Do field crop farms and mixed farms of old and new EU members improve productivity at the same rate? A regional level approach

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Abstract

In this paper we attempted to address the question presented in the title based on the data contained in the Farm Accounting Data Network (FADN). Analyses covered the first four years following the extension of the European Union in 2004. The adopted units comprised average farms representing 80 regions belonging to eleven countries of EU-15 and four new EU member states. Estimation of the Malmquist total factor productivity (TFP) and its components was conducted using data envelopment analysis, separately for each of the two types of farms taking into consideration their economic size.

The main findings concerning the pure technical efficiency change indicate that in the units from the old regions there was a slight improvement for field crop farms and stagnation for mixed farms, and a decrease in the units from the new regions, being bigger for mixed farms and smaller for field crop farms. The biggest effect was observed for the technical change index, with a bigger increase for crop farms from old regions than those from the new member states.

The estimated Malmquist index confirms a conjecture that the more specialized farms more effectively improve overall productivity than mixed farms, where modernization efforts are more scattered. At the same time the average growth rate of TFP in crop farms from the EU-15 regions in the analyzed period was much faster that in analogous farms from the new regions. For mixed farms the difference in the rate of change was similar, but at a much lower level.

Keywords: data envelopment analysis, technical efficiency change, scale efficiency change, Malmquist index,

1. Introduction

Efficiency and productivity have ranked among main interests of economists at least since the middle of the 20th century. In case of agricultural production this issue is especially complicated not only because of the instability of meteorological conditions, having a crucial influence on farming, but also due to the large variability of farms with respect to their sizes and production profiles. On the other hand, in the EU since the beginning it has been attempted to eliminate differences between regions, either supporting economically weaker regions or strengthening specific sectors of economy. In particular, the objective of the Common Agricultural Policy in the initial period was to assure food security, and in the course of further reforms to increase professional activity of rural communities, as well as improve efficiency of agricultural production.

In 2004 the EU was enlarged to incorporate ten new states. This extension has had an impact on agriculture in the new member states, which were characterized by a high share of this sector of economy in the generation of GDP and at the same time a high employment level as well as considerable diversity of organizational structures. A review and synthesis of several papers analyzing different factors determining efficiency of agricultural production in Central and East European Countries in the 1990's was presented by Gorton and Davidova (2004). Following 2004 agriculture in the new EU member countries faced a new economic situation. Subsidies, new potential sale markets for goods and new possibilities to purchase means of production were found, but at the same time the pressure of competition increased, leading as a result to the necessity to improve efficiency, and as a consequence to improve profitability.

It was attempted in this paper to address the question whether higher specialization and a bigger economic size class of farms contribute to improved productivity at the same rate for farms from the new and old countries of the EU. This hypothesis is analyzed at the regional level in reference to only two types of farms, i.e. those specializing in field crops and having multi-directional production. Investigations covered the first four years following the enlargement of the EU in 2004. The economic and statistical data were gathered from the FADN.

The paper is organized as follows. Section 2 presents a short introduction to the non-parametric estimation of the Malmquist total factor productivity (TFP) along with its basic components. Section 3 presents economic and statistical data constituting the foundation of the analyses. Section 4 contains results of estimation of the Malmquist index characterizing the rate of changes in productivity. The last section, Section 5, was devoted to conclusions summing up the entire body of conducted analyses in view of the proposed hypothesis.

2. Methodology

The concepts of efficiency and productivity growth have focused the attention of the economic community since the early papers by Koopmans (1951) and Debreu (1951). In the course of years several analytical methods have been developed to evaluate technical efficiency. Many details on the early history of efficiency analysis may be found in an interesting study by Førsund and Sarafoglou (2002). These methods represent two fundamentally different approaches. The first one, i.e. the parametric approach, initiated by studies of Aigner and Chu (1968), Timmer (1971) and Afriat (1972), uses the concept of the frontier production function and is based on a respectively modified regression analysis.

The other approach was initiated by Farrell (1957) and is related with the envelopment of all data points with a non-parametric frontier function. This idea, fully elaborated by Charnes, Cooper and Rhodes (1978), is accomplished by solving a series of linear programming problems, in which the frontiers, i.e. the most efficient producers, are identified by comparing the observed vectors of outputs and inputs characterizing all units under investigation. This method is known as data envelopment analysis (DEA). The only assumptions of DEA concern the type of technology, which can be constant return to scale (CRS) or variable return to scale (VRS), and the type of orientation, which can be focused on outputs maximization given the values of inputs, or on inputs minimization given the values of outputs. Many other formulations of the DEA were reviewed by Thanassoulis, Portela and Despić (2008) (see also Coelli, Rao, O'Donnell, and Battese, 2005).

Let $TE_C(i)$ and $TE_V(i)$ denote the technical efficiency of the i-th producer following from DEA under the CRS and the VRS assumption, respectively. The latter index, called also pure technical efficiency, is not less than $TE_C(i)$, because under the VRS assumption the data set is enveloped more tightly than in the case of CRS. If $TE_V(i) = 1$, then the firm operates at the best practice technology. The ratio, $SE(i) = TE_C(i)/TE_V(i)$, is known as the scale efficiency index. If it is equal to one, then the producer operates at the optimal scale.

In the case of panel data it is possible to compare the results of the *i*-th unit obtained in the period *t* technology with the results of the sample of units operating in the technology of period *s*. In such a case the efficiency scores $TE_C^s(i,t)$ and $TE_V^s(i,t)$ may not only be smaller, but also greater than one. For example, they may be greater than one when the results obtained in the later period are compared with those obtained in the earlier period, while the later technology is actually better than the previous one.

The ratios of two efficiency scores corresponding to two successive periods, i.e.

$$\Delta TE_C(i) = TE_C^{t+1}(i,t+1)/TE_C^t(i,t) \quad \text{and} \quad \Delta TE_V(i) = TE_V^{t+1}(i,t+1)/TE_V^t(i,t)$$

are known as technical efficiency change and pure technical efficiency change, respectively. In turn, the ratio of technical efficiency change and pure technical efficiency change provides a measure of scale efficiency change,

$$\Delta SE(i) = \Delta TE_C(i)/\Delta TE_V(i).$$

The third index, measuring the change in technology, is composed of two ratios of technical efficiency, corresponding to the technology of two successive periods. Their geometrical mean is known as technical change

$$\Delta T_C(i) = [TE_C^t(i,t)/TE_C^{t+1}(i,t) \cdot TE_C^t(i,t+1)/TE_C^{t+1}(i,t+1)]^{1/2}.$$

All the above indexes, when greater than one, indicate respectively some improvement in technical efficiency, in scale or in technology. In the other case, they indicate stagnation or even regression between periods *t* and *t*+1. Finally, the product of $\Delta TE_C(i)$ and $\Delta T_C(i)$ represents one possible decomposition of the so-called Malmquist productivity index,

$$M_C(i) = [TE_C^t(i,t+1)/TE_C^t(i,t) \cdot TE_C^{t+1}(i,t+1)/TE_C^{t+1}(i,t)]^{1/2} = \Delta TE_C(i) \cdot \Delta T_C(i).$$

The alternative decomposition is delivered by the product

$$M_C(i) = \Delta TE_V(i) \cdot \Delta SE(i) \cdot \Delta T_C(i),$$

where the first term expresses the technical efficiency change with respect to the best practice technology (for details see e.g. Färe, Grosskopf and Margaritis, 2008). The values of $M_C(i)$ greater or lower than one indicate, respectively, an increase or decrease in total productivity between two periods considered.

3. Data

Two types of economic and statistical data, published annually by FADN, were used in this study. The system supplies data with different levels of aggregation focusing on the biggest commercial farms, which jointly in a given region or member state generate at least 90% standard gross margin (SGM). The total value of SGM for each farm makes it possible to determine its economical size, which is expressed in European size nits (ESU). The system distinguishes six classes of farm size, i.e. very small farms (0-4 ESU), small farms (4-8), medium-sized farms (8-16), large farms (16-40), very large farms (40-100) and the biggest farms (over 100 ESU). On the other hand, the share of individual types of production in the total value of ESU makes it possible to determine the specialization of each farm to one of the eight distinguished types. As a result, the FADN system distinguishes 24 combinations of types and economic sizes of farms. However, due to the specific agro-technical and climatic conditions, usually only certain types and sizes of farms are found in individual regions. As a result, in the FADN system each region is represented by a certain set of average farms, of which each is determined on the basis of a set of farms classified to a specific combination of type and economic size.

Investigations were conducted for all regions of countries, which operated within the EU in the years 2004-2007. Due to the enlargement of the Union in 2004, these regions are divided into two groups, i.e. the old and the new EU countries. Average farms in individual classes of economic size and representing two economic types, i.e. specializing in field crops and those with multiple direction production (the mixed type), were assumed as the basic research units in each region. Such a selection of units resulted from the decision to possibly confirm or refute the conjecture that the mixed farms, considered less economically risky than specialist farms, are more difficult to increase their productivity. Hereinafter the basic units of analysis, i.e. average farms representing individual regions, will simply be referred to as farms.

Indexes of efficiency change were estimated separately for each of the two types of farms, using output-oriented, single-output, and multi-input DEA. As the output variable we used the sum of values of plant and animal production as well as those resulting from the other types of agricultural production activities, except for income from any type of subsidies. This variable in the FADN nomenclature is referred to as total output. Production factors (inputs) were assumed to include labor, expressed in the number of man-hours, i.e. work units (AWU), total utilized agricultural area (UAA), expressed in hectares, the consumption of fixed assets, referred to as depreciation, as well as working capital, determined as the difference between the total value of inputs and total wages and fixed capital costs.

Due to the value-oriented character of variables referring to the volume of production and the values of involved fixed and working capitals, values of these variables were corrected by the price index, i.e. they were expressed in fixed prices from the year 2000 taking into consideration annual national inflation indexes in relation to individual inputs. This conversion makes it possible to treat the above mentioned variables as synthetic aggregates for the volume of production and the amount of fixed and working capitals, respectively.

The European Union after its enlargement in 2004 included a total of 122 regions, of which only 96, or 46, respectively, were represented by average farms classified to at least one of the classes of economic size and specializing in field crops or running mixed-type production. Among these two groups of regions only 74 and 45 regions, respectively, were represented throughout the entire period of 2004-2007 by the same average farms in terms of economic size.

It should be noted that the analyzed regions vary in area. For example, Poland is divided into four regions and France, being almost two times bigger, is divided into 22 regions. This means that the numbers of farms, on the basis of which average farms were identified, were not uniform. This does not change the fact that averaging, leading to the units assumed in this study, reduces the effect of erroneous observations and outliers. Moreover, regions vary in terms of their geographical location, which significantly affects climatic and agronomic conditions. We may mention here regions of southern Spain or Greece and at the same time regions of northern Germany. As a consequence, we may expect high variation in values of analyzed economic indexes. This variation, in view of the above mentioned variables, is reflected in the basic characteristics averaged in relation to years and economic size of analyzed units, which are presented in Table 1.

Table 1. Basic descriptive statistics of farms

Variables	EU-15 regions				New regions			
	Mean	Standard deviation	Min	Max	Mean	Standard deviation	Min	Max
				Field crop farms				
Total output (€ 1000)	125.19	169.35	4.45	1142.29	178.32	320.90	6.36	1715.08
Labor (100 AWU)	42.67	38.73	9.42	289.27	117.88	191.26	5.70	867.48
Land (ha)	96.15	141.25	2.31	924.19	241.14	376.37	6.84	1482.90
Working capital (€ 1000)	83.75	127.72	2.25	861.32	120.63	225.19	3.06	1187.63
Capital (€ 1000)	17.21	21.87	0.02	155.28	20.11	34.32	0.68	249.84
Output/Labor	2.47	1.82	0.24	8.68	1.25	0.58	0.21	2.72
Output/Land	1,49	0.96	0.25	12.11	0.72	0.23	0.36	1.59
Land/Labor	2.07	1.69	0.09	7.98	1.99	1.08	0.20	4.49
Working capital/Labor	1.62	1.36	0.07	6.38	0.81	0.42	0.09	1.80
Capital/Labor	0.37	0.31	0.00	1.43	0.17	0.10	0.04	0.50
Working capital/Land	0.84	0.43	0.14	2.99	0.42	0.10	0.23	0.85
				Mixed farms				
Total output (€ 1000)	290.80	445.64	12.61	2842.40	211.37	461.65	4.26	1744.87
Labor (100 AWU)	72.45	123.55	17.71	774.24	168.84	350.54	23.81	1639.37
Land (ha)	167.56	270.21	11.51	1523.51	206.93	465.58	5.35	1856.07
Working capital (€ 1000)	209.89	323.83	6.08	2044.30	142.35	324.02	2.51	1259.76
Capital (€ 1000)	40.13	56.16	0.66	369.95	28.21	79.71	0.83	483.66
Output/Labor	4.17	1.93	0.41	8.26	0.83	0.55	0.16	2.00
Output/Land	2.02	1.05	0.29	6.78	1.05	0.25	0.65	1.97
Land/Labor	2.41	1.42	0.39	6.63	0.79	0.52	0.18	1.94
Working capital/Labor	3.03	1.45	0.20	5.85	0.50	0.35	0.09	1.25
Capital/Labor	0.64	0.37	0.02	1.62	0.11	0.07	0.03	0.41
Working capital/Land	1.40	0.68	0.16	4.45	0.61	0.16	0.38	1.15

A comparison of relative values presented in Table 1 indicates that in field crop farms on average the ratio of land to labor inputs from both groups of the “old” and “new” regions was comparable, whereas productivity of labor and land, as well as the ratio of capital to labor and working capital to land in the “old” regions were two times higher than in the analogous farms from the “new” regions. This indicates average technical equipment and material resources of farms from the “old” regions to be better, resulting in higher productivity of labor and land.

In case of mixed farms the disproportions between farms from the “old” and “new” regions are much bigger. The biggest differences were related to the level of fixed and current production factors. In farms from the “old” regions such a ratio of capital to labor, as well as that of working capital to labor, were six times higher than for farms from the “new” regions. In view of the above it is not surprising that productivity of land in farms from the “old” regions was two times higher and productivity of labor was even five times higher than in farms from the “new” regions.

It is also of interest to compare farms in terms of the type of production they run. In the EU-15 regions productivity of labor and the provision of fixed and working capital for labor in mixed farms were almost two-fold than in field crop farms. In turn, productivity of land and the ratio of working capital to land in mixed farms were higher than in field crop farms by as little as approx. 1/4 and 1/3, respectively. That means that productivity of labor and land in farms running mixed production were higher than in farms specializing in field crops, at a markedly higher provision of fixed and working capital in the former farms.

In turn, in mixed farms from the "new" regions productivity of labor and the provision of fixed and working capital to labor were lower than in field crop farms by approx. 1/3, but productivity of land and the ratio of working capital to land in mixed farms were by 1/2 higher than in field crop farms. This confirms a rather obvious statement that in modern agriculture high productivity of labor is not possible without an adequate supply of fixed and current production factors.

Since the class of the smallest economic units turned out to be represented by very limited numbers of farms both in case of field crop and mixed farms, in further considerations the class of the smallest farms was included in the class of small farms, thus forming the class of 0 - 8 ESU. As it turned out, these economically smallest farms are represented, except for one Greek region, by Polish regions. In view of earlier investigations, presented in particular in a study by Latruffe, Balcombe, Davidova and Zawalinska (2005) it is not surprising, since small and very small farms in terms of their area predominate in Polish agriculture.

4. Main findings

The basic index determined here is the Malmquist index, which value greater that one indicates an improvement of TFP. The components of the Malmquist index, i.e. indexes of pure technical efficiency change, scale efficiency change and technical change, are of equal interest. Average values of these indexes from the years 2004 - 2007 for field crop and mixed farms are presented in Tables 2 and 3, respectively. Additionally, standard deviations and sample sizes were given along with the results of testing for hypotheses on unit values of analyzed indexes. Testing was performed using the analysis of variance (ANOVA) under the standard assumption of normality of distribution. Although the assumption may be doubtful, standard deviation is involved in such a procedure irrespective of the type of distribution, which improves objectivity of the comparison.

Indexes of efficiency change in relation to the best practice technology for field crop farms from the "old" and "new" EU regions are close to one, but for farms from the "old" regions they were slightly higher than for farms from the "new" regions. The biggest increase in efficiency (on average by 4%) was recorded for economically the smallest farms from the "old" regions. In turn, among farms from the "new" regions the biggest change, this time a 4% decrease, was found for very large farms. In case of mixed farms a decrease was observed in efficiency for farms of all economic sizes, except for the biggest farms. The most marked decrease was reported for medium-sized, big and very big farms from the "new" regions. This decrease was relatively big and ranged from 6% to 10%. This suggests a conclusion that accession to the EU generally did not contribute to an improvement of efficiency in those farms, running diverse production, reducing economic risk, and which in most cases could not adapt to the requirements of the competition.

Indexes of scale efficiency change for most classes of farms did not differ from one, which suggests that in the analyzed period on average no progress was found in terms of an improvement of productivity. Exceptions in this respect include the smallest farms from the EU-15 regions and the biggest farms from the “new” EU regions specializing in field crops, as well as big farms from the “old” regions and the biggest farms from the “new” regions specializing in mixed production. In those farms generally the efficiency of scale decreased (on average from 4% to 6%), i.e. their productivity deteriorated. In the other cases no marked changes in the efficiency of scale were found.

Table 2. Indexes of change for field crop farms

Size (ESU)	EU-15 regions			New regions		
	Mean	Standard deviation	Sample size	Mean	Standard deviation	Sample size
			Pure technical efficiency change			
0-8	1.04	0.026	48	0.99	0.037	24
8-16	0.99	0.021	72	0.98	0.030	36
16-40	0.99	0.018	105	0.97	0.029	39
40-100	1.02	0.016	132	0.96	0.029	39
100<…	1.02	0.017	120	1.01	0.037	24
			Scale efficiency change			
0-8	0.96*	0.011	48	0.99	0.016	24
8-16	1.00	0.009	72	1.01	0.013	26
16-40	1.00	0.008	105	0.99	0.013	39
40-100	1.01	0.007	132	1.02	0.013	39
100<…	0.99	0.007	120	0.96*	0.016	24
			Technical change			
0-8	1.13*	0.039	48	1.08	0.055	24
8-16	1.16*	0.031	72	1.09*	0.045	26
16-40	1.11*	0.026	105	1.08	0.043	39
40-100	1.06*	0.023	132	1.06	0.043	39
100<…	1.04	0.024	120	1.03	0.055	24
			Malmquist productivity index			
0-8	1.10*	0.037	48	1.02	0.052	24
8-16	1.11*	0.030	72	1.02	0.042	26
16-40	1.07*	0.025	105	1.00	0.041	39
40-100	1.07*	0.022	132	1.02	0.041	39
100<…	1.04	0.023	120	0.98	0.052	24

* The estimated parameter differs significantly from one. $\alpha = 0.05$

The biggest changes were observed in relation to the technical change index. For all field crop and mixed farms from the EU-15 regions, except for the biggest farms, which generally showed the highest pure technical efficiency and at the same time high scale efficiency, the indexes of technical change were considerably bigger than one (from 4% to 16% for field crop farms and from 1% to 8% for mixed farms), which means a marked improvement in technology. For both types of farms from the “new” EU regions the estimates of these indexes turned out to be bigger than one, but the increases ranged from 3% to 9%. It also needs to be stressed here that for field crop farms the improvement was biggest for economically smaller farms from the “old” EU regions. In turn, among mixed farms a bigger improvement was observed for farms from the “new” regions and it was first of all for economically big, bigger and the biggest farms.

As a conclusion we may state that on average field crop farms from the “old” regions introduced technological progress more intensively than analogous farms of the “new” regions, while in contrast mixed farms from the “new” regions slightly faster absorbed new technical, technological and organizational solutions than those from the "old" regions.

The presented changes in the composite indexes determined the Malmquist total factor productivity index. This index only for field crops farms from the EU-15 regions turned out to be markedly bigger than one. For the other farms estimates of this index were close to one and even in case of the smallest and small mixed farms from the "new" regions this index was markedly smaller than one.

Table 3. Indexes of change for mixed farms

Size (ESU)	EU-15 regions			New regions		
	Mean	Standard deviation	Sample size	Mean	Standard deviation	Sample size
			Pure technical efficiency change			
0-8			0	0.97	0.019	18
8-16	0.98	0.023	12	0.94*	0.023	12
16-40	0.98	0.014	33	0.91*	0.021	15
40-100	0.98	0.010	60	0.90*	0.023	12
100<…	1.01	0.009	78	1.00	0.027	9
			Scale efficiency change			
0-8			0	0.96	0.017	18
8-16	0.99	0.021	12	1.00	0.021	12
16-40	0.97*	0.013	33	0.99	0.019	15
40-100	1.02	0.009	60	1.01	0.021	12
100<…	1.00	0.008	78	0.94*	0.024	9
			Technical change			
0-8			0	1.03	0.021	18
8-16	1.06*	0.025	12	1.04	0.025	12
16-40	1.08*	0.015	33	1.09*	0.023	15
40-100	1.02*	0.011	60	1.08*	0.025	12
100<…	1.01	0.010	78	1.07*	0.029	9
			Malmquist productivity index			
0-8			0	0.96*	0.019	18
8-16	1.02	0.023	12	0.96	0.023	12
16-40	1.02	0.014	33	0.98	0.021	15
40-100	1.01	0.010	60	0.98	0.023	12
100<…	1.01	0.009	78	1.01	0.027	9

* The estimated parameter differs significantly from one. $\alpha = 0.05$

Rather disheartening conclusions arise from the presented evaluations. The average annual growth rates for total productivity of inputs in field crop farms representing the EU-15 regions in the analyzed period were much bigger than in the farms of the "new" regions, with the biggest differences observed for economically smaller farms. In small and the smallest farms from the "old" regions the average annual increase amounted to 10%, while for farms in the "new" regions it was only 2%. In turn, in the biggest farms from the "old" regions an average increase of 4% was found, whereas in farms from the "new" regions a decrease of 2% was recorded.

The observed discrepancies in the Malmquist indexes could have been caused by the modernization taking place in the agriculture of the "new" member states, connected first of all with investments, which scope is not identical in small and large units. Since in agriculture it typically takes several years to see the economic effects of such actions, in farms from the "new" regions we may hardly expect a high growth rate for total productivity already in the first years after the accession to the European Union.

In case of mixed farms the situation is similar, but observed at a lower level. Although the Malmquist indexes for farms from both the "old" and "new" regions are close to one, still for farms from the "old" regions they are bigger than one (on average an increase of approx. 2%), while for farms from the "new" regions, except for economically biggest farms, they are smaller than one (generally a decrease of approx. 2 - 4%). Thus, if in farms from the "old" regions we may talk of slight progress in total productivity of inputs, in farms from the "new" regions a decrease was observed for this index.

5. Conclusions

In this study an analysis was conducted for economic results of average farms representing individual regions of the EU in the years 2004 - 2007. The analysis was made based on data available in the FADN system and concerned farms of different economic sizes and two economic types, i.e. those specializing in field crops and running mixed production. In these investigations four basic inputs were included, i.e. labor (AWU), utilized agricultural area (UAA) and the consumption of both fixed and working capital. In view of the enlargement of the EU in 2004, the regions were divided into two groups. One group, EU-15, comprised regions, which were parts of the EU before 2004, referred to as the "old" regions, while the other group included the "new" regions, incorporated in the EU in 2004.

The main objective of the analysis was to find an answer to the question whether bigger specialization and a higher class of economic size of farms contribute to an improvement in productivity at the same rate for farms from the "new" and "old" EU member states. Specialist farms, represented here by field crop farms, were compared with mixed farms. Such a hypothesis included several more basic issues. The first is connected with the determination whether efficiency increases with an increase in the economic size of farms and whether farms from the "old" regions are more efficient than those from the "new" regions. These questions, referred to both field crop farms and mixed farms, constituted a key for a determination of the rate of change throughout the entire period of analysis.

The indexes of change were estimated using output oriented DEA by determining the primary components of the Malmquist TFP, i.e. indexes of pure technical efficiency change, scale efficiency change and technical change.

It turned out that the biggest changes in the analyzed period were observed in relation to the technology of production, with an average rate of change being biggest in farms economically smaller, specializing in field crops. The rate of change in terms of scale and efficiency was markedly smaller, while for farms of certain economic sizes, particularly with a mixed type of production, the indexes were even observed to deteriorate markedly.

In order to focus on differences in the types of farms the further part of the remarks will be limited to conclusions based on values averaged in relation to farm size. These results are presented in Figs. 1 and 2.

The obtained estimates first of all indicate that indexes of pure technical efficiency change (TEv) for farms from the "old" regions are close to one, but for farms from the "new" regions they are much less than one. This reduction of efficiency was markedly bigger for mixed farms, amounting to as much as 6%. In turn, indexes of scale efficiency change (SE) indicate a lack of change in the scale of production for field crop farms and a slight decrease for mixed farms from the "new" regions. In a case of technical change (T) the highest rate of increase was obtained for field crop farms from the "old" regions (on average by approx. 9%), which were much higher (on average by approx. 6 percentage points) than for mixed farms also from the "old" regions. Similarly, in case of the units from the "new" regions the highest growth rate for technical change was found for field crop farms (on average approx. 7%), but they were only slightly bigger than that of mixed farms. As a result the Malmquist index (Mc) for the farms from the "old" regions indicated a relatively high improvement of total productivity for farms specializing in field crops (on average approx. 7%) and a smaller improvement for farms running mixed-type production, i.e. on average approx. 2%. The farms from the "new" regions recorded much inferior results. For field crop farms an increase was recorded, but it was only by 1%, while for mixed farms it was a decrease by as much as 3%.

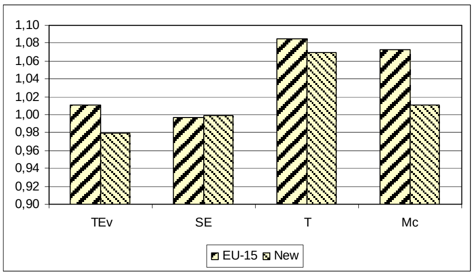

Fig. 1. Mean indexes of change for field crop farms.

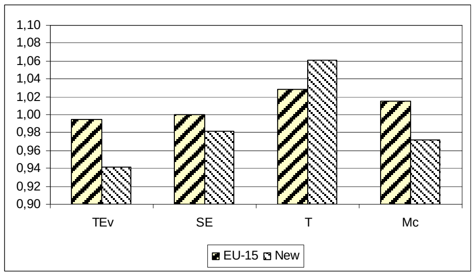

Fig. 2. Mean indexes of change for mixed farms

Based on the evaluations of pure technical efficiency change it may be stated that if in the units from the "old" regions typically we could observe a slight improvement (field crop farms) or stagnation (mixed farms), then in the units from the "new" regions decreases were found, being bigger for mixed farms and smaller for field crop farms. Although it is difficult to determine precisely the causes of such differences, since they may be connected both with management, organization or utilization of resources, and they may also result from the more difficult agricultural or weather conditions, still in the units from the "old" regions efficiency improved and in the units from the "new" regions it was rather a deterioration.

The biggest improvement was observed in the technical and technological aspects, to a more significant degree found in case of specialist farms from the "old" regions than those from the "new" regions. In turn, in farms running mixed-type production the farms from the "new" EU regions adopted new technological and technical solutions more intensively that analogous farms from the "old" regions.

Finally, evaluations of the Malmquist index confirm the assumption that specialist farms, represented here by field crop farms, more effectively improve total productivity than farms combining different directions of production, represented here by mixed farms, where the modernization efforts are by nature more scattered.

Summing up we may draw a conclusion that the average growth rate for TFP in field crop farms from the "old" regions in the analyzed period was much faster than in the analogous farms from the "new" regions. For mixed farms the difference in the rate of change was similar, but consistently with the earlier conclusion, at a much lower level.

As a consequence for the units from the "old" regions a slight increase was recorded, while for the units from the "new" regions it was the opposite, i.e. a decrease in TFP. These conclusions, formulated for average farms and in relation to the specific period immediately after the enlargement of the EU, obviously do not mean that there were no economic farms operating more efficiently. However, a question arises whether the current stimulating mechanisms in the EU are sufficient to lead at a further perspective to the uniformity of productivity in the EU agriculture.

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