Change of asset efficiency in EU agriculture: challenges for new members

Takács I.

Szent István University/Faculty of Economics and Social Sciences, Gödöllő, Hungary

Abstract— **Efficiency of farm assets is a very important factor of competitive production. It is in strong correlation with profitability of economic activities. One of the most important factor of the farm assets is the fixed assets, especially machinery. As it could be observed during the 1980s and 1990s on the farms of developed countries, the technical development was a considerable factor of farming. During that period the technical supply of farms increased significantly, at the same time the farm labour decreased, so the labour productivity rose considerably. This paper, based on the data of FADN, focuses on the investigation of some figures of the European Union for asset and labour efficiency between 1989 and 2005, and analyses what happened after 2004 when 10 new member countries accessed to the EU. The most important results of the research are that the farms of the new member countries are equipped at a considerably lower level in general and at the same time they use farm assets less efficiently than farms of the former member countries, and the result is that the competitiveness of the farms of new members is significantly lower. On the other hand, in the new member countries the agricultural policy focused on developing arable farming, so the gaps in the labour productivity are narrower in the field crop farms than in horticulture or animal husbandry. The gap in the labour productivity is the widest at the large-scale farms, which can be explained not only with less assets but with lower capital efficiency as well.**

Keywords— **productivity, labour, FADN**

I. INTRODUCTION

The analysis of main factors of agriculture's assets and capital efficiency is strongly related to the factors of technical development. The present paper follows the complex approach of technical development according to the definition by European agro-economists made in 1955, Helsinki. [2] It states that the technical development of agriculture is based on four pillars, namely biological, chemical, technical and human factors, among which „technical" includes mechanization and architecture, too.

The involvement of technical development into expansion theory models started only in the 1950s. Kaldor [3] was the first to introduce the function of technical progress, which included all the types of technical development. It said that the main driving force of economic growth is the technical change: new technologies require new investments and the growth can be explained only with the common changing of capital/production quotient. A lot of authors contributed significantly to the development of growth theories, but Solow [7] must be highlighted, because he complemented the general formula of production function by considering the impact of technical progress: Q=f(K,L,t), where „t" means the impact of technical progress in relation to time. Solow improved this in his subsequent works and highlighted that productivity has much bigger role in the growth of production than the expansion of production factors.

While the former theories examined the growth under pure market conditions, the economic trend of Keynes gave new direction when criticized the points of neo-classical school and argued for the necessity of state intervention. [5] Keynesian economists criticized the production function and the theory of marginal productivity. The basis of their criticism was that capital – as against to other factors of production – has no natural measure. Common measure of different capital assets can be only the price. The price system, however, depends on the income distribution system. By changing it, the price system and the price of capital assets will change, too, together with the marginal productivity of capital, without changing the physical productivity of capital. We have to face this when we deal with the capital efficiency of the European Union agriculture, because the role of the state is very, sometimes irrationally significant.

The measurement of impact of technical development is a complex task, because technical development includes all those changes in the production process in relation to time which produces more (or more valuable) products by using the same (or less) production factors, and produces the same (or more valuable) products with less production factors. Technical progress in general should increase output as a result, should change its structure positively, and cut production costs. [1] The interrelation of these two factors determines the efficiency. In this case we have to distinguish technological efficiency (relation of income and cost) from economic efficiency (proportion of production value and production cost). [6]

Labour use has been permanently decreasing in the European agriculture according to FADN data. Labour use in the EU-15 country group has been reduced by about 40% (annual labour capacity of 2.2 million persons) in 15 years. The efficiency has shown increasing tendency in all economic size groups.

One of the most widespread analysing method of technical development efficiency is the calculation of partial efficiency, where the change of productivity ($y \cdot L^{-1}$) is determined in the function of productivity of labour and capital: as the multiplication product of capital efficiency ($y \cdot K^{-1}$) and technical equipment ($K \cdot L^{-1}$):

$$\frac{y}{L} = \frac{y}{K} \cdot \frac{K}{L} \quad (1)$$

Internal or international comparison of this index points out that the productivity differences can refer back to the differences between capital productivity and capital supply (capital stock per head). [4]

The research aimed to explore the changes of factors which influenced the means and capital efficiency in the last fifteen years in the former 15 member countries of the European Union and the countries integrated in 2004. The examination covered the possible impact of identified factors on the competitiveness of farmers of new member countries and their ability to react on the changes of world economy, as well as the results of technical development of competitors.

II. MATERIAL AND METHODS

The examination has used secondary data: data of EUROSTAT and the FADN database of the European Union. The examined period was from 1989 to 2005. The available data were arranged in 6 groups according to economic farm size (ESU) (where (1) is 0 - <4 ESU; (2) 4 - <8 ESU; (3) 8 - <16 ESU; (4) 16 - <40 ESU; (5) 40 - <100 ESU; (6) >= 100 ESU) for 12 countries until 1994, 15 countries until 2003 and 25 countries from 2004.

Out of the 152 standard variables in the database, the following variables have been used for the research: number of represented farms, average annual labour use, average area utilized, gross production value (total output) and value of fixed assets, especially machinery. 10646 data per variable were available for the examinations.

In order to analyse partial efficiency, the changes of technical equipment ($K \cdot L^{-1}$) and capital efficiency ($y \cdot K^{-1}$) for the EU-12/15/25 countries were calculated, and the results are demonstrated on charts, on which the isoquantum curves of labour productivity ($y \cdot L^{-1}$) give references for evaluation of changes. In 2005 the groups of former (EU-15) and new (EU-10) members were also separated and the efficiency gaps were analysed between the two groups.

The introduction of results – due to their size – is made only for countries which have significant role in the agricultural production of the Union. More than 80% of gross added value of the EU-25 members and the two later accessed countries was produced by 7 countries in 2005: Germany, Greece, Spain, France, Italy, the Netherlands, and the United Kingdom. Within the Eastern-Central European region, the performance of Poland was significant. Hungary has only a 1.4% share from it, in spite of the fact that its share from the resources is 3.6% regarding agricultural land and 4.6% regarding agricultural labour use (Table 1). Following the Pareto principle, only these countries are in focus during the examination in the following, although in this way some countries which have model development and high-level agriculture in some aspects, will be left out.

The examination was made with uni- and two-variable statistical methods (average, dispersion, relative dispersion calculation, correlation calculation), as well as the use of graphical box-plot based on them. As regards box-plot analysis, it should be noted – due to the variety of marking systems of statistical programs - that significant differences can be found between groups if their confidence intervals do not overlap each other. The program which used analysing statistical evaluation, (EViews 5) marks the confidence interval with grey colour.

Table 1 Number of agricultural holdings in the European Union

	Utilised agricultural area[1)]	Distribu-tion	Gross value added[2)]	Distribu-tion	Agricul-tural labour force[3)]	Distribu-tion
	1000 ha	%	M EUR	%	1000 AWU	%
EU-27	164051	100.0	127162	100.0	9804	100.0
EU-15	130547	79.6	116758	91.8	6290	64.2
Belgium	1386	0.8	2282	1.8	70	0.7
Czech Republic	3606	2.2	1004	0.8	152	1.6
Denmark	2712	1.7	2449	1.9	58	0.6
Germany	**17035**	**10.4**	**13909**	**10.9**	**689**	**7.0**
Estonia	770	0.5	195	0.2	37	0.4
Greece	**3805**	**2.3**	**6349**	**5.0**	**614**	**6.3**
Spain	**25690**	**15.7**	**22450**	**17.7**	**998**	**10.2**
France	**29632**	**18.1**	**21281**	**16.7**	**914**	**9.3**
Ireland	4307	2.6	1711	1.3	160	1.6
Italy	**14710**	**9.0**	**25019**	**19.7**	**1476**	**15.1**
Latvia	1734	1.1	237	0.2	137	1.4
Lithuania	2837	1.7	417	0.3	222	2.3
Luxembourg	129	0.1	96	0.1	4	0.0
Hungary	**5864**	**3.6**	**1747**	**1.4**	**463**	**4.7**
Netherlands	**1924**	**1.2**	**8147**	**6.4**	**186**	**1.9**
Austria	3263	2.0	2190	1.7	175	1.8
Poland	**15906**	**9.7**	**5689**	**4.5**	**2274**	**23.2**
Portugal	3722	2.3	2338	1.8	455	4.6
Slovenia	509	0.3	402	0.3	95	1.0
Slovakia	1941	1.2	381	0.3	99	1.0
Finland	2267	1.4	516	0.4	84	0.9
Sweden	3201	2.0	863	0.7	71	0.7
United Kingdom	**16761**	**10.2**	**7160**	**5.6**	**336**	**3.4**

1) Estonia, France, Ireland, 2004; EU-25, EU-15, the United Kingdom, 2003; 2) at producer prices of agricultural industry, 2005; 3) 2005, Germany, Greece, Spain, France, Ireland, Italy, the Netherlands, Austria, Portugal, 2003
Source: EUROSTAT 2007

III. RESULTS

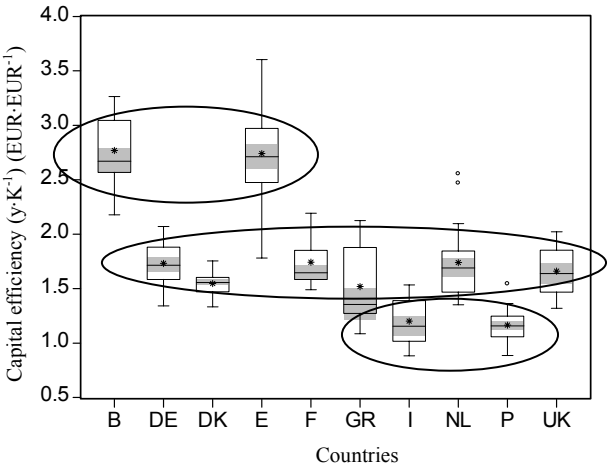
The development dynamics of the former decades was missing from the European agriculture in the 1990s and 2000s. Priorities have changed, instead of the former production intensification, the stabilization or small improvement of income situation of farmers has become the objective without increasing the output volume. The implementation of more extensive production methods (land resting, organic production) has been definitely supported. At the same time, technologies utilising the results of technological development have emerged which helped to carry on rational farming – with more and more expensive means – thus contributing to the decrease of input and stabilization of yields. It can be seen that the development has led to farm concentration and to the increasing of live labour productivity, which ultimately resulted that significant labour capacity became redundant. The experiences are supported by the figures, as it can be seen below.

The process of farm concentration is obvious in the European Union. The number of farms (shows a decreasing tendency, the break is caused by the extension processes (Eastern-German provinces, Scandinavian countries, Austria, integration of the Eastern and Central European countries in 2004).

Labour use has been permanently decreasing. Labour use in the EU-15 country group has been reduced by about 40% (annual labour capacity of 2.2 million persons) in 14 years. At the same time, the efficiency of labour has shown significant differences between farm groups. The efficiency has shown increasing tendency in all the groups, the rate of growth was quicker in the smaller plant size categories. The productivity of labour in large-scale farms was almost 7-fold of that of small-scale farms 15 years ago. This difference has been decreasing, because the productivity of labour is 45% in small-scale farms, while the growth in large-scale farms was only about 15%.

As it was mentioned above, the labour productivity depends on capital efficiency and the technical equipment. Analysing the changes of capital efficiency in the former member countries, significant differences can be observed among groups: the main group is the developed countries (mainly Germany, Denmark, the Netherland, France and the United Kingdom) which have a relatively narrow interval of change of capital efficiency (standard deviations are relatively low), their capital efficiency is from 1.5 to 1.8 $EUR \cdot EUR^{-1}$, their farms are well equipped and the total output is high. There are two other groups: one is Belgium and Spain, which have higher efficiency figures, Italy and Portugal belong to the other group, where farms are usually less equipped than in the developed countries, but the farm output is also lower than theirs. (Fig. 1, Table 2)

Analysing labour productivity of the former EU member countries (Fig. 2, Table 3) it can be confirmed that there are significant differences depending on economic sizes: larger farms are usually more efficient than smaller ones. Labour productivity of large farms with 80 to 85 thousand $EUR \cdot capita^{-1}$ is 10 to 12 times higher than of small ones.



Source: own construction

Fig. 1 Characteristics of the capital efficiency in the former EU member countries

Table 2 Results of the statistical analysis of the capital efficiency in the former EU countries

Country	Mean	Maximum	Minimum	Std. Dev.	Probability
B	2.77	3.26	2.17	0.3195	0.7416
DE	1.73	2.07	1.34	0.2099	0.7539
DK	1.54	1.75	1.33	0.1255	0.8820
E	2.74	3.60	1.78	0.4309	0.9478
F	1.74	2.19	1.49	0.2488	0.2267
GR	1.51	2.12	1.09	0.3513	0.4077
I	1.20	1.53	0.88	0.2082	0.5403
NL	1.73	2.55	1.35	0.3593	0.1845
P	1.16	1.54	0.89	0.1525	0.4696
UK	1.66	2.02	1.32	0.2112	0.5750

Source: own calculation

In 2004, the permanent development of farm efficiency was broken in the European Union due to the accession of new members. (Fig. 3) The EU-10 group has much lower efficiency indicators as the EU-15 countries. The labour productivity of the EU-10 is only 36% of the EU-15 countries which is due not only to the lower technical equipment supply (60%) but to the inefficient capital (asset) use (72%) as well.

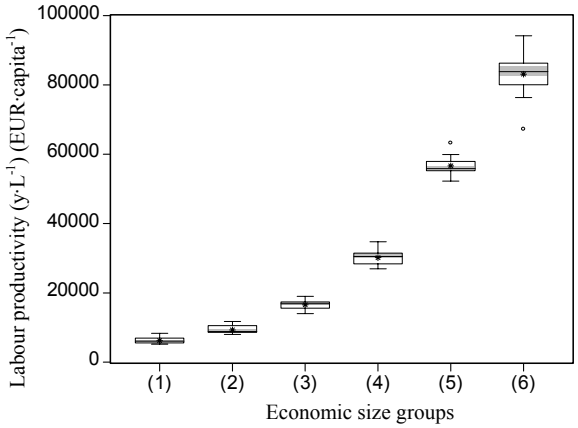


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Fig. 2 Characteristics of the labour productivity according to economic size

Table 2 Results of the statistical analysis of the labour productivity according to economic size

	(1)	(2)	(3)	(4)	(5)	(6)
Mean	6216	9346	16583	30153	56658	83112
Maximum	8324	11769	19017	34734	63221	94153
Minimum	5208	8041	14017	26970	52266	67249
Std. Dev.	889.55	1170.67	1264.68	2129.09	2614.46	6183.54
Probability	0.4010	0.3550	0.9010	0.7944	0.3116	0.3603
Observations	17	17	17	17	17	17

Source: own calculation

Every economic farm size category decreased the efficiency indices especially at large scale farms (over 100 ESU), which means that the large farms in the EU-10 countries are usually less efficient than in former member countries, despite of the fact that the productivity of these farms is the highest. (Fig. 4) During the 1990s in most of the size categories the labour productivity did not change significantly, technical supply rose and at the same time capital efficiency decreased.

It is a very interesting observation that the average labour productivity at the largest economic size category (6) of the EU-25 fell significantly, with 30% after 2004 from 9500 to 6700 EUR·capita^{-1}, which indicated lower labour productivity of the large-scale farms in new member countries.

According to farm activities the labour productivity usually decreased, especially in farms specialized in field crop, mixed (crops and livestock) activities and granivores. (Fig. 5)

Differences of the labour productivity in different specializations are considerable between the farms of former and new member countries, especially regarding animal husbandry (farms specialized in milk, granivores, as well as crop and livestock).

Categorizing member countries according to efficiency results that new members usually have much lower labour productivity than most of the former EU countries. (Fig. 6)

Centre of the efficiency of the new member countries is in the third part, which means that both the technical equipment and the capital efficiency of this group is below the average. They belong to the group of the waster poor. Position of Hungary and the Czech Republic is better, they are on same labour productivity isoquantum curve, close to the EU efficiency centre. Slovakia has a significantly higher capital efficiency, but the labour productivity is lower than in Czech or Hungarian agriculture. Due to higher capital efficiency, its farms are considerable competitive.

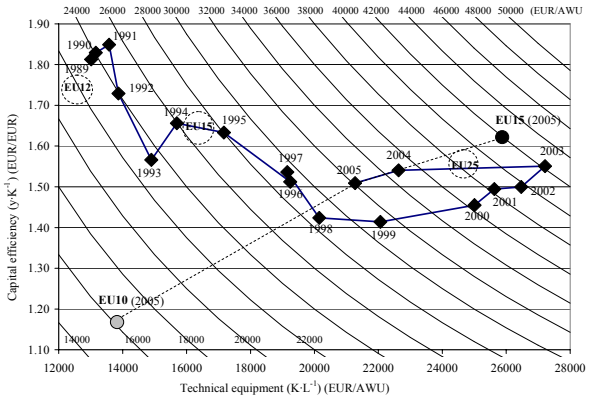

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Fig. 3 Changes of capital efficiency depending on technical equipment supply in the agriculture of the European Union from 1989 to 2005.

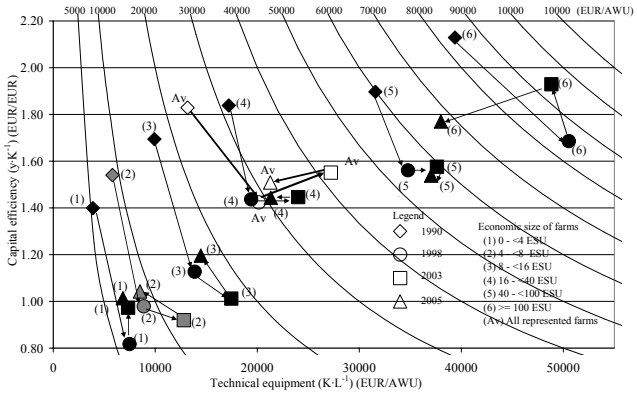

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Fig. 4 Changes of capital efficiency depending on technical equipment supply in the agriculture of the European Union according to economic farm sizes from 1989 to 2005

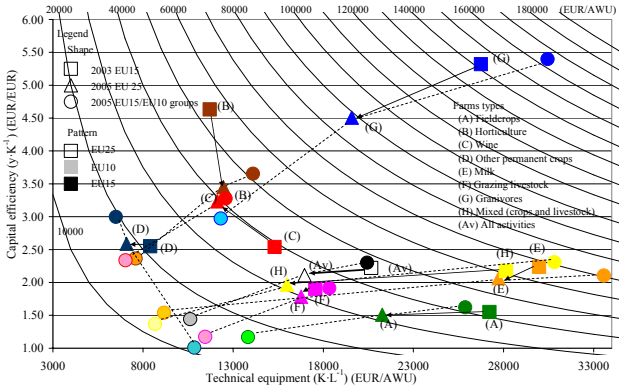

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Fig. 5 Changes of capital efficiency depending on technical equipment supply in the agriculture of the European Union according to farm specialization from 2003 to 2005

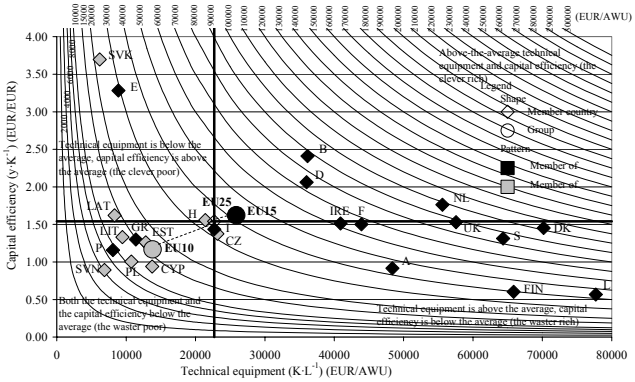

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Fig. 6 Position of the EU member countries according to economic capital efficiency and technical equipment supply in the agriculture in 2005

IV. CONCLUSIONS

The final conclusions of examinations on the basis of statistical and FADN databases are as follows:

- The productivity of labour has increased in the EU agriculture, which resulted that the annual labour use has decreased by more than two million persons in the last 15 years, besides increasing output;
- Production in a group of countries is made with high input, which contributes to the balancing of production, but the cost impact is also significant;
- When forming efficiency groups, it is obvious that the dominance of the wasting poor is significant (almost half of the member countries belong to this group and most of them are from the newly accessed countries);
- The agriculture of new members is at competitive disadvantage in this comparison. The only chance of these countries is the decreasing gap which develops capital (asset) efficiency by cooperation and modernization of technologies, because there is not enough capital to invest in the agriculture in order to multiply technical equipment.
- The labour productivity is considerably lower in the new member countries than in the former ones, especially those farms are less efficient which deal with animal husbandry (farms specialized in milk, granivores and mixed (crop and livestock) production). The farms of the new members are equipped at lower level than those of the former member countries, and, at the same time the capital efficiency is also lower in the newly accessed countries.

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Dr. hab István TAKÁCS, PhD
Szent István University, Faculty of Economics and Social Sciences
Páter Károly 1.
Gödöllő
Hungary
takacs.istvan@gtk.szie.hu