

## **The Impact of the Main Determinants and Changes in Agricultural Labour Productivity in Macedonia**

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### **Abstract**

The aim of this paper is to analyze changes and impacts on the level of labour productivity in the agricultural sector in Macedonia in the period from 2006 to 2017. Labour productivity is an important determinant for establishing the competitiveness of a particular sector or overall economy and helps in creating the necessary conditions for economic development. Agricultural sector in many countries represents the basis for growth in gross domestic product. Agriculture plays a key role in development of the national economy in Macedonia as a third largest sector after services and industry. Therefore, in order to increase the agricultural labour productivity, it is necessary to increase agricultural production, i.e., the part of gross domestic product created by the agriculture sector. In this direction, the paper also analyzes the relationship between agricultural labour productivity and gross domestic product and employment in agriculture. Synthesis and analysis, induction and deduction, descriptive statistics, comparative analysis, correlation analysis and regression analysis are used for the purpose of the paper.

The results show that changes in gross domestic product in agricultural sector in Macedonia have a greater impact on agricultural labour productivity for the analyzed period compared to the impact of changes in the number of employees in the agriculture sector where the relationship is weak to moderate. Research results also showed that there is a positive and strong quantitative relationship between agricultural labour productivity growth rate and GDP growth rate in Macedonian economy. Agricultural GDP is the determinant which has to be influenced through intensification of agricultural production in order to increase the agricultural productivity.

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**Keywords:** Agriculture, productivity, labour, GDP, Macedonia

## **Introduction**

Agriculture plays a key role in the development of the national economy. Agriculture and industry are the two most important sectors of the economy, but also the service sector has gained importance in recent years. Agriculture is traditionally one of the most important sectors in the economy. The growth in agriculture and its productivity are considered essential for achieving sustainable growth and a significant reduction in poverty in developing countries. Productivity growth in agriculture has been a subject of intense research over the past five decades. Developing economists and agricultural economists have analyzed the sources of productivity growth and productivity differences between countries and regions (Rao and Coelli, 2004). In the past, the importance of agriculture was reduced to the role of providing labour surplus and capital for the industry, which was seen as a true engine for economic development (Kjosev, 2015). Today, agriculture plays an important role in Macedonia as a third largest sector after services and industry. It has always been one of the most important sectors in the economy. Without reducing or losing its role, the share of the agriculture sector in total gross domestic product is relatively stable. The stable share of agriculture in national gross domestic product, which average in the period from 2006 to 2017 is around 8.7%, is a result of a moderate development of this sector, as well as a large decrease in the industry activities.

Labour productivity is an indicator of the efficiency of production, which indicates efficient use of the workforce, as a vital resource or a factor of production (Krstic and Jankovic-Milic, 2003). In economic literature, total productivity refers to the amount of output derived from given levels of inputs, i.e. employees in an economy or sector. This is an important topic of research, since productivity is one of the two main sources of larger income streams, where the other source is saving. The significance and importance of strong growth in labour productivity have been strengthened by a number of key processes, as well as by a phenomenon of economic development. Current economic studies see labour productivity as a central problem for understanding the economic development. At the macroeconomic level, labour productivity, i.e. GDP per employee, depends on the dynamics of two aggregates (GDP and employment). Productivity will increase if GDP increases faster than employment. Separation of a labour market and a macroeconomic policy can lead to a higher employment rate without growth in GDP, hence leading to low productivity.

Although the reasons for differences in the level of economic development between countries are numerous, it can be assumed that the differences in economic development are due to the productivity differences and the factors that determine it such as physical capital, labour, natural resources and technological knowledge. In the long run, the only way to

increase economic growth and improve living standards of the population is to increase productivity. Major economists believe that labour productivity is a central problem in understanding the economic evolution. The rising growth rate of labour productivity in the 1990s is seen as a driving force for excellent economic performances (Blinder and Yellen, 2001).

The paper is organized in several parts. First part includes a current knowledge about agricultural labour productivity and agriculture as an economic sector, i.e. theoretical contributions through literature review. The second section covers the methodological approach applied to the research in this paper. The third part covers the theoretical background for the importance of the agricultural sector and agricultural labour productivity, as well as the role of human capital in increasing agricultural production and improving labour productivity. The analysis of changes in agricultural labour productivity in Macedonia within results of the impact of main determinants (gross domestic product and number of employees) on the agricultural labour productivity are presented and explained in the fourth part, and the last section covers the conclusion of the research, with some recommendations for improving the analyzed issue.

### **Literature review**

Agriculture faces with challenges and demands for efficiency, reduction of unemployment, competitiveness, technological progress, environmental protection, demand for greater organic production, rural development. There are authors that analyze the business cycles and have found that the strength of the economic recovery and of the labour market depend importantly on labour productivity. Filipovski, et al., (2017) investigate the degree of synchronization of business cycles in a small open EU-candidate country such as the Republic of Macedonia with the cycle of the EU economy. They apply linear and nonlinear methods for delineating the production gap cycle in the Macedonian economy and autoregressive methods to assess the size and speed of cyclical adjustment of the Macedonian economy to output shocks to the Euro-zone economy. The results of their analysis suggest: first, a high degree of synchronization of the Macedonian business cycles with the cycles of the EU economy; second, the shocks in economic activity in the Euro-zone economy are transmitted almost instantaneously, and with a large magnitude, to the Macedonian economy and third, the impact of the Euro-zone output contraction is less pronounced than the impact of the Euro-zone output expansion, suggesting an impact of the country's autonomous countercyclical economic policies.

Examining the relationship between labour productivity and GDP growth, Trpeski and Cvetanoska (2016) indicated that the relation between

labour productivity and economic growth significantly differs and it is not a constant or stable relation over the periods of time.

Meijerink and Roza (2007) indicated that agricultural sector in many countries represents the basis for growth in gross domestic product, development and competitiveness of the national economy and that in recent years there have been major changes in economic development of developing countries, and especially in the agricultural sector. According to them, there is a general consensus that agriculture is less productive, compared to non-agricultural sectors in terms of value creation. In other words, most countries dominated by non-agricultural sectors are richer than economies where agriculture dominates.

By definition, labour productivity is the ratio between the real gross domestic product and the number of employees (or the number of working hours). Hence, Kitov and Kitov (2008) showed that productivity growth is also driven by the only macroeconomic variable - GDP per capita or change in a certain age of the population.

According to Johnston and Mellor (as cited in Dethier and Effenberger, 2012), productivity in agriculture can play a vital role in economic growth by linking the supply and demand. For example, the agricultural sector supplies raw to industrial or other non-agricultural sectors and demand inputs from modern sectors such as science and information technology. On the consumption side, higher agricultural productivity can increase the income of the rural population and thereby create greater demand for domestically produced industrial output.

Polyzos and Arabatzis (2015) showed that labour productivity plays an important role in shaping the competitiveness of a particular sector or the whole economy and helps in creating the necessary conditions for economic development. In order to increase the agricultural labour productivity it is necessary to increase agricultural production.

Omorogiuwa et al., (2014) used trend analysis in terms of a historical and current perspective and various descriptive methods to analyse the development of Nigeria through each decade since its independence in 1960 and examined the factors that have had an impact on its agricultural productivity and they demonstrated that it is plausible for Nigeria to diversity into the agriculture market in their effort to become more self-sustainable and a world economic power.

In their study, Stanojevic et al., (2015) have written that modern farming and the modern way of organizing agricultural production requires not only increasing the level of knowledge of the agricultural population, but also a development of entrepreneurial skills and abilities, a competent, highly educated workforce that will easily adapt and accept new methods of modern agricultural production.

The increase in agricultural labour productivity in poor agricultural economies simultaneously increases the productivity of poor countries and its critical resources (the workforce in the agricultural sector), increases their real incomes and stimulates the supply and demand of non-food goods and services. According to Dorward (2013), creating supply and demand is crucial, but often there are no changes triggered by developmental interventions.

Gutierrez (2002) showed that countries which have greater agricultural labour productivity have higher rates of investment in physical and human capital. Hence, in the long run, the performance of the agricultural sector is determined by government policies aimed at promoting the development of institutions that will encourage farmers to invest, increase work skills and introduce new production methods.

Analyzing businesses operating in the rural areas, Mece (2016) found difficulty in hiring local workers for agriculture that are capable of matching the skills required for their jobs while the labour market appears to not include adequate mechanisms for job information dissemination.

Grycova (2014) estimated the significance of the influence of labour productivity in agriculture, calculated as the ratio of gross value added and total employment in the agricultural sector, on wages in agriculture, as labour productivity in agriculture can be a possible solution to the problem of wage differentials.

Trpeski et al., (2016) analyzed the relationship between agricultural labour productivity and real net wages and found that in the post crisis period agricultural labour productivity has an impact on real wages in agriculture.

Hence, the aim of this paper is to calculate the level and changes in agricultural labour productivity regarded to its main determinants, as well as to examine the interdependence between agricultural labour productivity, gross domestic product and number of employees in agriculture in order to indicate the critical determinants of productivity that require improvement. The hypothesis which arise from the subject and problem of research assumes that level and changes in agriculture labour productivity in Macedonia are a result of the changes in the gross domestic product in agriculture and the number of employees and that the impact of gross domestic product on agriculture labour productivity is greater than the impact of the number of employees. Knowing the changes and determinants is essential for understanding the importance of agricultural labour productivity for the economic growth.

### **Methodological approach**

Methods, such as synthesis, analysis, induction and deduction, descriptive statistics, comparative analysis, correlation analysis and regression analysis, are used in order to calculate the level and changes in agricultural

labour productivity regarded to its main determinants, as well as to examine the interdependence between agricultural labour productivity, gross domestic product and number of employees in agriculture. Correlation analysis and regression analysis have been used to show if there is a link between labour productivity in agriculture and gross domestic product in agriculture in Macedonia and how productivity in agriculture is important for economic growth.

Labour force, as an input in the production of goods and services, can be measured in two ways: as an average annual number of employees or as a total number of working hours per year. The second way of expressing labour as an input in the production process is more convenient for determining the labour productivity. But, in the calculation of productivity, it should be clearly defined how labour as an input is measured. Output growth rates per worker and number of working hours may vary when there is a change in working hours over time. Historically, a large drop in average working time would mean that hourly production increases significantly faster than the output per worker (Sharpe, 2002).

For the purposes of this paper, output, i.e. gross domestic product per employee, is taken as an input for calculating labour productivity because the procedure for calculating labour productivity in the long run is simpler and overtime or overtime working hours are very common and not fully registered in the past period in Macedonia. Therefore, in order to analyze labour productivity, as an indicator of efficiency, number of employees in agriculture is taken as a denominator for calculating the labour productivity ratios.

A level of productivity and a productivity growth rate are also used to analyze the agriculture labour productivity in Macedonia. The level of productivity shows how much the gross domestic product is generated per employee in the current year, while productivity growth rates show the change in two different periods.

Official data from State Statistical Office of the Republic of Macedonia and National Bank of the Republic of Macedonia are used for the qualitative and quantitative analysis. A chain index is used in order to calculate changes in gross domestic product, number of employees and agricultural labour productivity, while for calculating changes in labour productivity under the influence of gross domestic product ( $K_{pg}$ ) and changes in labour productivity under the influence of number of employees ( $K_{pl}$ ), following formulas are used (Krstic and Sekulic, cited in Stanojevic et al., 2015):

$$Kpg = \frac{Kg^4}{1 \pm KI^5} \times 100$$

$$Kpl = \frac{KI}{1 \pm KI} \times 100$$

### **The significance of agricultural sector and the effect of human capital on agriculture labour productivity**

Agriculture in Macedonia has become an aim of research after gaining its independence. Since then, agricultural policy has been involved in overall changes in Macedonia's economy, from a centralized to a market-oriented model. The aim of this agricultural policy in Macedonia was directed towards creation of market-oriented production, liberalization of agricultural production from the state protection and stimulation of individual agricultural sectors for increasing productivity. Today, agriculture and its development are key pre-accession elements of Macedonia for joining the European Union.

In the period 2006 - 2017, the share of agriculture in total GDP in Macedonia is relatively stable and amounts at approximately 8.7%. The constant share of agriculture in total GDP is due to the modest recovery of the sector and the simultaneous decline of production sector share. In the period of economic restructuring, agriculture has contributed to the country's social and economic stability.

The following table gives a more detailed overview of the share of agricultural sector in total gross domestic product in Macedonia.

Table 1. Share of agricultural sector in Macedonia for the period 2006 – 2017

|        | Total GDP* | GDP of agriculture (% of total GDP) |
|--------|------------|-------------------------------------|
| 2006   | 324292,0   | 9,2                                 |
| 2007   | 345285,0   | 8,8                                 |
| 2008   | 364179,0   | 10,3                                |
| 2009   | 362873,0   | 10,6                                |
| 2010   | 375061,0   | 8,9                                 |
| 2011   | 383837,0   | 8,8                                 |
| 2012   | 382086,7   | 7,4                                 |
| 2013   | 393262,1   | 7,9                                 |
| 2014   | 407535,0   | 7,8                                 |
| 2015   | 423249,4   | 7,7                                 |
| 2016   | 435564,3   | 9,1                                 |
| 2017** | 320563,2   | 7,5                                 |

\* GDP is expressed in million denars

\*\* The amount refers to the first three quarters and it is estimated

Source: National Bank of the Republic of Macedonia: Quarterly

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<sup>4</sup> coefficient of change in agricultural gross domestic product in the current period (t) compared to the previous period (t-1)

<sup>5</sup> coefficient of change in a number of employees in agriculture in the current period compared to the previous period (t-1)

Agricultural productivity is important for many reasons. Beside the production of goods which are of primary concern to people, productivity is important for providing growth prospects and competitiveness on the agricultural market, income distribution, and labour migration. An increase in agricultural productivity implies greater efficiency in the distribution of rare resources. Furthermore, those more productive producers provide greater well-being for themselves than those who are less productive, who would leave this sector and seek greater opportunities in other activities. Agriculture is an important economic activity in any national economy, even for countries where the market economy has been developed. Kjosev (2015) has written that the reasons lay in the role that agriculture has in the wider economy. Namely, the country can start with the process of achieving economic development only at the moment when agriculture will be able to provide an abundance of food for the entire population in the country. Usually, a modern farming is an important component of the demand for industrial products and other services. Agricultural productivity growth leads to a growth in the agricultural sector and it can especially contribute for poverty alleviation in poor and developing countries, where agriculture provides jobs for the vast majority of the population.

Having in mind the importance of human capital for agricultural productivity growth and taking into account the general perception that agriculture is a labor-intensive sector, it is also important to make an analysis of some dimensions of agricultural population. The reasons for a development or a decline in agriculture, and hence in the labour productivity of an economic sector or a country, can be not only due to a favorable or an unfavorable position and natural resources, but also due to the institutionalization and management of human resources in the country. Economists have long been interested in evaluating the capacity of workers in the economy in terms of productivity. Human capital defined as a fund of knowledge, skills and abilities determines the level of productivity of individuals. In principle, this includes the abilities and skills acquired through education, training and experience.

Generally, farmers acquire necessary knowledge through an educational system. However, beside formal education system, farmers receive additional information, knowledge, recommendations and advice through advisory services of the appropriate responsible ministry.

Formal education for agriculture in Macedonia takes place in secondary agricultural schools, higher vocational schools and higher education institutions. Non-formal education is not institutionalized and is implemented irregularly, within national and international projects. The structure of Macedonian agriculture is characterized by a large number of individual and small agricultural economies whose human resources are



characterized by a relatively low educational level (Ministry of Agriculture, Forestry and Water Economy, 2014).

The number of students in Macedonia enrolled in the higher education system in the field of agricultural science is 2.5% in average in the period from 2010 to 2017, and it has been falling dramatically since 2015 (Table 2). This points to the fact that the interest in formal education in this field is very low.

Table 2. Students enrolled at faculties of agricultural sciences in Macedonia in the period 2010-2017

| Year | Total number of students* | Students at faculty of agricultural science (%) |
|------|---------------------------|---|
| 2010 | 50110                     | 2,42  |
| 2011 | 43686                     | 2,81  |
| 2012 | 50761                     | 2,79  |
| 2013 | 49675                     | 2,32  |
| 2014 | 49420                     | 2,64  |
| 2015 | 51093                     | 2,62  |
| 2016 | 51845                     | 2,38  |
| 2017 | 51949                     | 2,15  |

\*The amounts refer to the number of students enrolled at state faculties / universities

Source: Statistical Yearbook of the Republic of Macedonia 2010,2011, 2012, 2013, 2014, 2015, 2016, 2017

As an example of analysis in terms of education, a number of employees in agricultural enterprises and cooperatives in Macedonia has been taken. Table 3 shows the same declining trend of higher education workers compared to the share of employed persons with secondary education who has seen a significant increase in recent years. Furthermore, the number of employees with secondary education is significantly higher than the number of employees with higher education in the period after 2012.

Table 3. Employees in agricultural enterprises and agricultural cooperatives in Macedonia according to the education profile, 2008 - 2016

| Year | Total number of employees* | Employees with higher education (%)<br>** | Employees with secondary education (%) |
|------|----------------------------|---|--|
| 2008 | 2647                       | 13  | 11                                     |
| 2009 | 2604                       | 13  | 12                                     |
| 2010 | 2743                       | 14  | 12                                     |
| 2011 | 2753                       | 12  | 10                                     |
| 2012 | 2382                       | 12  | 17                                     |
| 2013 | 3087                       | 11  | 14                                     |
| 2014 | 2900                       | 9   | 12                                     |
| 2015 | 2993                       | 9   | 13                                     |
| 2016 | 2526                       | 10  | 17                                     |

\* Not taken into account workers in administration

\*\* The calculations also include the employees of the Upper School

Source: Statistical Yearbook of the Republic of Macedonia, 2013 and 2017

The development of human capital in agriculture imposes the need for creating and implementing lifelong learning strategies by improving the quality and effectiveness of education in order to acquire the knowledge and skills needed for human capital. The knowledge, as well as the transfer of knowledge through advisory services, are very important elements for successful development of the agricultural sector. The processes of effective creation, transformation and transfer of knowledge are critical for creating a highly productive labour force in the agricultural sector. In Macedonia, one of the leading institutions for knowledge transfer in agriculture is the Agency for Promotion of Agricultural Development, as a state administration body that operates independently in its work.

### Discussion and results of agricultural labour productivity analysis in Macedonia

In table 4, agricultural labour productivity is calculated as a ratio between gross domestic product in agriculture and labour force, i.e the number of employees as a factor or input in agricultural production for the observed year. The greatest changes in Macedonia, i.e. a decrease in labour productivity is noted in the period when consequences of the Great financial and economic crisis from 2008 are felt. Since 2013, GDP in agriculture sector has been stabilizing and recovering, which can be shown by positive growth rates.

Table 4. Agriculture labour productivity in Macedonia in the period  
2006 – 2017 година

| Year   | GDP in agriculture* | Number of employees in agriculture | Labour productivity |
|--------|---------------------|------------------------------------|---------------------|
| 2006   | 29869,0             | 114777,0                           | 260235,1            |
| 2007   | 30557,0             | 107717,0                           | 283678,5            |
| 2008   | 37428,0             | 119749,0                           | 312553,8            |
| 2009   | 38446,0             | 116668,0                           | 329533,4            |
| 2010   | 33264,0             | 121770,8                           | 273169,0            |
| 2011   | 33874,0             | 120893,3                           | 280197,6            |
| 2012   | 28439,3             | 112584,8                           | 252603,2            |
| 2013   | 30877,7             | 127185,8                           | 242776,2            |
| 2014   | 31841,0             | 127438,3                           | 249854,3            |
| 2015   | 32433,3             | 126126,3                           | 257149,5            |
| 2016   | 39586,1             | 120303,3                           | 329052,7            |
| 2017** | 24200,1             | 120472,0                           | 200877,1            |

\* GDP is expressed in million denars

\*\* The data refers to the first three quarters

Source: National Bank of the Republic of Macedonia: Quarterly Report III / 2017

Table 5 illustrates labour productivity in Macedonia in the period from 2006 to 2017, with its rates of change and its determinants' rates of change for the current year compared to the previous year.

Table 5. Analysis of changes in labour productivity in agriculture (Kp) in Macedonia in the period 2006 - 2017

| Year       | Kg <sup>6</sup> | Kl <sup>7</sup> | Kp <sup>8</sup> | Kpg <sup>9</sup> | Kpl <sup>10</sup> |
|------------|-----------------|-----------------|-----------------|------------------|-------------------|
| 2007/2006  | 2,3             | -6,2            | 9,0             | 2,5              | 6,6               |
| 2008/2007  | 22,5            | 11,2            | 10,2            | 20,2             | -10,0             |
| 2009/2008  | 2,7             | -2,6            | 5,4             | 2,8              | 2,6               |
| 2010/2009  | -13,5           | 4,4             | -17,1           | -12,9            | -4,2              |
| 2011/2010  | 1,8             | -0,7            | 2,6             | 1,8              | 0,7               |
| 2012/2011  | -16,0           | -6,9            | -9,8            | -17,2            | 7,4               |
| 2013/2012  | 8,6             | 13,0            | -3,9            | 7,6              | -11,5             |
| 2014/2013  | 3,1             | 0,2             | 2,9             | 3,1              | -0,2              |
| 2015/2014  | 1,9             | -1,0            | 2,9             | 1,9              | 1,0               |
| 2016/2015  | 22,1            | -4,6            | 28,0            | 23,1             | 4,8               |
| 2017/2016* | 4,2             | 0,1             | 4,0             | 4,2              | -0,1              |

\* The comparison was made for a period of 9 months (without last quarter)

Source: Authors' calculations

Agricultural labour productivity in 2007 increased by 9% compared to 2006. Gross domestic product increased by 2.3%, while the number of employees in the agricultural sector decreased by 6.2%, whereby this ratio has a positive impact on the change, i.e. an increase of labour productivity in agriculture in 2007 compared to 2006. Namely, the reduction in the number of employees is greater than the increase in agricultural gross domestic product, which means that the change in agricultural labour productivity is significantly affected by the change in agricultural employment.

In all of the years, labour productivity in agriculture is analyzed as a result of the changes in the gross domestic product and the number of employees in agricultural sector. In 2016, labour productivity is increased by 28% compared to 2015. Gross domestic product increased by 22.1%, while

<sup>6</sup> coefficient of change in agricultural gross domestic product in the current period (t) compared to the previous period (t-1)

<sup>7</sup> coefficient of change in a number of employees in agriculture in the current period compared to the previous period (t-1)

<sup>8</sup> coefficient of change in agricultural labour productivity in the current period (t) compared to the previous period (t-1)

<sup>9</sup> coefficient of change in agricultural labour productivity under the influence of agricultural gross domestic product in an observed year in comparison to the previous year

<sup>10</sup> coefficient of change in agricultural labour productivity under the influence of number of employees in agriculture in an observed year in comparison to the previous year

the number of employees decreased by 4.6% compared to 2015. The growth of the gross domestic product of 22.1% in 2016 causes a rise in labour productivity by 23.1%, while the reduction in the number of employees in agriculture sector by 4.6% leads to an increase in labour productivity by 4.8%. Such effects, i.e. changes in the output and the number of employees in agriculture, lead to an increase in labour productivity by 28% in 2016 compared to 2015.

Before analyzing the relationship between gross domestic product in agriculture and agricultural labour productivity, we will examine their interdependence. The aim is to determine if there is a quantitative relationship between GDP variations and agricultural labour productivity and, if so, how strong it is.

Table 6. Correlation coefficients in the period 2006 -2017

|                                  | Agricultural labour productivity | GDP in agriculture | Number of employees in agriculture |
|----------------------------------|----------------------------------|--------------------|------------------------------------|
| Agricultural labour productivity | 1                                | 0.962              | -0.332                             |

Authors' calculations.

Based on data for GDP and labour productivity in agriculture, a coefficient of 0.96 was calculated on a quarterly and annual basis for the period 2006 - 2017. This coefficient shows that there is a positive and strong quantitative relationship between gross domestic product in agriculture and agricultural labour productivity, which means that changes in both variables occur in the same direction and it is very likely to predict the movement of labour productivity through this variable. On the other hand, the quantitative link between the number of employees in agriculture and agricultural labour productivity is negative and moderate, with a coefficient of correlation of 0.33.

In order to show the importance of agricultural labour productivity in overall economy, the following table shows a regression analysis of agricultural labour productivity growth rate and overall GDP growth rate. For this purpose, following regression model is set:  $y = b_0 + b_1x$ ; where  $y$  is overall GDP growth rate, and  $x$  is an agricultural labour productivity growth rate.  $b_0$  and  $b_1$  are regression coefficients.

Table 7. Regression analysis of growth rates of agricultural labour productivity and total GDP in the period 2000 - 2017 (quarterly data)

| Variable           | Coefficient | Std. Error            | t-Statistic | Prob.    |
|--------------------|-------------|-----------------------|-------------|----------|
| C                  | 0.014797    | 0.742221              | 0.019936    | 0.9842   |
| D(prod_growth)     | 0.135336    | 0.012703              | 10.65374    | 0.0000   |
| R-squared          | 0.725243    | Mean dependent var    |             | 0.015928 |
| Adjusted R-squared | 0.718854    | S.D. dependent var    |             | 9.390171 |
| S.E. of regression | 4.978971    | Akaike info criterion |             | 6.091750 |
| Sum squared resid  | 1065.977    | Schwarz criterion     |             | 6.172046 |
| Log likelihood     | -135.0644   | Hannan-Quinn criter.  |             | 6.121684 |
| F-statistic        | 113.5022    | Durbin-Watson stat    |             | 2.742375 |
| Prob(F-statistic)  | 0.000000    |                       |             |          |

Dependent variable: total GDP growth rate

Note:  $p < 0,05^*$ ; correl. 0.82

Source: Authors' calculations.

The coefficient  $b_1$  shows the relationship between agricultural labour productivity growth rate and GDP growth rate in the overall economy. It also shows to what extent agricultural labour productivity growth rate affects the rate of GDP growth in the overall economy. Before conducting the regression model, a Unit Root test for stationarity in a time series is done. It is important for examination of a time series because a non-stationary regressor invalidates many empirical results. A time series have stationarity if a shift in time does not cause a change in the shape of the distribution. For this analyze, Unit Root test is tested by using Augmented Dickey-Fuller test. The test showed that agricultural growth rates and GDP growth rates are non-stationary and therefore it is made a first differentiation where time series become stationary. Then a regression model is set on the first level of differentiation of the series agricultural growth rates and GDP growth rates. A low p-value of 0.0000 ( $< 0.05$ ) indicates that variables are significant and the null hypothesis is rejected (Bucevska, 2016). Or, growth in agricultural productivity has an influence and causes a growth in the overall GDP in Macedonia. Also, the statistical analysis shows that the model explains 71,9% of the variability of the response data.

Furthermore, the coefficient  $b_1$  for agricultural labour productivity growth rate shows that an increase in agricultural labour productivity growth rate for one unit will lead to an increase in total GDP growth rate for 13,5%. The coefficient of correlation is 0.82, which means that there is a positive and strong quantitative relationship between agricultural labour productivity growth rate and GDP growth rate in the economy.

The analysis confirms that changes in gross domestic product in agricultural sector have a greater impact on the agricultural labour

productivity, compared to changes in the number of employees in agricultural sector and that agricultural labour productivity is particularly important for economic growth. In this direction, gross domestic product of agriculture is the determinant which has to be influenced through intensification of agricultural production in order to increase the agricultural productivity, and it should not be influenced only by changes in the number of employees.

## **Conclusion**

As a sector which has a significant influence on the economic development in Macedonia, it can be concluded that agricultural labour productivity depends on its growth, i.e., the growth of its determinants. At macroeconomic level, labour productivity will increase if gross domestic product increases faster than employment. In the analyzed period, labour productivity in agriculture is a result of the changes in a gross domestic product and a number of employees in the agriculture sector.

There is a strong quantitative relationship between agricultural gross domestic product and agricultural labour productivity in Macedonia compared to the relationship between agricultural labour productivity and the number of employees whose relationship is almost weak. This means that in the example of Macedonia, a growth of a gross domestic product created by agricultural sector is particularly important for a growth of labour productivity. Furthermore, it can be concluded that Macedonia is characterized mainly by low agricultural labour productivity, which has seen a slight increase in recent years. Although the analysis showed a low level of education, the high potential for agricultural production, as well as the availability of educational facilities and functional education system in the field of agriculture can be cited as main advantages and opportunities for agricultural productivity growth.

The initial recommendation is that attention should be focused on increasing the production of those products which are integral elements of agricultural growth and also significant for this growth. This involves defining an appropriate group of macroeconomic policies that correspond to the specific economic conditions in the Macedonian economy, applying technology that is appropriate for existing conditions in agriculture, as well as a communication infrastructure, marketing and institutional arrangements. On the other hand, agricultural population constitutes the most upward mobility part of the population and workforce. With a reduction of agricultural population, real opportunities for intensifying agricultural production are created, and in the place of a reduced contingent of agricultural population, modern technology and innovations for agricultural production are introduced. All this leads to an increase in total agricultural production and productivity.

Agricultural production can be increased by improving technological equipment, increasing the level of technological efficiency, retraining and enabling employees to use modern technology in agriculture. Also, special attention should be paid in finding ways to increase the correlation between agricultural labour productivity and GDP realized in this sector in Macedonian economy, due to a positive correlation observed in the analyzed period. The general productivity and economy of agricultural sector remains to be significantly hampered by serious structural weaknesses. In that direction, specific measures and investments should be undertaken for improving agricultural labour productivity, i.e. increasing the average net value added per unit of labour engaged in agriculture. One of the key aspects that leads to increased agricultural labour productivity is mainly directed towards improving production efficiency and introducing new technology in production with emphasis placed on the human factor (changing the size and compactness of the production capacities, launching new agricultural businesses by young farmers, investing in a modernization of the available technical equipment, encouraging an entry of direct foreign investments in the agro-food sector, etc.). This would also mean a transfer of non-productive workers to other sectors. The other aspect relates to investments for appropriate education, as well as training workers for a proper use of the modern technology. The lack of adequate education staff is a clear signal of the need for improving the educational system in order to attract quality labour force in direction of increased agricultural production and increased agricultural labour productivity.

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