region. Sci. Assoc., 6, 98–112.

Grzybowska, B. (2013). Przestrzenna koncentracja potencjału innowacyjnego w przemyśle spożywczym. Rocz. Ekon. Roln. Rozw. Obsz. Wiej., 100(2), 53–64.

Kopiński, J. (2014). Trendy zmian głównych kierunków produkcji zwierzęcej w Polsce w okresie członkostwa w UE. Prace Nauk. Uniw. Ekon. Wroc., 361, 116–128.

Mayor, M., Lopez, A. J. (2008). Spatial shift-share analysis versus spatial filtering: an application to Spanish employment data. Empir. Econ., 34(1), 123–142.

Perloff, H. S., Dunn, E. S., Lampard, E. E., Muth, R. F. (1960) Regions, resources and economic growth. Baltimore: Johns Hopkins Press.

Suchecki, B. (Ed.). (2010). Ekonometria przestrzenna. Metody i modele analizy danych przestrzennych. Warszawa: C. H. Beck.

Szewczyk, M., Zygmunt, A. (2011). Opolskie Voivodship: perspectives of the mining and quarrying sector. In: K. Malik (Ed.), Regional and local development: Capitals and drivers (p. 199–218). Katowice–Opole: Faculty Economy and Management of the Opole University of Technology, Self-Government of the Opole Voivodeship, Committee of Spatial Economy and Regional Planning of the Polish Academy of Sciences, Committee Organization and Management Sciences of the Polish Academy of Sciences.

Tłuczak, A. (2015). Przestrzenna metoda przesunięć udziałów w ocenie zróżnicowania produkcji zwierzęcej w Polsce. Metody Iloś. Bad. Ekon., XVI(4), 171–180.

Trzpiot, G., Ojrzyńska, A., Szołtysek, J., Twaróg, S. (2013). Wykorzystanie shift share analysis w opisie zmian struktury honorowych dawców krwi w Polsce. Wielowymiarowe modelowanie i analiza ryzyka (p. 84–98). Katowice: UE Katowice.

ZMIANY STRUKTURALNE W PRODUKCJI ŻYWCA RZEŹNEGO W POLSCE W LATACH 2004–2014 W PRZEKROJU WOJEWÓDZTW

Streszczenie. Celem artykułu jest określenie zmian struktury oraz tempa wzrostu produkcji żywca rzeźnego w województwach Polski w latach 2004–2014 według gatunków, z zastosowaniem klasycznej metody przesunięć udziałów. Ponadto zidentyfikowano i oszacowano udział czynników strukturalnych oraz regionalnych w wielkości efektu globalnego (produkcji żywca rzeźnego w Polsce ogółem) w przekroju województw. Na podstawie wyników badań wykazano, że zróżnicowanie tempa zmian produkcji żywca rzeźnego związane jest przede wszystkim z pozycją konkurencyjną regionu, a w mniejszym stopniu zależne od zmian struktury produkcji.

Słowa kluczowe: produkcja żywca rzeźnego, zmiany strukturalne, Polska, województwa