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USING THE TFP INDEX TO MEASURE CHANGES IN AGRICULTURAL PRODUCTIVITY IN THE EU

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Abstract: *In its development paper Europe 2020, the European Commission defined the ambitious goal of raising the level of resource efficiency. As a means of achieving this goal in the agricultural sector, the demand for increased productivity was replaced by the naturally based development of agriculture, which should be based on scientific foundation. The main results of this change should be higher outputs obtained with less investment. The aim of this paper is to determine whether this requirement is met. In this context, and in this paper, an analysis of the trends in agricultural productivity in the countries of the European Union in the period 2005-2015 was carried out by using the model of total factor productivity. The selection of the TFP index for measuring agricultural productivity in the paper proved to be correct since it enabled us to determine which of the several observed input factors had the greatest impact on the observed productivity trends. A general conclusion derived from the obtained results is that the overall productivity of agriculture in the EU has slowed growth in recent years and has started to lag behind leading global competitors. This indicates that, observed by the standards of modern agriculture, the modest growth of productivity in agriculture, is based on unsustainable principles, primarily in the intensive reduction of employees in agriculture, rather than on the application of scientific achievements. In the circumstances of limited natural resources, these achievements are the only possible source of sustainable growth.*

Keywords: *Total factor productivity, Agricultural productivity, European Union*

JEL classification: *Q10, Q11, Q18.*

INTRODUCTION

Economic theory claiming that the richness of the nation is dependent on the available quantity of its natural resources has been abandoned a long time ago and replaced by a proven theory that the main cause of an increase in well-being

of the population is a more effective production, or in the productivity (Basu S., L. Pascals, F. Schiantareli Serv, L., 2013). This theory has been confirmed by the fact that in the past 20th century a lot of progress in reducing poverty in the world was achieved due to the growth of productivity in agricultural production (OECD, 2001). Today, approaching the end of the second decade of the 21st century, agricultural production is again gaining importance, where once again raises the question whether this branch of production can give answers to numerous challenges facing the world in the coming decades. This primarily refers to the possibility of meeting the food needs of a population of over 9 billion people; a figure population of the planet is expected to reach by 2050. According to estimates by FAO (2013), the global agricultural productivity in the coming decades should grow by approximately 1.75% in order to supply sufficient quantities of food in the future. The European Union, which is itself determined to the role of the world's leading economic entity in the coming decades, should be one of the pillars of this growth.

Growth in the volume of agricultural production today, in conditions of limited natural resources, climate change and growing demands for respect of the principles of sustainable development is possible only by increasing the agricultural productivity. It is also impossible to raise further this productivity by the increase of natural input factors. However, its growth should primarily be based on the application of new scientific innovation achievements - in order to increase outputs by using existing (or even decreasing) material resources (Doberman and Nelson, 2013, European Commission 2012). Such development path defined by the European Union's last reform of its agricultural policy is consistent with the ruling development strategy (Europe 2020). According to this document, one of the main objectives to be reached is effectively sustainable use of resources and environmental protection along with the development of new green technologies and production methods (Ilić, Krstić, Jovanović, 2016).

However, recent analysis based on statistical data from the European Commission shows that agricultural productivity in this region in recent years has stagnated, and in some member states even decreased. According to the latest summary report of the European Commission published in the EU Agricultural Markets Brief in December of 2016, average productivity growth in agriculture in the EU between 1995 and 2005 was 1%, while in the next decade (between 2005 and 2015) was reduced to 0.8% (European Commission, 2016). This trend is considered to be unsustainable, both in terms of the competitiveness of the EU compared to other global food manufacturers, the US, Australia, Canada and

China, and in terms of opportunities for further growth of total world agricultural productivity in which the EU has always had a major impact. Therefore, this paper analyzes the main trends in the growth of agricultural productivity of the European Union, in order to determine the main indicators that explain current growth up to now. The paper also presents the results obtained on the basis of data published by Word Bank and FAO. It has been found that the data of these two institutions on the changes of agricultural productivity in the EU, which is based on the statistical database United States Department of Agriculture, differ from the data displayed by Eurostat, as the official source of statistics of the European Union.

However, both papers agree in their assessment that the main factor on which productivity increase in the EU was based in the last decade was labor factor, namely a significant reduction in the workforce in the agricultural sector. Taking into account that in modern economies the productivity of capital and intermediate consumption are considered as the main indicators of the success and of further development of agriculture, the obtained results suggest that the management of productivity in the European Union should be approached in a different way in order to fulfill the principle of a science-based management.

METHODS AND DATA

Productivity in agriculture of the EU for the defined period from 2005 to 2015 was observed in this paper. The performed analysis was based on data on realized productivity of the EU agriculture accounted by the Total Factor Productivity in agriculture index (TFP index), as the main criteria used in the economic accounts for agriculture of the European Union, a leading Eurostat. TFP index is regarded as the combined effect of several factors that include new technology, increasing efficiency, economies of scale, managerial skills and changes in the organization of production.

Total Factor Productivity index is expressed as the ratio between the Output Index -i.e. the change in production volumes and considered over a period- and the Input Index - the corresponding change in inputs / factors used to produce them (Coelli at. all 2005, pp. 66). The main output of the entrance is the gross agricultural production, while the inputs are usually divided into six categories: labor factor, the factor of agricultural land, capital (which is expressed in two forms - machinery and livestock) and intermediate consumption ((also expressed in two forms - as a consumption of inorganic fertilizers and animal consumption as food).

TFP index, due to different reference periods, which include statistically processing, is used in two different analytic forms. The first is Laspeyres indicer, which is defined as the arithmetic mean of the observed factors referred in 0 at time zero (the base year). Another form is Paasche index, which measures the factors, referred to in the time t (current year).

Geometric mean and Laspeyers Paasche index is typically represented by Fishcer Index, which is calculated by the following formula:

$$TFP\_F=\sqrt{TFP\_L * TFP\_P}.$$

The main source of data in the paper are the Economic Accounts for agriculture (EAA) published by Eurostat to obtain data regarding the individual values of selected factors and total (TFP) productivity, which later in the paper were compared by the correlation coefficient.

The complementary data were collected from the following sources:
- European database, where the relevant data from the database European account for agriculture were collected from;
- Brief EU agricultural market, No. 10, December 2016 - as a document in which the analyzed data on actual growth rates of productivity per individual members is represented, which was later compared with the data from other sources;
- USDA database for control data on realized European and total world productivity, which were compared with Eurostat data;
- World Bank database for information on the realized partial labor productivity in individual countries and regions of the European Union;
- FAO (Food and Agriculture organization of United Nations), for information on the status and projected trends in the world of agriculture.

REFERENCE OVERVIEW

Productivity is commonly defined as a ratio of a volume measure of output to a volume measure of input use (OECD, 2001). The classical economic theory measures productivity as the productivity of production factors, where labor and capital are considered as basic input factors of production. In this case, productivity implies measures of the efficiency of these two factors in the process of production (Jaško et al., 2014, pp. 331-339). In order to make optimal decisions regarding the combination of production factors, it is necessary to conduct the analysis of productivity. The

classical method of calculating the productivity is expressed by the formula:
$Y = A \times L\alpha \times K\beta$
Y = total product, monetary value of all goods and services made in some time,
L- labor factor,
K - capital factor,
A - productivity factor, based on the specific technology,

α and ß - output elasticity of labor and capital, i.e. a constant that indicates the degree of influence factors on the output, caused by changing technology. In labor-intensive technology α value is higher, while in the technologies that are capital-intensive value ß is higher. In the economic literature a number of ways of productivity measurement based on the technology and the working factor have been shown, and a significant development of the mathematical models of measurement were gained (Saiford L. and Thrall R. 1990).

Measuring of agricultural productivity can be, as well as in other activities, carried out by analysis of partial productivity of each individual factors, such as relations of effort and output, ratio of invested capital and production value etc. This method of measurement can provide important information to improve individual factors of production, but, as already said, it does not provide a complete picture of the relations between the input and output components. Therefore, the measurement of agricultural productivity is increasingly using Index of Total Factor Productivity (TFP).

Index of full productivity based on yields, is established by measuring the change of the productivity in successive periods, by comparing changes in the yield of production factors released from the influence of the price disorders (Jaško et al., 2014). This allows direct connection of changes in the productivity of the effectiveness of technological changes or changes in the use of input factors. Using the TFP index we can observe several input elements. By choosing this method, a dilemma which often arises in statistical surveys is avoided, which concerns the question of whether the function selected for measurement best represents the trend of the observed phenomenon (Grandov Z., Stankov M., and Djokić M. 2013: 173). For comparisons made using the total productivity factor, revenue and costs are used in two consecutive periods. This allows direct connection of changes in the productivity and the effectiveness of technological change or use of inputs. Income and expenses are used for comparison in two consecutive periods. Productivity in agriculture has not been for a long time seen only as the production of large quantities of food or effective yield. The purpose of Total Factor Productivity index is to

understand the relationship between agricultural outputs (gross crop and livestock output) to inputs (land, labor, fertilizer, feed, machinery and livestock). This index allows the consideration of changes in the efficiency of transforming inputs into outputs based not on increasing inputs, but as a result of innovation adaptation (Hulten at al., 2007).

For measuring total factor productivity, Kors Malmquist productivity index is mostly used in the literature, as well as Hicks-Moorsteen indices, Laspeyres indices and Paasche indices. Malmquist index established by Rolf (FARE Fare R. Lovell Cak, 1988) is often applied in the analysis of manufacturing productivity, but some consider that its accuracy in measuring the productivity is questionable in situations of inconstant yield (Arjomand A, Salleh I. Mad, Mohammadzadeh A. 2015). Therefore, more and more theorists have committed to using Hicks-Moorsteen index as a more flexible indicator, particularly useful for measuring changes in productivity and elaborate technical efficiency (Grifell-Tatje and Lovell 1995), (O'Donnell 2010 and 2012), and (K. Kerstens and Van de Woestyne 2013).

For measuring of agricultural productivity Laspeyres Paasche (and Machek Špička) indices are most often used. The geometric mean between the two indices is calculated by the usual Fischer index (Dewait and Nakamura, 2002). These three indices, Laspeyres and Paasche and Fisher index, are used by Eurostat for calculating TFP index productivity of the European Union.

However, regarding the use of these indices in theory there is no full consent (Baráth and Fertő 2016). It is believed that they are suitable for analysis when considering the prices of inputs and outputs, while without the price data, it is best to use Malmquist, Hick-Moorsteen and Fare - Primont indexes.

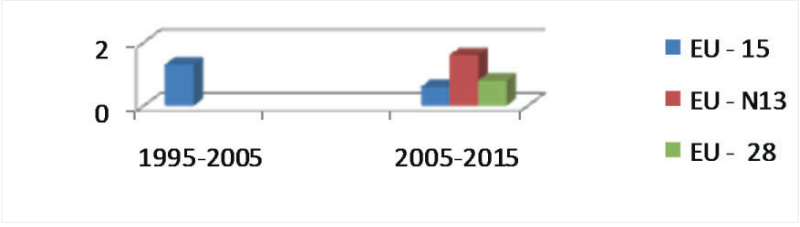
Regarding the great importance and the contribution that the productivity of agriculture has in the whole world of economy, it has constantly been studied in scientific and professional studies throughout the world. About the developments in this field thousands of studies have been published, such as Lao and Yotopoulos (1981), Johnson and Gale (2000), Foster and Rosenzweing (2003), Doberman and Nellson (2013) and others. In addition, several international institutions like the World Bank, FAO, the European Commission, UNCTAD and other, issue their periodicals on general economic trends that include the field of agriculture. Also, they all have their own specific annual or many years of statistical overview of the trends in agriculture and thematic reports are compiled for the purposes of the annual conferences and other meetings that address management policies in agricultural development.

All studies have fully confirmed the fact that agriculture in the world in recent decades has had a constant growth rate, namely by 2005, thanks to which it has significantly reduced poverty in the world and achieved great economic progress. Such favorable rating is also valid for the movement of the productivity in the European Union in the last 60 years, as indicated by the analyses which are carried out by the following authors among the others (Y. Hayami, V. W. Ruttan 1970, 1971, 1986), (L. E. Fulginiti, R. K. Perrin 1993, 1997), (Coelli 1998 and Serrao 2003).

RESULTS AND DISCUSSION

Agricultural production in the past fifty years has expressed a high rate of growth of total production, which is accomplished thanks to high productivity (Fuglie, Wang and Ball 2012, pp. 13-22). In developed countries, and therefore in most current EU member states, in that period maximum yield levels have been achieved, as observed by the employee, and per hectare. This growth was primarily due to the high increase of inputs that today are considered degrading in terms of the environment, such as high quantities of fertilizers, increased irrigation and greater use of machinery. The outbreak of the global economic crisis in 2008 resulted in a general decrease in economic activity in the world, with its consequential negative impact on the results of agricultural productivity in the European Union. Comparative analysis of the productivity growth, reported by Total Factor Productivity index for the period between 1995-2005 and for the period 2005-2015, which were published in EU Agricultural Market Brief, No. 10, December 2016 show a decline in the productivity of 1.3% in the first reporting period, to 0.8% in the second. In the last decade the analyzed agricultural productivity has increased by a total of 9% (EU Commission 2016). This analysis also confirmed that there is a gap between realized productivity in some EU member states. TFP annual growth in the period 2005-2015 was the largest in the EU-N13 and amounted to an average of 1.6%, while in the EU-15 was significantly lower and amounted to only 0.6% (Graph 1).

Graph 1. TFP annual growth in EU



Source: Author view according to EU Commission -EU Agricultural Market Brief, No. 10, December 2016.

On the other hand, agricultural output, which in 2015 reached the amount of 165.7 billion euros, was 8.2 % higher than the first observed in 1995. But its average growth in the period 2005-2015 is half, 4.2%, due to the fact that in 2009, there was a decline of 11.2%, and, in 2010, of 1.1%. Overall results on the movement of EU productivity would have been even worse if this analysis included the previous 2016, in which value added amounted to 159.6 billion euros, a decrease of about 4% compared to 2015.

Agricultural productivity and the growth of agricultural production in the world have experienced similar trends, but in some countries, especially in those that have been the main competitor to the European Union in the world, agricultural market growth rate is quite favorable. According to the USDA (United State Development Agriculture) that processed the summarized data for the period 2001 to 2013, TFP growth in the European Union is approximately 1.5% per year, which is much higher than shown by Eurostat. But no matter which results are accurate, they both agree that agriculture of European Union begins to lose its competitiveness and that the only region that has a lower productivity than EU is Sub-Saharan Africa (Table 1).

Table 1. Change in global agricultural output, inputs and Total Factor Productivity by region, 2001-2013 (Average annual growth)

Global region	Agri-cultural output	TFP index	All inputs	Land	Labour	Machi-nery capital	Live stock capital	Fertili-zers	Animal feed
Developed countries	0.55	1.92	-1.37	-0.11	0.81	-0.12	-0.02	-0.20	-014
North America	1.05	1.80	-.075	-0.11	-.044	-0.06	-0.03	0.17	-0.28
Europe	-0.07	1.51	-.158	-005	-1.00	0.08	-0.04	-0.32	-0.09
Developing coun. .	3.36	1.93	1.43	0.20	-0.07	0.48	0.20	0.37	0.23
Asia (exc. W. Asia)	3.43	2.57	0.86	0.18	-0.33	0.33	0.20	0.27	0.21
Latin America	3.12	2.14	0.98	0.14	-019	0.11	0.08	0.59	0.25
West Asia & North Africa	2.48	2.10	0.39	-002	-0.19	0.18	0.10	-013	0.27
Sub-Sah. Africa	3.24	0.58	2.66	0.65	0.59	0.06	0.87	0.28	0.21
Transition economies	1.76	1.73	0.03	-.004	-0.38	-.011	-011	0.29	0.29
World	2.52	1.69	0.83	-0.08	-0.09	0.20	0.15	0.31	0.19

Source: USDA, Economic Research Service, International Agricultural Productivity data product (available at: https://www.usda.gov)

Analyzing the reasons for modest growth in the productivity of EU agriculture, it was concluded that the main reason is the inadequate representation of the factors of its growth. Namely, since the primary purpose of TFP measurement is the efficiency with which all inputs in agricultural production are transformed into outputs, it is the basic requiremens of a modern economy that realized output results are based on the use of new scientific and practical innovation rather than on capital inputs. This means that the basic tendency is a more efficient use of existing inputs or resources. However, the productivity of EU agriculture is based on wrong principles and owes its growth mainly to reducing the number of employees (Madre Y, Devuyst, P, 2017). This can be concluded from the analysis of the data in Table 2 which shows that the three regions (Asia, Latin America and West Asia & North Africa), which in the period from 2001 to 2013, recorded the highest growth of TFP (2.57, 2.14 and 2.10). These regions, in the observed period, had a small percentage of decreased factor of labor (-0.33, -0.19 and -0.01), compared to Europe and the developed countries where the ratio was -1.00 and -0.81. In contrast, the investment in the intermediate consumption factors (machinery capital and livestock capital) in regions with a higher productivity had a positive rate of growth, while in Europe and the industrialized countries resulted in its reduction. This unfavorable trend in decreasing intermediate consumption factors that should be the holder of the application of new scientific achievements and contribute to increasing agricultural productivity can be observed from the analysis of the results achieved in 2014 and 2015. Despite the EU's efforts to improve the innovative climate in agriculture, intermediate consumption was reduced by 2.2%

The thesis that the downsizing is the main driver of EU agriculture over the past decade is represented in the official reports of the European Commission, and, in this paper, it will be further tested through the analysis of the impact factors of the workforce and intermediate consumption to gross value added of agricultural production in the European Union for the period 2005- 2015. The starting point is data of the European agrarian account for the observed factors - labor, intermediatte consumption and gross value edit. Verification of the hypothesis was done by calculating a correlation coefficient between the two input factors - labor and intermediate consumption, with newly added as the main input factor (table 2 and 3).

Table 2. Correlation gross value edit and labor force in the EU (2005-2015)

State	Coefficient of determination	Standard error	Coefficient of correlation
EU (28 countries)	0,341635892	8667,8762	-0,5845
EU (15 countries)	0,199932425	7705,3142	-0,44714
Belgium	0,009693964	243,86865	0,098458
Bulgaria	0,1265804	196,7721	-0,35578
Czech Republic	0,294422497	217,75816	-0,54261
Denmark	0,237281606	527,90813	-0,48712
Germany	0,161041031	2416,8661	-0,4013
Estonia	0,362562281	50,976405	-0,60213
Ireland	0,284299916	383,49597	0,533198
Greece	0,589973873	497,58565	0,768098
Spain	0,025789273	1459,2135	0,16059
France	0,042673266	2343,7707	-0,20658
Croatia	0,058442471	161,56925	0,241749
Italy	0,373272245	1780,3386	-0,61096
Cyprus	0,241148029	20,380337	0,491068
Latvia	0,008337674	49,355242	0,091311
Lithuania	0,262313251	206,59292	-0,51217
Luxembourg	0,000286583	14,893426	-0,01693
Hungary	0,074639014	519,61566	-0,2732
Malta	0,020911135	2,3469626	-0,14461
Netherlands	0,085419731	679,95288	-0,29227
Austria	0,323707939	228,8232	-0,56895
Poland	0,494068026	810,22469	-0,7029
Portugal	0,280402296	198,25975	0,52953
Romania	0,028162194	811,32236	-0,16782
Slovenia	0,050181046	48,200717	0,224011
Slovakia	0,025584561	111,546	-0,15995
Finland	0,063118571	159,83115	0,251234
Sweden	0,37333329	203,07898	-0,61101
United Kingdom	0,021552356	1916,3793	0,146807

Source: Author projection according to European agricultar accounting table ((aact_ali01) and (aact_eaa01)

Table 3. Correlation gross value edit and intermediate consumption in the EU for the period 2005-2015.

State	Coefficient of determination	Standard error	Coefficient of correlation
EU (28 countries)	0,543132753	7220,6224	0,736975
EU (15 countries)	0,428893815	6510,0669	0,6549
Belgium	0,001331339	244,89616	-0,03649
Bulgaria	0,212281231	186,86917	0,46074
Czech Republic	0,518797671	179,83157	0,720276
Denmark	0,209742059	537,35423	0,457976
Germany	0,200554277	2359,265	0,447833
Estonia	0,411078189	48,998089	0,641154
Ireland	0,234824926	396,52966	0,484587
Greece	0,657782927	454,58272	-0,81104
Spain	0,011097583	1470,1752	-0,10535
France	0,030801567	2358,2584	0,175504
Croatia	0,453092415	123,13804	0,673121
Italy	0,364092287	1793,3299	0,603401
Cyprus	0,11855397	21,964974	-0,34432
Latvia	0,034662781	48,695733	0,186179
Lithuania	0,858468631	90,491084	0,926536
Luxembourg	0,067999008	14,380204	0,260766
Hungary	0,520919884	373,87869	0,721748
Malta	0,299290504	1,9854736	-0,54707
Netherlands	0,063936598	687,89244	0,252857
Austria	0,429937232	210,08461	0,655696
Poland	0,668420414	655,92367	0,81757
Portugal	0,488446738	167,16105	-0,69889
Romania	0,570613408	539,28804	0,75539
Slovenia	0,024151047	48,856729	-0,15541
Slovakia	0,221377376	99,711545	0,470508
Finland	0,10691954	156,05023	-0,32699
Sweden	0,568673072	168,48062	0,754104
United Kingdom	0,959857682	388,16279	0,979723

Source: Author projection according to European agricultar accounting table (aact_ali01) and (aact_eaa01)

The results obtained show that the gross value added and labor force are inversely proportional. The correlation coefficient for the EU 28 in the period 2005-2015 is negative and is -0.5845 which approaches significant difference and confirms the assumption that the main source of productivity growth in the

EU was workforce reductions. The largest reduction in the workforce happened in Sweden, Italy and Estonia, while the smallest outflow of workers from agriculture to other activities was recorded in Greece, Portugal and Ireland. The correlation coefficient between gross value added and intermediate consumption in EU 28 is 0.7365975 and is significantly higher than zero, which confirms the thesis that the main disagreement between the observed parameters of the relationship is between the workforce and newly added value.

CONCLUSION

Evident increase of needs for higher agricultural production in the world, to meet the needs for food of growing world population, can only be achieved by increasing productivity. However, limited natural resources, climate changes and the growing demands for the application of the principles of sustainable development in agriculture significantly limit many factors of growth in agricultural productivity. Following its commitment to become the most efficient economy until 2020, as the last goal of its development, the European Commission defined the growth of productivity in the agricultural sector on the principle of achieving more with less.

Movements in agrarian production of the European Union in previous years show that this goal, for now, is hardly achievable, both in achieving general growth, and even more so in achieving the principles of scientifically based productivity. This conclusion was achieved by analyzing the realized changes in the efficiency of EU agricultural productivity in the period 2005-2015, which was measured using the index of total factor productivity. The application of this index has made it possible to identify the essential characteristics of the movement of the productivity of agricultural production in the EU. Analysis of key inputs covered by the TFP index showed that the modest growth of agricultural productivity achieved in the EU is not based on scientific and technological efficiency, but solely by reducing the number of employees, or by reducing the number of engaged workers.

This is further proven by the analysis performed in this paper in which were observed the influences of two selected input factors of productivity - workforce and intermediate consumption to gross value added. The values obtained confirmed the expressed assumption that the reduction of the workforce in the reporting period had a substantial effect on the final results of agricultural production in the European Union.

These results are a warning signal that the management of the agriculture productivity in the EU should rapidly change a lot. Primarily, by improving its efficiency through the implementation of new, scientifically based innovation that should enable the achievement of higher productivity, and achieve greater production volume with fewer resources invested.

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PRIMENA TFP INDEKSA U MERENJU PROMENA POLJOPRIVREDNE PRODUKTIVNOSTI U EU

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Apstrakt: *Evropska komisija je u svom razvojnom dokumentu Evropa 2020, definisala ambiciozan cilj podizanja nivoa resurske efikasnosti. Kao način ostvarenja tog cilja u sektoru poljoprivrede, postavljen je zahtev povećanja produktivnosti zamenom naturalno zasnovanog razvoja poljoprivrede razvojem koji treba da bude zasnovan na naučnim osnovama. Glavni rezultati ove promene treba da budu veći izlazni rezultati dobijeni sa manje ulaganja. Cilj ovog rada jeste da utvrdi da li se taj zahtev ispunjava. Radi dobijanja odgovora na to pitanje u radu je primenom modela totalne faktorske produktivnosti izvršena analiza kretanja u poljoprivrednoj produktivnosti u zemljama Evropske unije u periodu 2005-2015. godine. Odabir TFP indeksa za merenje poljoprivredne produktivnosti u radu se pokazao ispravnim jer je omogućio da se utvrdi koji je od posmatranih više ulaznih faktora najviše uticao na kretanje posmtrane produktivnosti. Opšti zaključak izveden iz dobijenih rezultata jeste da ukupna produktivnost poljoprivrede u EU poslednjih godina usporava rast i počinje da zaostaje za vodećim svetskim konkurentima. Pored toga, izvršena analiza učešća odabranih pojedinačnih faktora u ukupnoj produktivnosti EU pokazala je da je najveći doprinos rastu produktivnosti u poslednjoj deceniji imao faktor rada. To ukazuje na činjenicu da se skroman rast produktivnosti u poljoprivredi EU, posmatrano po merilima moderne poljoprivrede, zasniva na neodrživim principima, pre svega na intenzivnom smanjenju zaposlenih u poljoprivredi, a ne na primeni naučnih dostignuća koja su u uslovima ograničenih prirodnih resursa jedini mogući izvor održivog rasta.*

Ključne reči: *Total factor productivity, Poljoprivredna produktivnost, Evropska unija.*

Jel klasifikacija: *Q10, Q11, Q18.*