STOWARZYSZENIE EKONOMISTÓW ROLNICTWA I AGROBIZNESU
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CHANGE OF LABOUR PRODUCTIVITY ON FARMS IN EUROPEAN UNION MEMBER COUNTRIES (2004-2011)[1]

ZMIANY WYDAJNOŚCI PRACY W GOSPODARSTWACH ROLNYCH W KRAJACH CZŁONKOWSKICH UNII EUROPEJSKIEJ (2004-2011)

Key words: agriculture, technical supply, efficiency, competitiveness, disadvantage
Słowa kluczowe: rolnictwo, techniczne zaplecze, wydajność, konkurencyjność, wady

Abstract. In 2004, eight Central and Eastern European countries joined the European Union. Their agriculture was significantly behind the majority of the 15 former EU member countries both from technical and productivity perspectives. In the common market the competitiveness of products and producers is a key factor. One important factor of competitiveness is labour productivity, which can be divided into partial factors such as technical equipment (tools) and the resulting productivity from those tools. The study examines the changes of these two partial productivity factors in Poland and Hungary as well as the countries integrated in 2004. The research question was whether the Central and Eastern European countries were able to shorten the gap behind EU-15 countries. The results indicate that over the course of a decade labour productivity in Hungarian farms increased, however, the pace of farm investments lagged far behind the EU-15 countries, resulting in more efficient capital use. The rate of Polish farm investments in agriculture was higher than that of the EU-15 countries, while the relative disadvantage in labour productivity, as well as in capital productivity did not decrease.

Introduction

One of the key factors of competitiveness in agriculture is how efficiently it can use available resources and how their level (both in terms of quantity and quality) is related to that of competitors [Vásáry 2012, Vásáry et al. 2013]. In respect to technology, Hungarian agriculture caught up with the leading edge of world agriculture before the post-socialist transition. The „Americanized" production model operated with large plots, high utilization indices, a high-performance but mixed technical level. The equipment was both modern (imported mainly from Western Europe and North America) as well as obsolete but cheap (mostly Eastern European). Though this production model fit into the large-scale farm model, its structure included several problems. Due to the transformed farm structure following post-socialist transition, small and medium-scale farms created by land privatization started their production (in the case of asset-intensive technologies) either without any equipment or with high-performance equipment inherited from large-scale farms, the efficient utilisation of which became impossible. Starting from 1993, sectoral policy has given high priority to the fulfilment of capacity needs, aiming to develop an asset system in composition and performance which fits into the new farm structure [Takács 2002].

Polish agriculture was built on private ownership even in the decades before post-socialist transition and it was rather advantageous in regard to farm structure in the 1990s. The actual impetus to the development of the Polish agriculture, however, was given by European Union accession.

As a result of innovation activities going on in recent decades in agricultural machinery production all over the world [Husti 1998], high-performance machinery has prevailed in the supply of marketed products. However, trend-like processes such as the reduction of environmental load, the emergence of soil-protecting technologies, the improvement of production quality and the expansion of sustainable development theories [Magó 2006], as well as new technical pos-

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sibilities (for example the wide-range availability of geographical positioning which enabled the implementation of precision crop farming) [Takácsné György 2012, Barkaszi, Takács-György 2007, Takács-György 2007] have all increased the supply of new technical and technological solutions. These are relatively expensive solutions, therefore the value of assets in agriculture has grown substantially, however they can only give a return at higher levels of utilisation and efficient asset use [Erdeiné Késmárki-Gally 2008].

The relations between technical progress and economic growth can be examined by quantifying the key factors of productivity (productivity of labour and assets, that is the productivity of capital manifested in technical equipment and assets).A widely used method for this is the calculation of partial efficiency. This approach determines the change of labour as a function of asset supply (technical equipment) and the productivity of capital, as a product of their multiplication. The inter-company or international comparison of the partial efficiency index clearly shows the differences in productivity factors [Késmárki-Gally 2006].

Material and methods

The data for the examination of factors determining the productivity of labour come from the FADN database of the European Union. The research covered the period of 2004-2011 (since consistent data was available for this period). There were data for 25 countries until 2007 and for 27 countries from 2007. The averages of 25 countries were used as a benchmark in the research, disregarding the data of Romania and Bulgaria. As regards the countries accessed in 2004, the data of Malta and Cyprus were left out because their economic development in the past and the role of agriculture in both countries are considerably different to the other countries.

The classification of farms was made according to the economic size unit and the production line. The farms could be classified into 6 groups on the basis of the European size unit (according to the methodology of the European Union): (1) 2000 – < 8000 EUR, (2) 8000 – < 25 000 EUR, (3) 25 000 – < 50 000 EUR, (4) 50 000 – < 100 000 EUR, (5) 100 000 – < 500 000 EUR, (6) >= 500 000 EUR). The production line included field crop production, horticulture, vineyards and wineries (wine), other permanent crops, milk production, other grazing livestock, granivores and mixed farms. The following standard variables from the database were used: the number of represented farms, average annual labour use, gross production value, total assets and invested assets. There were 11169 data available per variable for the research.

The partial efficiency analysis was made for EU-10 (8) countries (countries which joined the EU in 2004 excluding Malta and Cyprus), EU-15 countries (member countries of the EU before the accession in 2004) and EU-25 countries. The function used for the analysis of partial efficiency is as follows:

$$\frac{y}{L} = \frac{y}{K} \cdot \frac{K}{L}$$ where: $\frac{y}{L}$ = is labour productivity [currency unit/annual work unit], [EUR/AWU]; $\frac{y}{K}$ = capital productivity [currency unit/currency unit], [EUR/EUR]; $\frac{K}{L}$ = technical equipment [currency unit/annual work unit], [EUR/AWU].

The following data were used from the FADN database for the calculation of partial efficiency: gross production value (the title of the variable in the database: SE131-Total output-c.u.); total annual labour use (SE010-Total labour input-AWU); value of machinery (SE455-machinery-c.u.). Note: instead of the fixed assets (SE441-Total fixed assets-c.u.) variable machinery use was applied because in some countries the land and the value of quotas have a substantial share, therefore these would distort the results of asset capital efficiency analysis (Tab. 1).

In the depiction, iso-productivity curves help to identify the inner components of productivity change (Fig. 1). If two points are located on the same iso-productivity curve, it means that labour productivity is unchanged, while technical equipment and capital productivity change in the opposite direction. With the aim of reducing „rambling" of factor values, the average values of years between 2004-2006 and 2009-2011 are compared in order to present the change tendency of partial efficiency factors.

Table 1. Breakdown of non-current assets and share of machinery according to production line in EU countries, in 2011
Tabela 1. Podział aktywów trwałych oraz udział maszyn według linii produkcyjnej w krajach UE, w 2011 roku

Country/*Kraj*	Fixed asset supply compared to the average of EU-25/ *Podaż środka trwałego w stosunku do średniej UE-25*	Share of fixed assets in total assets/*Udział aktywów trwałych w aktywach ogółem*	Land, plantation and quotes *Ziemia, plantacje i kwoty*	Buildings/ *Budynki*	Machinery/ *Maszyny*	Breeding stock/ *Zwierzęta hodowlane*
Hungary/*Węgry*	30.2	61.8	42.4	26.0	27.0	4.6
Poland/*Polska*	41.7	87.8	56.3	25.1	16.3	2.4
EU/*UE*-15	120.6	79.1	70.5	14.2	11.2	4.1
EU/*UE*-10(8)	25.1	80.4	45.5	30.7	19.6	4.2
EU/*UE*-25	100.0	79.5	68.2	15.6	12.2	4.0

Share of machinery in total non-current assets/*Udział maszyn w całości aktywów trwałych [%]*								
Country/*Kraj*	field crops/ *uprawy polowe*	horticulture/ *ogrodnictwo*	wine/ *wino*	other permanent crops/ *inne uprawy trwałe*	milk/ *mleko*	other grazing livestock/*inne trawożerne*	granivores/ *ziarnożerne*	mixed/ *mieszane*
Hungary/*Węgry*	31.0	16.4	21.8	15.1	21.5	18.2	26.1	28.0
Poland/*Polska*	17.5	19.9	-	16.2	18.7	12.4	18.3	13.6
EU/*UE*-15	11.5	21.4	13.3	14.3	11.9	12.7	10.0	13.2
EU/*UE*-10(8)	37.3	21.4	20.2	19.4	25.6	24.4	32.1	31.8
EU/*UE*-25	13.7	18.5	13.8	11.5	13.7	13.1	16.0	15.5

Source: own study based on FADN
Źródło: opracowanie własne na podstawie FADN

Results

During the decade following the EU accession of Central-Eastern European countries, annual labour input declined by 199000 people in Hungary, 43000 people in Poland, and altogether by 405000 people in Central-Eastern European countries, while in the old member states of the EU it decreased by a further 516 thousand people (Tab. 2). During the examined period, output increased all over the EU, and the countries which integrated in 2004 had an outstanding performance (39% growth). The value of machinery stock within fixed assets substantially increased both in regard to the European Union and the group of countries accessing in 2004, although within this the value of machinery stock in Hungary declined significantly, while the same value increased markedly in Poland. The output growth and the parallel decline in labour use predicts the increase of labour productivity. Typically there is a moderate or strong statistical relation between the partial factors of productivity during the examined period. In the case of the EU-10(8) country group the value of the correlation coefficient was -0.521 between labour input and output; -0.700 between labour use and machine asset value; while in the case of the EU-25 country group it was -0.612 between labour input and output, 0.857 between machine asset value and output; while it was -0.815

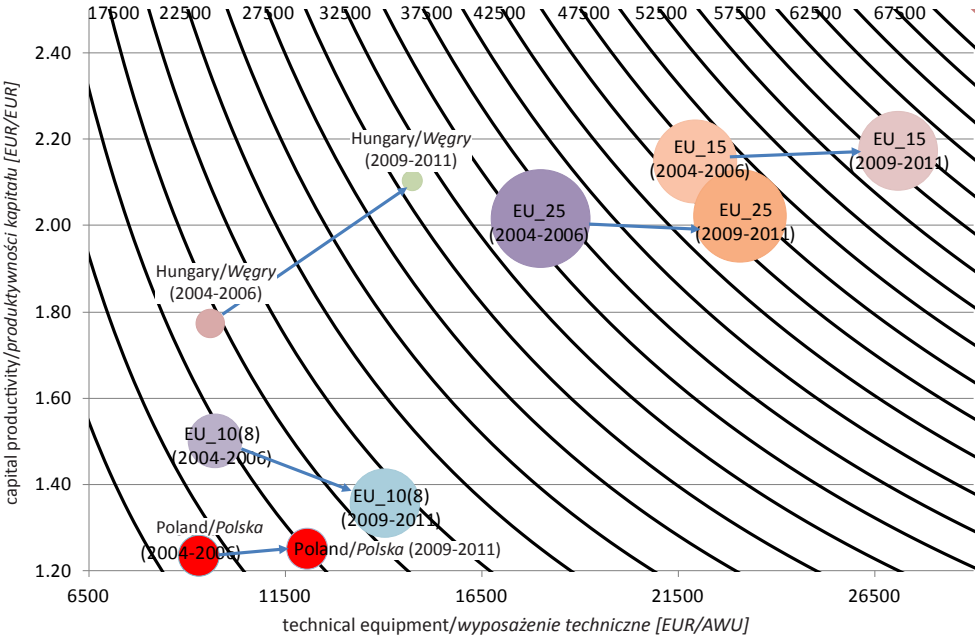

Figure 1. Change of labour productivity in EU country groups and Hungary in relation to partial efficiency components (technical equipment and capital efficiency), 2004-2011
Rysunek 1. Zmiana wydajności pracy w grupach krajów UE i na Węgrzech w odniesieniu do efektywności (częściowych elementów wyposażenia technicznego i efektywności kapitału), 2004-2011
Note: the area of marking is proportionate to the number of farms belonging to each group*/obszar oznaczania jest proporcjonalny do liczby gospodarstw należących do danej grupy*
Source: own study based on FADN
Źródło: opracowanie własne na podstawie FADN

between labour use and machine asset value. By analysing the change in productivity (Fig. 1) it can be concluded that EU-25 countries, owing to the EU-15 countries, have achieved substantial labour productivity growth, realized at an essentially permanent capital productivity. The change can be due to the expansion of technical equipment (machinery stock). In all the countries which accessed in 2004, labour productivity increased slightly. This was a result of declining capital productivity and increasing technical equipment. There are significant differences within the country group which is also indicated by the fact that the capital productivity of Hungary approached the average of EU-15 countries but was only about one-third of their labour productivity due to less technical equipment. Labour productivity improved in Poland, too, but it resulted primarily from increasing technical equipment and substantial investments in the agricultural sector.

The productivity of labour increased if the economic size unit grew (Tab. 3). By relating the figures to the change of technical equipment, it can be concluded that the smaller farms have a relatively higher equipment supply (compared to output), thus their capital productivity (asset efficiency) is lower than that of larger holdings. It can also be stated that capital productivity generally improved in the size categories. The growth was outstanding in the smaller economic size categories, approaching the average of farms in the larger size categories. Though the labour productivity of size category (5) and (6) is basically the same, the average of category (6) production is achieved with less technical equipment and higher capital productivity, which indicates better competitiveness.

Table 2. Annual labour input, annual output and machine asset value in 2011, average annual change between 2004 and 2011

Table 2. Roczny nakład prac, produkcja i wartość aktywów maszyna w 2011 roku, średnia roczna zmiana w latach 2004 i 2011

Country/*Kraj*	Annual labour input in 2011/*Roczny nakład pracy w 2011 r.*	Average annual change (slope of linear trend)/*Średnia roczna zmiana (nachylenie trendu liniowego)*	Change/*Zmiana* (2011/2004)	
	1000 ÉME	1000 ÉME	1000 ÉME	%
Hungary/*Węgry*	156.0	-33.49	-198.5	-56.0
Poland/*Polska*	1248.1	-9.68	-43.2	-3.3
EU/UE-15	4120.7	-92.95	-516.4	-11.1
EU/UE-10(8)	1767.3	-70.18	-404.6	-18.6
EU/UE-25	5907.5	-163.85	-925.6	-13.5
	annual output in 2011/ *roczna produkcja w 2011 r.*	average annual change (slope of linear trend)/*średnia roczna zmiana (nachylenie trendu liniowego)*	change/*zmiana* (2011/2004)	
	1000 EUR	1000 EUR	1000 EUR	%
Hungary/*Węgry*	6 427	-62.29	48.3	0.8
Poland/*Polska*	21 160	876.59	7367.4	53.4
EU/UE-15	263 806	5733.97	49 778.6	23.3
EU/UE-10(8)	39 358	1197.80	11 017.2	38.9
EU/UE-25	303 631	6924.61	60 751.4	25.0
	machine asset value in 2011/*wartość aktywów maszyn w 2011 r.*	average annual change (slope of linear trend)/*średnia roczna zmiana (nachylenie trendu liniowego)*	change/*zmiana* (2011/2004)	
	1000 EUR	1000 EUR	1000 EUR	%
Hungary/*Węgry*	2 601	-172.07	-1401.9	-35.0
Poland/*Polska*	15 480	602.92	4071.6	35.7
EU/UE-15	115 826	2191.85	16 949.6	17.1
EU/UE-10(8)	26 199	867.20	6009.7	54.2
EU/UE-25	142 219	3040.29	22 831.9	19.1

Source: own study based on FADN

Źródło: opracowanie własne na podstawie FADN

By analysing the productivity of farms and changes according to production lines, it can be concluded that the labour productivity of field crop farming (which is a determinant in the performance of agriculture) is outstanding. This is due primarily to the technical equipment of the sector. However, it belongs to weakly performing sectors (such as wine production, granivores, other permanent crops) in regards to capital productivity.

Table 3. Labour productivity in field crop farms
Table 3. Wydajność pracy w gospodarstwach nastawionych na uprawy polowe

Year/*Rok*	EU-25 average [EUR/head]/ *Średnia UE-25 [euro/szt.]*	Labour productivity compared to EU-25 average/ *Wydajność pracy w stosunku do średniej UE-25 [[%]*					
		(1) 2 000 - < 8 000 EUR	(2) 8 000 - < 25 000 EUR	(3) 25 000 - < 50 000 EUR	(4) 50 000 - < 100 000 EUR	(5) 100 000 - < 500 000 EUR	(6) ≥ 500 000 EUR
2004	34 889	34.2	47.5	95.8	136.7	209.4	219.9
2011	52 676	20.7	40.1	78.1	125.7	201.0	202.9
Member countries/ *Kraje członkowskie*	Variation of labour productivity from EU average (2011)/ *Zmienność wydajności pracy od średniej UE [%]*						
Hungary/*Węgry*	2004	152.2	127.3	98.9	86.8	60.3	67.1
	2011	151.1	163.5	112.6	84.7	65.9	66.3
Poland/*Polska*	2004	59.0	63.0	53.1	62.9	63.7	0.0
	2011	63.8	55.3	53.2	56.7	53.3	52.8
EU/*UE*-15	2004	111.6	96.2	107.3	108.9	106.8	123.6
	2011	127.4	109.8	107.6	108.2	107.3	118.7
EU/*UE*-10(8)	2004	96.2	72.8	62.1	70.5	55.4	49.6
	2011	73.7	69.5	65.9	67.8	61.8	61.2
EU/*UE*-25	2004	100.0	100.0	100.0	100.0	100.0	100.0
	2011	100.0	100.0	100.0	100.0	100.0	100.0
Change of relative situation compared to EU-15 countries/*Zmiana w stosunku do sytuacji krajów UE-15*							
Hungary/*Węgry*	2011/2004	0.87	1.13	1.14	0.98	1.09	1.03
Poland/*Polska*	2011/2004	0.95	0.77	1.00	0.91	0.83	-

Source: own study based on FADN
Źródło: opracowanie własne na podstawie FADN

Table 4. Technical equipment in field crop farms
Tabela 4. Wyposażenie techniczne w gospodarstwach nastawionych na uprawy polowe

Year/*Rok*	EU-25 average [EUR/head]/ *Średnia UE-25 [euro/szt.]*	Technical equipment compared to EU-25 average/ *Wyposażenie techniczne w porównaniu do średniej UE-25 [%]*					
		(1) 2 000 - < 8 000 EUR	(2) 8 000 - < 25 000 EUR	(3) 25 000 - < 50 000 EUR	(4) 50 000 - < 100 000 EUR	(5) 100 000 - < 500 000 EUR	(6) ≥ 500 000 EUR
2004	23 901	44.9	66.8	98.5	140.1	191.0	140.5
2011	32 404	33.5	57.1	89.0	130.7	179.9	145.5
Member countries/ *Kraje członkowskie*	Variation of technical equipment from EU average (2011)/ *Zróżnicowanie wyposażenia technicznego od średniej w UE [%]*						
Hungary/*Węgry*	2004	95.3	143.3	105.7	111.4	65.0	67.6
	2011	61.0	90.0	85.4	72.1	72.0	54.7
Poland/*Polska*	2004	72.2	75.5	85.2	88.4	74.1	0.0
	2011	58.3	65.7	83.7	110.0	74.6	45.3
EU/*UE*-15	2004	161.5	122.0	109.2	110.4	105.0	108.7
	2011	131.4	103.4	99.8	99.9	101.2	109.0
EU/*UE*-10(8)	2004	80.8	84.6	84.3	91.9	63.7	56.9
	2011	50.9	69.4	79.8	83.9	71.4	60.8
EU/*UE*-25	2004	100.0	100.0	100.0	100.0	100.0	100.0
	2011	100.0	100.0	100.0	100.0	100.0	100.0
Change of relative situation compared to EU-15 countries/*Zmiana w stosunku do sytuacji krajów UE-15*							
Hungary/*Węgry*	2011/2004	0.79	0.74	0.88	0.72	1.15	0.81
Poland/*Polska*	2011/2004	0.99	1.03	1.07	1.38	1.04	-

Source: own study based on FADN
Źródło: opracowanie własne na podstawie FADN

Conclusions

As far as the whole European Union is concerned, the value of labour productivity more than doubled during the period following accession in 2004. The development was typically extensive due to the growth of equipment supply, at permanent (sometimes deteriorating) capital productivity levels. Field crop farming – which performs a key role in the agriculture of the European Union – has achieved the leading labour productivity with technical equipment. This is outstanding even compared to other sectors. Most of the labour intensive sectors can be characterized by a substantially lower specific output, at a capital productivity indicating variable asset efficiency.

The growth of labour productivity indicates the improvement of competitiveness in regards to the agriculture of Hungary and Poland during the examined period. In the case of Hungary agriculture has caught up with the average of EU-15 countries, while Poland could increase its productivity by increasing the level of technical equipment. The agricultural enterprises of both countries, however, are still far behind the leading member countries of the European Union.

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Streszczenie

W 2004 roku osiem krajów centralnej i wschodniej Europy przystąpiło do UE. Ich przemysł rolny znacznie ustępował rolnictwu 15 pierwszych państw członkowskich, zarówno pod względem technicznym, jak i produkcyjnym. Jednym z ważnych czynników konkurencyjności jest wydajność pracy, którą można rozłożyć na dwie części składowe – z jednej strony wyposażenie techniczne, a z drugiej wydajność tych narzędzi. Analizowano zmiany wydajności pracy czynników, jakie zaszły w Polsce i na Węgrzech oraz w innych krajach członkowskich wcielonych do UE w 2004 roku. Podjęto próbę odpowiedzi na pytanie, czy kraje centralnej i wschodniej Europy były w stanie zmniejszyć swoje opóźnienie pod tym względem w stosunku do krajów EU-15. Wyniki badań wykazały, że na przestrzeni dekady wydajność pracy gospodarstw rolnych na Węgrzech wzrosła, jednocześnie tempo inwestycji w gospodarstwach rolnych było opóźnione względem krajów UE-15, co skutkowało wydajniejszym użyciem kapitału. Wskaźnik inwestycji w polskich gospodarstwach rolnych był wyższy niż w krajach UE-15, podczas gdy problemy związane z wydajnością pracy i produkcyjnością kapitału nie zostały zminimalizowane.

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