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Global Challenges and Policies of the European Union
– Consequences for the "New Member States"

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THE INFLUENCE OF THE INTEGRATION WITH THE EUROPEAN UNION ON CENTRAL AND EASTERN EUROPEAN COUNTRIES' AGRICULTURAL PRODUCTIVITY

1. Introduction

The role of agriculture in national economies cannot be neglected. As it is stressed in literature [Czyżewski 2000; Timmer 1990] there are many links between agriculture and other economic sectors. Thus the effectiveness of national economies is partly influenced by the productivity of agriculture.

Central and Eastern European countries tend to differ significantly in terms of agricultural productivity [Baer-Nawrocka, Kiryluk-Dryjska 2006]. However, it should be emphasized that many problems inherited from centrally planned system are still shared by the economies of these countries. Despite ongoing transition, the production structure of agriculture of these countries is still determined by the historical and political circumstances, inherited ownership structure, resource endowments, and reform pace [Trzeciak-Duval 1999]. Joining the EU and operating on its market enforced the changes in agricultural structures where the effectiveness in compliance with competitiveness gained importance. The pace of these changes will strongly determine the competitiveness of agriculture of these countries on the EU and on the global market in the future.

The objective of the article is to illustrate and compare changes in agricultural productivity of CEECs between 2002 (pre-accession period) and 2008 (post-accession period). In most studies [Poczta 2003] in order to assess the productivity of agriculture, partial effectiveness of particular production factors is calculated. In agricultural sector the labour, land and capital are the main production factors, thus

the agricultural production is a result of synergy of those three components in the production process.

2. Methodology

To assess and compare the productivity of agriculture in different CEECs the synthetic coefficient of partial productivities has been calculated using Hellwig method [Hellwig 1968]. The construction of this coefficient requests arranging the population of m units (analyzed countries) Q_i (i = 1, ..., m) characterized by k partial variables (indexes) x_1, ..., x_k in the following steps:

1) choice of diagnostic features,
2) normalization of diagnostic features,
3) weight determination for diagnostic features,
4) calculation of synthetic coefficient,
5) delimitation of groups.

Step 1) choice of diagnostic features. The synthetic coefficient is based on simple features that directly determine the characteristics of analyzed units. The diagnostic features used in the analysis are illustrated by the following indexes:

- agricultural production/1 ha of UAA (utilized arable area),
- agricultural production/AWU (annual work unit),[1]
- agricultural production/total assets value.[2]

The selected values of features for different units were inserted in the matrix [Wysocki 1996]:

$$\mathbf{X} = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1K} \\ x_{21} & x_{22} & \dots & x_{2K} \\ \dots & \dots & \dots & \dots \\ x_{N1} & x_{N2} & \dots & x_{NK} \end{bmatrix},$$

where x_{ik} (i = 1, 2, ..., N; k = 1, 2, ..., K) stands for the value of k simple feature of statistical unit numbered i. The matrix constitutes a base to construct a synthetic coefficient.

Step 2) normalization of diagnostic features. The aim of the normalization is to standardize the features by converting destimulants and nominates into stimulants and assuring the comparability of features [Wysocki, Lira 2003]. In our case all selected diagnostic features were stimulants, which means that they are positively correlated with the synthetic feature. Thus, a direct move towards standardization was possible.

[1] Annual Work Unit corresponds to the work performed by one person who is occupied in an agricultural holding on a full-time basis. In most EU countries there are 2200 hours per year.

[2] The sum of intermediate consumption (all fixed and variable costs that are necessary for agricultural activity) and depreciation (calculated on the basis of replacement of fixed assets value).

Step 3) weight determination for diagnostic features. It was assumed that the degree of influence of particular diagnostic features on synthetic one was equal, thus identical weights were determined for all features.

Step 4) calculation of synthetic coefficient. There are two main groups of methods used to calculate the synthetic coefficient: model-method and non-model-method [Grabiński 1988; Guzik 1989; Wysocki 1996]. The former one was used in this paper. The idea behind the model-method is to calculate the difference between normalized values of diagnostic features and so-called model (optimal) unit-value:

$$\overline{q}_i^{(2)} = \sqrt{\frac{\sum_{k=1}^{K}(z_{ik} - z_{0k})^2}{K}} \quad (i = 1, 2, ..., K),$$

where z_{0k} is normalized value of k-feature for a model unit. Model unit may be demonstrated as a vector $z = (z_{01}, z_{02}, ..., z_{0k})'$. In most analysis $z_{0k} = \max_i \{z_{ik}\}$ for k-diagnostic feature being stimulant.

The obtained values q were used to calculate the synthetic coefficient of development

$$\tilde{q}_i = 1 - \frac{q_i^{(2)}}{q_0},$$

where: $q_0 = \overline{q}_0 \cdot s_0$,

$$\overline{q}_0 = \frac{\sum_{i=1}^{N} q_i^{(2)}}{N},$$

$$s_0 = \sqrt{\frac{\sum_{i=1}^{N}(q_i^{(2)} - \overline{q}_0)^2}{N}}.$$

Synthetic Hellwig's coefficient of development q in most of the cases is in the range (1,0). The magnitude of values is related to the high productivity of agriculture.

Step 5) delimitation of groups. The method resulted in ranging analyzed countries according to synthetic agricultural production value. The values of synthetic coefficients were arranged from the highest to the lowest in order to delimit the categories of units. The analyzed units – countries – were separated into four groups using arithmetic mean q and standard deviation s:

Group I $q_i \geq \overline{q} + s_q$,

Group II $\overline{q} + s_q > q_i \geq \overline{q}$,

Group III $\overline{q} > q_i \geq \overline{q} - s_q$,

Group IV $q_i < \overline{q} - s_q$.

The two classifications of countries (based on 2002 and 2008 data) according to indexes of productivity were in the last section compared and analysed.

3. Results

Table 1 presents partial productivities of agriculture of analyzed countries in 2002 (pre-accession) and 2008 (post-accession period). In order to assess differentiation of the productivity of production factors among countries, values of synthetic coefficients of productivity q_i, were calculated using Hellwig method. Afterwards values of these coefficients were arranged from the highest to the lowest and countries were classified into fourth categories into the categories shown in Table 2.

Table 1. Productivity of resources of production factors in UE member countries from Central and Eastern Europe in 2002 and 2008 (basic prices)

Countries	Agriculture production (million euro)			Productivity (euro)								
				Agriculture production/ /1 ha of UAA			Agriculture production/AWU			Agriculture production/total assets value		
	2002	2008	change 2008/2002 (%)	2002	2008	change 2008/2002 (%)	2002	2008	change 2008/2002 (%)	2002	2008	change 2008/2002 (%)
Bulgaria	3050.8	4098.3	34.3	895.8	789.6	–11.9	3853.9	9291.0	141.1	1.4	1.8	28.4
Czech Republic	3281.0	4648.1	41.7	767.8	1303.4	69.8	23008.4	34354.0	49.3	1.2	1.3	4.9
Estonia	400.0	601.8	50.5	449.4	789.8	75.7	6269.6	19284.6	207.6	1.2	1.3	4.4
Hungary	5890.0	7479.6	27.0	1003.9	1287.6	28.3	9255.2	17248.8	86.4	1.3	1.5	10.4
Latvia	531.0	951.4	79.2	214.6	512.6	138.8	2737.1	9507.4	247.4	1.4	1.2	–15.8
Lithuania	1049.0	2141.8	104.2	300.8	767.4	155.1	7284.7	22761.1	212.4	1.2	1.4	18.2
Poland	13059.0	21637.2	65.7	772.8	1335.6	72.8	5791.6	9210.0	59.0	1.4	1.6	18.9
Romania	10100.7	17035.9	68.7	644.4	1206.8	87.3	3653.1	7916.3	116.7	1.7	1.6	–6.9
Slovakia	1507.0	2327.4	54.4	619.4	1200.3	93.8	11416.7	27381.1	139.8	1.1	1.3	21.8
Slovenia	1062.0	1173.8	10.5	2103.0	2390.7	13.7	10018.9	14110.9	40.8	1.4	1.3	–10.6

Source: own calculations on the basis of *Economic Accounts for Agriculture Data*.

Table 2. Delimitation of groups

	2002	2008	Productivity level
Group I	$q_i \geq 0.379$	$q_i \geq 0.342$	high
Group II	$0.379 > q_i \geq 0.253$	$0.342 > q_i \geq 0.255$	medium
Group III	$0.253 > q_i \geq 0.126$	$0.255 > q_i \geq 0.168$	low
Group IV	$q_i < 0.126$	$q_i < 0.168$	very low

Source: own elaboration on the basis of Table 1.

Table 3. Differentiation of productivity level of land, labour and capital in UE member countries from Central and Eastern Europe in 2002 and 2008

Countries	Value of synthetic coefficient		Category		
	2002	2008	2002	2008	change 2008/2002
Slovenia	0.529	0.315	I	II	↓
Hungary	0.349	0.355	II	I	↑
Czech Republic	0.348	0.338	II	II	=
Romania	0.271	0.248	II	III	↓
Bulgaria	0.263	0.195	II	III	↓
Poland	0.262	0.305	II	II	=
Slovakia	0.147	0.327	III	II	↑
Estonia	0.143	0.154	III	III	=
Lithuania	0.110	0.245	IV	III	↑
Latvia	0.107	0.070	IV	IV	=

Source: own calculations on the basis of Table 1.

The results of classification are presented in Table 3 and Figure 1. In 2002 the highest productivity of production factors (first category of countries) concerned Slovenia. Agriculture in this country was featured mainly by relatively high land productivity. The relatively lower position of Slovenia in 2008 in comparison with 2002 is due to the lowest increase in agricultural production value (10.5%) among analysed countries. It should be emphasized that the growth of production value may be observed in all countries in the analyzed period[3] mainly because of the prices convergence for agricultural product and increase in product subsidy after the accession. Chaplin et al. [2004] assume that Slovenia was the only among analyzed countries where before the accession the support for farmers was at the highest level like in EU-15 countries. Thus, it may be concluded that the accession to the EU did not strongly influence the changes of production structures in

[3] The authors realize that the most accurate way to measure changes in volume from one year to another is to use the values at constant prices expressed in relation to the reference year, however, the calculation of synthetic coefficient of partial productivities may be based on the production values at basic prices.

Slovenian agriculture. In Slovenia, as well as in Poland, family farms had already been the predominant farm type prior to transition and as a result far less farm restructuring took place in these countries in comparison with the other CEEC [Lerman et al. 2002]. However, fragmented agricultural holdings' territorial structure negatively influenced the flow of labour out of agriculture. In consequence the process of reduction of agricultural labour force is very slow in Slovenia and Poland. The proportion of employed in agriculture in national economy is about 10 and 16% respectively [Baer-Nawrocka 2008].

In 2008 the group with the highest value of synthetic coefficient consisted Hungary. This country moved from the second to the first delimination group mostly because of both labour and total assets value productivity growth. The labour productivity growth is also a result of 33% decline of the number of AWU in analyzed period – from 646.7 to 433.6 thousand of AWU [*Economic Accounts for Agriculture* data base]. Hungarian agriculture is featured by comparatively high land productivity which amounts to 1000 euro per 1 ha of UAA.

The second group in pre and post-accession period consists of the Czech Republic and Poland – countries with medium values of synthetic coefficient of partial productivity. In Polish agriculture low labour productivity constitutes the main disadvantage – one person employed in agriculture (in AWU) generates one of the lowest values of production which amounts to 9210 euro. Almost four-time higher labour productivity is reached in the Czech Republic (34 354 euro) which gained the best result among all analyzed countries. Relatively high labour productivity (27 381 euro per one AWU in 2008) is also observed in Slovak agriculture, which moved from the third group in 2002 to the second cluster of countries in 2008. According to M. Schiff and C.E. Montenegro [1997] and also *Study on employment in rural areas* [2006] in the Czech Republic and Slovakia there was a significant slump in agricultural employment in the early 1990s, with annual average change rates of 10-30%, coinciding with the consolidation of large scale farm structures and the release of non-family labour. Moreover, the labour force in agriculture of these countries is still declining, in analysed period the employment share in agriculture dropped by 11% in the Czech Republic and by 35% in Slovakia. According to Poczta [1994] labour productivity index is in general more important than land productivity, while the sense of economic growth derives from achieving by a worker more with available resources. The effective usage of labour resources leads to the decrease of costs, greater supply of cheaper products, and the growth of buying potential of society, what enhances the competitiveness of economy. Z. Ziętara [2003] emphasized that labour effectiveness is a key factor determining the level of economic growth of the society and the main reason of wealth differentiation between sectors and economies.

In 2008 the third group of countries consisted of Romania, Bulgaria, Estonia and Lithuania, which were characterized by relatively low productivity level of production

factors. In Lithuania, which shifted from the fourth group in 2002, the value of agricultural production increased the most – above two times – which is indirectly influenced by the high increase of partial effectiveness of production factors. It is worth emphasizing that the growth of labour productivity is the result of the significant reduction (above 50%) in AWU number, too [*Economic Accounts for Agriculture* data base]. As J. Mačiulytė [2008] states the decline of overpopulation in Lithuanian agriculture was influenced by the opening of labour market in Western European countries. The emergence of small family farms through the land privatisation process, migration from urban to rural areas and (semi-)subsistence agriculture acting as "social buffer" determined the lowest labour productivity in Bulgaria and Romania, which dropped from the third to the fourth group in 2008.

Latvia was set in the fourth category of countries with relatively less favourite productivity of agriculture in both pre- and post-accession periods.

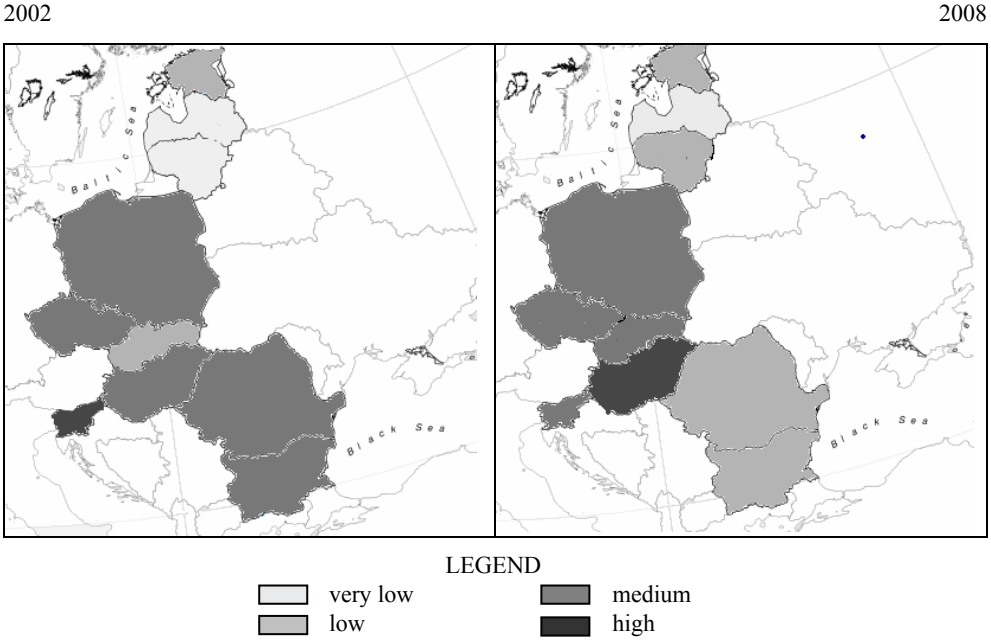

Figure 1. Differentiation of productivity level of land, labour and capital in the new UE member countries from Central and Eastern Europe in 2002 and 2008.

Source: own elaboration on the basis of Table 3.

4. Conclusions

Since the beginning of the transformation academics and policy makers have been interested in relative efficiency of farming in Central and Eastern European

countries [Gordon, Davidova 2004]. This interest has been stimulated by the desire to assess the impact of the EU integration on agriculture of CEECs. Competitiveness on EU market is determined by the level of efficiency of production factors. In conditions of growing international interdependence, joining of regional unions is considered as an effective measure to enhance the competitiveness of economy and prepare to act on a global market [Puślecki (ed.), 2002]. The production potential of agriculture depends on labour, land, capital and appropriateness of relations between them. These factors are the cornerstone of effective agricultural production. The analysis conducted in this paper proves that the growth of agriculture productivity indexes may be observed in all analyzed countries. The recent changes in agriculture of analyzed countries: farm restructuring, modernization of agricultural holdings, reduction of employment in agriculture and downsizing the number of farms in CEECs for sure positively influenced the rationalization of production factors relations, and in consequence enhanced the agricultural productivity. However, there are some relative changes in the pace of productivity growth among analysed countries. The situation of Slovenia, Romania and Bulgaria relatively deteriorated from 2002 to 2008. The changes in agricultural structures stimulated by the accession to the EU have been more visible in Hungary, Slovakia and Lithuania – these countries reached a relatively higher position. The position of the Czech Republic, Poland, Estonia and Latvia has not changed. The different pace of productivity growth may lead to the discrepancies in competitiveness of agricultural sector of these countries what might affect their national economies.

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