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COMPARATIVE ANALYSIS OF THE AGRICULTURAL SECTOR IN SELECTED EU MEMBER STATES

by

NIKOLA MITKO TRENDOV

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Name of Doctoral School:	Doctoral School of Management and Business Administration
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Acting Director:	**Professor Dr. Lakner, Zoltán, DSc,** Head of the Doctoral School, Faculty of Economic and Social Sciences, Szent István University, Gödöllő, Hungary
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Abbreviations

AWU	Annual Working Unit
CAP	Common Agricultural Policy
CEE	Central East Europe
CELY	Cereal Equivalent Land Yield
CEC	Competitive Universal Commercial Bank
CEPAL	Cereal Equivalent Productivity of Agricultural Labour
CEPIF	Cereal Equivalent Productivity of Inorganic Fertiliser
CFP	Common Fisheries Policy
CGIAR	International Network of 15 International Agricultural Research Centres
CGE	Computable General Equilibrium
CMO	Common Market Organisation
COM	Communication
CPI	Consumer Price Index
DG ECFIN	European Commission, Directorate-General for Economic and Financial Affairs
EAA	Economic Accounts for Agriculture
EAP	East Asia Pacific
EC 1	European Community
EC 2	European Commission
EEA	European Environment Agency
EEC	European Economic Community
EMEP	European Monitoring and Evaluation Programme
ESI	Economic Sentiment Indicator
ESU	Economic Size Unit
EU-13	Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia
EU-15	Estonia, Latvia, Lithuania, Poland, Czech Republic, Slovakia, Hungary, Romania, Bulgaria, Slovenia, Croatia, Italy, Greece, Austria and Denmark
EU-28	European Union
EUROSTAT	European statistics in European Union
FAO UN	Food and Agriculture Organization of United Nation
FDI	Foreign Direct Investment
FER	Food Expenditure Ratio

FSS	Farm Structure Survey
GCAP	Global Call to Action Against Poverty
GDP	Gross domestic product
GFCF	Gross Fixed Capital Formulation
GVA	Gross Value Added
HICP	Harmonised Index of Consumer Prices
IAASTD	International Assessment of Agricultural Knowledge, Science and Technology for Development
ICT	Information and Communication Technologies
IPCC	Intergovernmental Panel on Climate Change
ISCED	International Standard Classification of Education
LFS	Labour Force Survey
LULUCF	Land-Use, Land Change and Forestry
MDG	Millennium Development Goals
NACE	National Association of Colleges and Employers
NUTS	Classification of Territorial Units for Statistics
OECD	Organization for Economic Cooperation and Development
PDO	Protected Designation of Origin
PGI	Protected Geographical Indication
PPS	Purchasing Power Standard
R&D	Research and Development
SAPARD	Support for Pre-Accession measures for Agriculture and Rural Development
SILC	Statistics on Income and Living Conditions
SMB	System Management Board
SPSS	Statistical Package for the Social Sciences
TFP	Total Factor Productivity
UAA	Utilised Agricultural Area
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
WB	World Bank
WDI	World Development Indicator

SPSS Special Program for Social Sciences Abbreviations

OUTPUT171 = Output of the agricultural industry - basic and producer prices, Million EUR, Production value at basic price, 2010= 100, 2010-2017
https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tag00102&plugin=1

INPUT172 = Own calculation: OUTPUT-GVA = INPUT based on data of Eurostat, Million EUR, Input of the agricultural industry - basic and producer prices,
2010= 100, 2010-2017

GVA173 = Gross value added of the agricultural industry - basic and producer prices, Million ECU/EUR, Production value at basic price, 2010= 100, 2010-2017
https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tag00056&plugin=1

PrivInv164 = Private investments, jobs and gross value added related to circular economy sectors, Value added at factor cost (Million EUR), 2010= 100, 2010-2016
https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=cei_cie010&plugin=1

RIFAWU175 = Real Income Factor per Annual Working Unit equivalent between 2010-2017 at factor price. Economic accounts for agriculture - agricultural income (indicators A, B, C) [aact_eaa06], 2010= 100, 2010-2017, Index of the real income of factors in agriculture per annual work unit,
http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=aact_eaa06&lang=en

GDPGrowth176 = GDP Growth, 2000-2017, Gross domestic product at market prices, Chain linked volumes, index 2010=100

AWU20177 = Labour force directly employed - annual working unit in number 1000, in 2017 Farm indicators by agricultural area, type of farm, standard output, legal form and NUTS 2 regions [ef_m_farmleg]

RLProd20178 = Real labour productivity per person, 2010= 100, Labour productivity and unit labour costs [nama_10_lp_ulc], Index of the real income of factors in agriculture per annual work unit,
http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nama_10_lp_ulc&lang=en

Subsidies169 = Subsidies 2010-2016, Million EUR, 2010= 100, The difference between an economy's external financial assets and liabilities is the economy's net IIP, which may be positive or negative.

DIRINV1710 = Direct Investment in million units of ***national currencies*** between 2010-2017, ***in percent, 2010 = 100***, [tipsii12],
IIP = international investment position
Balance of Foreign Direct Investment and Domestic National Investment,
International Direct investment in million units of *national currencies* between 2010-2017, ***In percent, 2010 = 100***

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1. INTRODUCTION

The study analyses the main developing trends and differences in agricultural industry of the selected EU-15 Member States, mostly in Central-East Europe (CEE) for the period of 2010 and 2017. Examined EU-15 Member States are Estonia, Latvia, Lithuania, Poland, Czech Republic, Slovakia, Hungary, Romania, Bulgaria, Slovenia, Croatia, Italy, Greece, Austria and Denmark.

Main indicators for agricultural conditions research in this region are:
- GDP growth;
- Agricultural production growth;
- Efficiency of the agricultural production (real income factor; output/input; gross value added/real income; private investment; real labour productivity per annual working unit);
- Income conditions of agricultural producers/farmers: price income, taxed income, central subsidies;
- Central subsidies changes for farmers;
- Number of the annual working unit (AWU);
- Technological development;
- Balance of Foreign Direct Investment (FDI) and the National Domestic Investment in performance of the EU-15-member states and its influences on the investment in agricultural industry.

Generally, the Visegrad-4 EU member states, Poland, Czech Republic, Hungary and Slovakia have achieved outstanding agricultural development and growth. Moreover the development and growth are significantly higher compared to the rest of EU-28 countries. According to Eurostat the economic growth with agricultural development in Visegrad-4 EU member states is at highest level in all of the EU-28. Additionally, to the Visegrad-4 EU member states, the other East and Central European economies of EU-28 have also played a significant role for continuous developing trend of the agriculture in EU-28. Therefore, my PhD study and research are focused on EU-15 including Austria, Italy and Denmark. In spite that these three countries are not so strong in their performance or less than the performance of Germany, France and UK (United Kingdom), their performance and agricultural development, along with the strong effect Austria and Denmark have on the agricultural industry of East and Central European, make them eligible for research. Moreover, Italian agriculture is in a leading position in terms

of organic farming and sustainable agriculture. Also, UN FAO (Food and Agriculture Organization) is located in Rome, therefore I extend my PhD research work also for Italy.

The agricultural development research in these EU-15 member states is based on the Statistical Package for the Social Sciences (SPSS). The analysis of the agricultural development and growth is based on five variances in 15 states. The analysis is consisted of two parts. This is due to the limitation of the SPSS statistical system, namely it only allows five economic variances in case of analysing 15-member states. In my study ten economic variances are used for the selected EU-15 member states. It is in my belief that five more economic variances are required in order to get clear results on the economic differences among these member states.

The main Hypotheses in my PhD research are as following:

1) There is a strong correlation between the input and output of the economic variances in EU-15 countries.

2) There is a strong correlation between private investment and the input; but also, between private investment and the output of the economic variances in EU-15.

3) Gross value-added changes have strong influence on the real income factor per annual working unit. There is correlation between the two economic variances.

4) Private investment has strong or mid correlation with the real income factor per annual working unit. FDIs have stronger impact on consumption of fixed capital increase (rise) in EU-15.

5) There is a strong and mid correlations between *GDP growth (GDPGrowth176)* and the *real labour productivity (RLProd20178).*

6) FDIs increased during the examined research period. GDP growth increase was higher than agriculture real labour productivity increase, hence the majority of FDIs were realised in other economic sector, and not in agricultural industry.

7) There is a mid-strong correlation between number of the *annual working unit (AWU20177)* and the *real labour productivity per annual working unit (RLProd20178)*

because the labour force in number of Annual Working Unit can make an *efficient labour separation by more specialization,* and therefore, this can strengthen the growing trend of the real labour productivity per person (RLProd20178).

The scientific economic analyses are based on the main Eurostat statistical sources covering the economic conditions of all of the EU-28 member states including the EU-15 member states analysed in this dissertation.

The analyse focuses on the income position of farmers and AWU in EU-15 selected member states from 2010 to 2017 using Eurostat data.

As the statistical overview shows "as a factor of production in agriculture, *capital* can be thought of as the tools, *machinery* and *equipment, farm buildings and plantations* that are required to help produce crops or animal products. The *Gross Fixed Capital Formation (GFCF)* refers to the change in *physical assets* within a defined time period. It does *not include depreciation of land nor land purchases*. GFCF measures how much of the *value added* created by agriculture is *invested rather than consumed* and is, therefore, a key element for *understanding future competitiveness* in the agricultural sector. The agricultural sector in the EU invested EUR 57,2 billion euro in 2017, accounting for 30,4 % of gross value added (GVA). Almost one half of this investment was made in France (17,6 % of the EU total), Germany (16,2 %) and Italy (15,0 %). Relative to the size of their respective agricultural sectors and the value added generated, GFCF was highest in Finland, and then Latvia and Luxembourg". (See detailed in Statistical Books 2018, p. 30).

According to Eurostat database (2018), "the level of investment in EU agriculture was very similar in 2017 to that in 2009, the level of investment in EU agriculture was very similar in 2017 to that in 2009, although there were some fluctuations in the intervening years. Among the member states, there was particularly strong investment growth in Lithuania and Latvia (an average 18,1 % and 11,8 % per year respectively), although this should be seen as timing lows in 2009. In contrast, there were strong contractions in Greece (-4,7 % per year on average), Luxembourg (-6,0 % per year), Malta (-6,8 % per year on average) and Croatia (-8,7 % per year on average). The Eurostat also widely shows the agricultural land prices and rents: huge variation between Member States, as each factor of production used in agriculture typically earns a type of income; *labour receives a wage, entrepreneurs' profit, capital an interest and*

land a rent. Understanding *land prices and rents* is also a key element for understanding future perspectives for agriculture." (See detailed in Eurostat Statistical Books 2018, p. 30 and p. 71).

In my dissertation the research focuses on the correlation and significance among ten economic variances in EU-15 selected member states. The analysis emphasizes the correlation among the economic variances, and how the correlation can strengthen in case income of farms increases by representing the situation of AWU as equivalent with full time farming unit. In addition, the analysis aims to reveal how central subsidies influence the income positions of farming households and their agricultural production. Moreover, the research is also oriented towards finding whether increased investment in agriculture has impact on increased GVA in the year 2017.

The agricultural subsidies are of crucial importance for East and Central European EU member, as they boost the investment and development, hence improving income position of farmers. These investments could possibly contribute to increase the level of future competitiveness of the EU member states.

2. LITERATURE REVIEW

The scientific international literature deeply analyses some variances of my dissertation. Main economic variances examined in my research work are labour productivity, GVA, number of the AWU in the agricultural industry, investment, subsidies, real income factor per AWU, more favourable income position of farmers and GDP growth rate and economic development at the national economic level in cases of the selected 15-EU-member states. Labour productivity is calculated as ratio between the GVA and AWU. Also, the other calculation of GVA is based on the output and add to the input of the agricultural production.

Experts, such as Madre and Devuyst (02/2017), described the current state of the agriculture and declared that meeting the future demand for food will largely depend on the ability of the farming sector to increase its production by improving its productivity. Essentially, improvement in agricultural productivity means that less input is needed to produce the same amount (or more) of output. In other words, this means that farmers are faced with the challenge to produce 'more with less'. At the beginning of December 2016, the European Commission published a briefing on this issue under the name 'Productivity in EU Agriculture – slowly but steadily growing', which was presented at the EU Agricultural Outlook Conference on 6th and 7th December. This report analyses agricultural productivity levels in the European Union by measuring Total Factor Productivity (TFP). TFP is a comprehensive indicator representing the ratio of agricultural output (production) to their input (such as land, labour and capital). (Madre-Devuyst 2017).

Main conclusion of the report is that agricultural productivity in the EU has increased over time, but has slowed down in recent years: while annual TFP growth exceeded 1% between 1995 and 2005, it only reached 0,8% between 2005 and 2015. This productivity growth is mainly the result of developments within the EU-13 countries, which experienced an annual TFP growth of 1,6% over the last decade. However, the share of these 'new' Member States in overall EU agricultural production is much more limited than for the traditional Member States. Since there are also no data available on the TFP growth in the EU-13 prior to 2005, it is only possible to make an accurate assessment of the evolution of agricultural productivity in the EU-15 (Madre and Devuyst, 2017; Milward et al, 2000, Hays 2013). These authors analysed the agricultural productivity of the former EU-member states including UK.

2.1 Labour productivity for the development of agricultural industry

Eurostat, on continuous base, conducts research on labour productivity in EU-28" under the title as *"Labour productivity per person employed and hour worked (EU-28=100) in percent (%)".* The conception is worked out by the Eurostat in detailed, which are as follows: *Gross domestic product (GDP) is a measure for the economic activity. It is defined as the value of all goods and services produced less the value of any goods or services used in their creation. GDP per person employed is intended to give an overall impression of the productivity of national economies expressed in relation to the European Union (EU-28) average. If the index of a country is higher than 100, this country's level of GDP per person employed is higher than the EU average and vice versa. Basic figures are expressed in PPS, i.e. a common currency that eliminates the differences in price levels between countries allowing meaningful volume comparisons of GDP between countries. Please note that 'persons employed' does not distinguish between full-time and part-time employment."*

Labour productivity per hour worked is calculated as real output per unit of labour input (measured by the total number of hours worked). Measuring labour productivity per hour worked provides a better picture of productivity developments in the economy than labour productivity per person employed, as it eliminates differences in the full time/part time composition of the work force across countries and years (See in detailed in Eurostat, 2018a).

In the last few years high and unstable food and agricultural commodity prices and concerns about population growth, increasing per capita food demands and environmental constraints have pushed agriculture and food production up national and international political, policy and research agendas. Drawing on both theory and empirical evidence, this paper argues that fundamental impacts of links between agricultural productivity sustainability and real food price changes are often overlooked in current policy analysis. This is exacerbated by a lack of relevant and accessible indicators for monitoring agricultural productivity sustainability and real food prices. Two relatively simple and widely applicable sets of indicators are proposed for use in policy development and monitoring. Historical series of these indices are estimated for selected countries, regions and the world. Their strengths, weaknesses and potential value are then discussed in the context of the need for better sustainable agricultural development and

food security indicators in any post 2015 successors to the current Millennium Development Goals (MDGs) (Dorward, 2013, pp. 40; Milward et al, 2000; also see Binswanger-Mkhize and Morris, 2009).

Other experts emphasized that the four agricultural measures, namely Cereal Equivalent Productivity of Agricultural Labour (CEPAL), Cereal Equivalent Land Yield (CELY), Cereal Equivalent Productivity of Inorganic Fertiliser (CEPIF) and Food Expenditure Ratio (FER) address calls for a post 2015 international agreement to include explicit attention to the problems of agriculture, the environment, sustainability, growth and food security; to integration and holism across and within sectors; to aggregate and disaggregated targets and indicators that promote accountability; and to changes needed as regards production and consumption within high as well as middle and low income economies (for example Bond, 2011; Global Call to Action Against Poverty (GCAP), 2015; Melamed, 2012a, Melamed, 2012b; Waage et al., 2010). In this CEPAL's integration with CELY and CEPIF provides holistic attention to the environment, sustainability and growth in high as well as low- and middle-income countries. The FER is concerned with the effects of food price changes on equity and food security. All the measures have been examined at global, regional or income group and national scales of aggregation and disaggregation. Furthermore, they comply with principles for 'useful' indicators set out earlier. There is, however, need for substantial improvement in the coverage and reliability of some national and international statistics and statistical systems – for example there are widely recognised difficulties with international statistics on agricultural production and areas (for example Headey, 2011; Headey-Fan, 2010), with gaps in coverage of income and expenditure surveys and domestic price information and, as noted earlier, in standard definitions of variables such as 'agricultural employment'. Assimilation of these indicators into post 2015 goals and targets could therefore not only utilise existing data on these issues, but also stimulate improvements in information on them in the future (an important side benefit of the MDGs was improved information on some topics Waage et al., 2010; Mellor, 1995; Naylor, 2011; North, 1990).

My opinion is that the farmers can create a relatively low gate price for their agricultural and food products based on the agricultural production and labour productivity, and how these are impacted by usage of advanced mechanization.

Madre and Devuyst, (2017), concluded that 'old' Member States have encountered sharp drop in annual TFP growth, from 1,3% in the period 1995-2005 to 0,6% between 2005 and 2015, which means that productivity in the main European producing countries is on the edge of stagnation. Some of these Member States, most notably Germany, have even experienced negative TFP growth numbers in recent years.

In the report, the Commission explains that the modest TFP growth in EU agriculture is the result of *'labour productivity growth'*, since *'output growth has been achieved in a context of a shrinking workforce'*. Agricultural production has only increased very slightly while the number of farmers has reduced sharply. In the EU as a whole, agricultural output has increased with around 6% per year between 2005 and 2015, while the number of farmers declined with 25% and capital use stagnated after an initial increase of 4% per year before the economic crisis. Within the EU-13, the number of farmers dropped by 33% and capital use increased by 10%, with output rising by 7,1%. Meanwhile, the EU-15 countries achieved an annual production growth of 5,1% while experiencing a drop-in farm employment of more than 20% and achieving only a very limited increase in their capital stock levels (EC, 2016).

The productivity of the agricultural sector is quite differentiated in respective member states of the EU (Błażejczyk-Majka et al. 2012, Nowak et al. 2016). Identification of the determinants of growth in agricultural productivity is the precondition to make up differences in TFP between member states. Studies on factors improving the productivity of agriculture are described in papers written by Rao et al. (2004) and Kijek et al. (2016). They put emphasis on the significance of education, health, knowledge, experience, human capital, innovation, expenditure on research and development (R&D), infrastructure, institutions, economic openness, competition, and geographical situation.

Dudu and Kristkova (2017) investigated the impact of payments under Common Agricultural Policy (CAP) Pillar II on the productivity of agriculture in the member states of the EU. The results confirmed significant positive effects of physical, human capital and agri-environmental payments on factor-augmenting technical change in agriculture. It was found that human capital subsidies stimulate labour-augmenting technical change, whereas physical capital subsidies increase capital-augmenting technical change. Agri-environmental payments are important in stimulating land-augmenting technical change (Kijek et al, 2019).

Also, these authors (Kristkova et al, 2017) wrote “Empirical estimates of the speed and the direction of factor-augmenting technical change are key inputs for multi-country, multisector computable general equilibrium (CGE) models. Such models are increasingly being used to assess major global and highly complex issues such as food security, climate change, biodiversity and land use-change.“

Key examples of such assessments are the OECD Environmental Outlook (2012), AgMIP food climate model comparison (Nelson et al., 2013), Alternative Futures (OECD, 2016) and the IPCC Assessment Reports. Future productivity growth and its principal component, technical change, are key drivers of sectoral and macro-economic growth projections that are generated by these models (von Lampe et al., 2014). Most models assume labour augmenting or Harrod-neutral technical change, which is predicated on a long-run constant capital-output ratio (Uzawa, 1961; Jones and Scrimgeour, 2008; Robinson et al., 2014). But, at present, the empirical foundation of key technology parameters is weak, which likely results in biased projections of future economic development. Carraro and De Cian (2013, p. 14) found “total absence of empirical studies on the drivers of factor productivities”.

Robinson et al. (2014) further argue that in most global CGE models, total TFP (representing a measure of neutral technical change) is calibrated residually with rather ad hoc assumptions on future productivity change and furthermore homogenously across different countries and sectors. Furthermore, the authors continue and conclude that by neglecting the endogeneity of technical change, the models fail to account for crucial investment dynamics and dynamics related to diffusion of knowledge. Finally, this might lead to biased projections in the global impact assessment models.

2.2 Impact of the Research and Development on labour productivity

In an experiment performed by Robinson et al. (2014), under higher labour-saving technical change in agriculture compared to manufacturing and services, agricultural prices are rising, whereas under a uniformly distributed labour-augmenting technical change, projected prices are stable. When technical change is endogenized via R&D, CGE and integrated assessment models can evaluate R&D policies and their impacts on economic growth, land use and food

security, which makes their findings potentially very interesting to policy-makers (Kristkova et al, 2017).

- R&D stocks in manufacturing represent a substantial part of all R&D investments: as described in Roeger et al. (2008), manufacturing R&D is largely patented and also supplies the bulk of innovative goods used in other industries. In relation to new technologies supplied by the manufacturing sector, organizational changes occur that stimulate productivity of services (as occurred for instance in retail, wholesale and banking due to information and communication technology (ICT) investments in the USA). Therefore, it is assumed that R&D stocks in manufacturing affect not only productivity of manufacturing itself (intra-industry effects), but also enhance the productivity of other domestic industries (interindustry effects).

- R&D stocks in services: a study by the European Commission (2008 and 2014) points out that R&D in services remains relatively invisible and unknown. But its importance is nonnegligible since around 80% of science and technology jobs are in services sectors. For instance, services sectors with a high content of knowledge are financial, insurance and retail sectors, where typical R&D activities include the development of new insurance and financial metrics and IT systems development. Business and legal services, wholesale trade and retail trade, on the other hand, largely invest in socio-economic and customer research. Transportation services, such as airlines also carry out R&D, mostly in the form of logistics simulation and system management. Based on this evidence, R&D in services is accorded their own R&D category in this research (Kristkova et al, 2017; Roeger et al, 2008; EC, 2008; EC, 2014).

However, the identification of TFP determinants is not the only significant issue of agricultural development. An important aspect of studies concerning the differentiation of productivity in member states of the EU is the analysis of trends in TFP variance and evaluating whether the gap between EU member states in terms of agricultural productivity is reduced (Baráth and Fertő 2017). Analysis of the process of aligning the economic growth between member states with different operating conditions (historical, institutional, and related to resources) is a major issue which has concerned economists for years. In order to determine the existence of TFP convergence, a criterion for verifying the convergence hypotheses must be set out. Convergence is interpreted as aligning the level of the analysed indicator between member states/regions in

which initial levels of the indicator were different. A contrary phenomenon – growth in variance – is called divergence (polarization) (Kijek et al, 2016; Kijek et al, 2019).

The analysis of the long-term productivity growth of the various inputs confirms these findings: the report shows that labour productivity has increased significantly, while *the productivity of intermediate consumption has stagnated and the productivity of capital has evolved negatively***.** Capital productivity is now actually lower than in 2002, as a steady decline until 2009 was only followed by a partial recovery. To sum up, the modest TFP growth in the last decade has been mainly driven by 'labour productivity' – a harsh reduction in the number of farmers and farm labour – at the expense of capital, whose productivity has even decreased. "*In modern economies, it is less to say that productivity of capital and productivity of intermediate consumption are obvious index of the health of an economic sector and of its ability to develop."* (Madre and Devuyst, 2017). In their work, the authors analysed the agriculture of earlier EU-15 Member States as 'old' or Former member states (EC, 2016).

Naturally the *labour productivity can be dependent by the AWU per farming household and the measure of the land and output*. Some experts declared that „This is important in ongoing debates about the relative roles of small-scale and large-scale farms in agricultural development (Collier and Dercon, 2009; Hazell et al., 2010). Of course, policy may seek to reproduce these coordinated stimuli, using taxes and subsidies to transfer income from owners of capital and smaller numbers of skilled workers to poor rural people (as for example with social protection policies in Brazil). However, this presents significant political economy and governance challenges and requires a large, highly productive and rapidly growing large-scale capital-intensive sector to support these very large transfers. It also misses an important potential growth opportunity by not simultaneously raising the productivity of poor people's labour – unless rural labour can be quickly absorbed into rapidly growing labour-intensive manufacturing. Consideration of the relative merits of large-scale and small-scale agricultural development must take these issues into consideration as well as differences in productivity, productivity growth and size between the large- and small-scale agriculture sectors.

Christiaensen et al. (2011) and World Bank (2012a) provide a useful empirical examination of these issues. Large capital-intensive agriculture may be appropriate in emerging and middle-income economies, but despite significant difficulties with smallholder development is unlikely to provide efficient and rapid routes to poverty reduction and broad-based growth in many poor

agrarian economies – though they may still have useful roles to play alongside smaller farms. The arguments in this paragraph are also relevant to explanations of how some small trading countries (such as Singapore and Hong Kong) and some oil rich countries have achieved rapid growth without developing their own agricultural sectors: these countries have normally started with very small poor rural populations and have relied on agricultural development in other countries for low price food imports (Collier and Dercon, 2009; Chapoto et al, 2009; Christiaensen et al., 2011; Conforti, 2011).

Some experts analysed the land fragmentation concerning the increasing revenue on unit of lands, for example Xuding Rao (2014), who declared that, " Meanwhile, our analysis suggests that land fragmentation is efficiency enhancing by increasing the revenue on unit land, leaving it instrumental to farmers in terms of both efficiency and risk management (experts dub this result "double bonuses)", a finding that contradicts those of many studies in the literature but not all. For example, a few studies have found either a statistically insignificant (e.g. Blarel et al., 1992; Belletti et al., 2015; and Di Falco et al., 2010) or economically insignificant (e.g. Wan and Cheng, 2001) effect of land fragmentation.

Deininger et al. (2012), apply the stochastic frontier model to the LSMS survey data of Albania and find land fragmentation measured by number of plots has a statistically significant positive effect on efficiency although the authors suggest that this positive economic impact is small. Their study also investigates land fragmentation's impact on farmers' cropland abandonment decisions. They found that about 10% of Albania's productive land has been left idle mostly because of land market imperfections. In contrast, there are only a few cases of land abandonment where land fragmentation leads to plots too small for economically viable cultivation. Among those currently cultivated plots, land fragmentation is found to have a statistically significant positive effect on efficiency. Although their study does not give an overall appraisal of land fragmentation when both cultivation-related and abandonment-related productivity are considered, they conclude that their analysis does not support the argument of land fragmentation undermining productivity (Xuding Rao, 2014).

An even more interesting observation has been made by Niroula and Thapa (2005 and 2007), who report that in Nepal parcels with smaller size, as a result of land fragmentation, experience more labour inputs and a higher yield. They further argued that "land fragmentation has a rather positive impact on production. However, the higher crop yield from small parcels is attributed

to the application of considerably higher amount of labour, fertilizers and compost." Yet they did not give any clue on whether or how input intensity is connected with land fragmentation (Xuding Rao, 2014)

In spite of the pending impact of land fragmentation on efficiency, this study still generates sufficient implications for future land reforms. First and foremost, land fragmentation as a tool for farmers to manage risk should be recognized. By utilizing the heterogeneous growing conditions, land fragmentation can spread out risk onto separate plots and reduce the revenue variability on the whole farm. This aspect is of special significance to farmers with no or limited access to crop insurance to secure their agricultural income. Second, the vast differences in farm structure, agricultural productivity and farming traditions warn against any hasty generalization on fragmentation and once-and-for-all consolidation propositions.

In a smallholding and traditional agriculture like the Tanzanian case, the small plot size and rare use of machinery can minimize the potential negative effects of land fragmentation, while it may become a more serious issue for places with a more mechanized agriculture such as Japan. According to Kawasaki (2010) land fragmentation reduces the cost efficiency of Japanese rice growing. Average farm size in his sample is about 6,8 acres, roughly comparable to the 6,1 acres among the Tanzanian farmers in our sample when area used for perennial crops and trees is also counted. In contrast to the Tanzanian case, in Japan the planting and harvesting is done mostly with small machines. Large machines are hardly used because they cannot maneuver around in small plots and need long tracts of uniform land to do the job efficiently (Hays, 2013; Xuding Rao, 2014).

Also, Deininger et al. (2014), declared in their works that "In India with ill-functioning land markets, farmers may try to offset adverse effects of fragmentation in several ways. Substitution between inputs, in particular replacing machinery and to a lesser extent seeds and chemicals with bullocks and labour, is found to be an important mechanism for doing so. Differentiating by farm size group also illustrates that addressing different dimensions of fragmentation separately is important: Increases in the number of fragments have limited effect on unit costs by large farms while the opposite is true for fragment-fragment distances. With a cost elasticity of total cost with respect to the Simpson index of 0,63 for small farmers, 0,41 for medium sized, and insignificant effects for large farmers, the cost associated with more fragmented holding structures falls disproportionately on the smallest farm size group. By comparison, estimated

cost elasticities with respect to distances between fragments are, with 0,107 for large, 0,68 for medium and zero for small farms, more modest. Our findings suggest that moves towards a more consolidated structure of operational holdings could disproportionately benefit small farms. But policies to address this phenomenon will be warranted only if they reinforce rather than run counter to market forces, cost less than the benefits they bring, and can be sustained over time. The restrictions on leasing and other forms of land transfer prevailing in most Indian states undermine producers' ability to use market mechanisms to move closer towards their optimum holding structure. Eliminating the restrictions in ways that recognize the rights of tenants and landlords can potentially deliver high benefits. Unambiguous land records, together with mechanisms to keep them current over time, will be essential to underpin any market transactions. By comparison, one-off efforts to consolidate holdings are less attractive in terms of costs and sustainability and, if deemed to be needed, should be combined with elimination of restrictions on functioning of market and clarification records."

Also, the real labour productivity connects with rural development including the rural labour productivity. Some experts as Waage et al (2010) and Weis (2010), wrote and summarised their conceptions. Waage et al. (2010) stated following: "Research and policy for high rural labour productivity in sustainable and resilient agricultural and food systems therefore need much greater explicit attention in international policy than they have had in the past – they should for example be a core part of any successor to the MDGs after 2015." (Waage et al., 2010). Their inclusion in such a scheme, however, needs coordination around policy goals and targets, and targets need indicators. In the following sections we therefore consider possible indicators for use in national and international policy. We consider first indicators of agricultural productivity change and then of food price changes." (also see in Dorward, 2013).

We now consider possible indicators for use in national and international policy concerned with promoting agricultural productivity that supports the fundamental development processes and addresses the constraints and threats identified in the previous section. This is an issue that is of particular importance given growing debate about what could and should follow the current MDGs after 2015. We first identify the desirable features that such indicators should have if they are to be useful in supporting national and international target setting and monitoring. Experience with the MDGs is useful here (see Waage et al., 2010; von Cramon-Taubadel et al, 2011; Dorward, 2013). They identify 4 broad criteria:

1) Indicators must first be relevant to policy goals and targets. This demands that they should have a sound theoretical basis, discourage 'goal displacement' difficulties, be intuitively meaningful and appealing to policy makers and the wider public, and promote holistic thinking within and across sectors (see in detailed in Van Der Ploeg, 2010).

2) Indicators should also be consistently applicable over time and across different countries and different circumstances in order to allow:
    a. comparison across countries and regions; and
    b. analysis of change within countries and regions.

3) Timely and sufficiently comprehensive and reliable and accurate data for these indicators should be either available or potentially available (ideally the former), at reasonable cost for national, regional and global calculations (see more detailed in Weis, 2010).

4) Ideally such data should already be available for historical analysis and comparisons.

In addition Madre and Devuyst (2017) declared that "In practice, there has been in the European Union a standstill in agricultural investments while farmers continue to leave their lands, having in mind that in some European areas this figures reflect to some extend that part of the labour force was underemployed: the general bearish economy inducing a non-optimal use of labour force between sectors and thus a maintenance of people counted as full time on farms not requiring fully these full time jobs". My opinion is that the agricultural investment aims at improving the production technology leading to increased production and labour productivity. New technology is needed for innovation and extending knowledge of human resources.

The current situation is inherently unsustainable: it is very unlikely that the necessary productivity gains – which are estimated at 1,8% per year by the FAO – can be achieved without improving the farm infrastructure and technologies. Given that real long-term productivity growth is determined by the level of private and public expenditure on research and innovation, *renewed investments in the agricultural sector will be crucial to meet the growing global food demand in the future. A further stagnation in the amount of investments would also amplify the risk that the EU will increasingly lag behind its main global competitors*. With a

TFP growth of only 0,8% in the last decade, the EU performed far worse than the other main producers – developed countries such as the United States (1,76%), Canada (1,26%) and Australia (2,1%), as well as the major developing countries Brazil (2,96%) and China (3,32%). Among others, *Smart Farming Technologies have a huge potential to tackle these challenges and represent major opportunities to increase the productivity and competitiveness of EU agriculture on the world stage* (Madre and Devuyst, 2017 and web-site).

The labour productivity is *changing in Central-East Europe and in several EU-member states, for example in Romania,* where the backwardness can easily be followed by the experts. *Popescu* analysed the agricultural conditions based on the labour productivity in the first decade of the 21st century and described some important developing trends in agricultural industry of Romania (Popescu, 2009).

"The productivity gap diminution needs the rejuvenation of the population working in Romania's agriculture. While on the legal entity units the farm heads aged 65 and over represented only 3.2% and the whole population employed on these farms represented 1.6%, on the individual holdings the farm heads aged 65 and over represented 43.7% and the members of these farms 29.5% (*The Farm Structure Survey, 2005; The Farm Structure Survey, 2007*). An important role in the rejuvenation of the population employed in agriculture could be played by the application of the provisions of the Rural Development National Plan, according to which the young farmers under 40 who wish to settle in the countryside will benefit of the non-refundable funds (for the measure 112) from EU, the received amount ranging from EUR 10000 to EUR 25000 per holding, on the condition that the beneficiary farmer owns an agricultural holding ranging from 6 to 40 ESU (one ESU = EUR 1200). The same target could be reached by the application of the Life Annuity Scheme, as well as by the establishment of cooperative companies. Besides the increase of the labour force training and education level, labour productivity is directly or indirectly influenced by a series of natural, technical, economic, social, psycho-social, organizational and structural factors. The following actions could have an important contribution to farmers' labour productivity growth in Romania and to bridging up the gaps between Romania and the EU (see more in NIS, 2001-2007):

- Finance improvement: Agriculture has been and still is an under-financed sector. In the period 2001–2007, the net investments index grew only by 20,4%, compared to the year 2000, and the share of the investments in agriculture, hunting and forestry in total

investments was lower each year, to represent only 3,4% of total investments in the year 2007. As a result, the fixed capital share in total tangible fixed assets was maintained at a very low level throughout the years, ranging from 1,3% in 2003 to 1.7% in 2007. With such an evolution of investments and of capital, agriculture lacked a development engine. This is one of the main reasons for the situation of agriculture in our country, for the accelerated diminution of agriculture contribution to GDP formation (the share of GVA in agriculture to GDP formation was down from 11,4% in 2002 to 5,7% in 2007) and for the negative contribution of agriculture to GDP increase in certain years (in 2007 and not only). The improvement of the agricultural finance is Labour Employment in Romania's Agriculture and Labour Productivity Increase possible through the change of vision of the decision-makers, of governors, with regard to agriculture, through the access to the EU non-refundable funds and their rational use, through determining the banks to provide mutually beneficial credits to farmers. As the banks with foreign capital (which dominate the banking system in Romania) are very cautious in providing credits to farmers, and the CEC-Bank is facing difficulties (from the EC) in increasing the capital, a bank with Romanian capital should be created, specialized in farm credits (see more in NIS, 2002).

- Increase of farmers' capacity to counteract the destructive effects of some natural factors: global heating, drought, flooding, soil erosion, landslides, etc. by the creation of modern irrigation systems, the afforestation of non-productive land, the development of the forest shelter belts, etc.

- Improvement of the technical endowment by the gradual replacement of the worn out and obsolete technical means by other new equipment, with higher technical and economic parameters. The application of the "Old Car" program in agriculture, too, could be beneficial on the short term. On the medium and long term, we consider it necessary to develop the national industry for the production of tractors and agricultural machinery. Romania, as a country where agriculture will continue to have an important role, should not become fully dependent of the imports of technical means (see more detailed in Retortillo - Pinilla, 2014; Zenka et al, 2015).

- Agricultural production concentration through the increase of the economic and physical size of holdings: Romania is now on one of the last places in EU-27 in this

respect. The fact that the largest part of farmers carries out their activity on holdings with less than one ESU (equivalent to EUR 1200) and with a physical size of less than 3 ha represents a constraint to labour productivity growth and to the diminution of the productivity gap between Romania and the EU average.

- Agricultural production structure change having in view a better use of the agricultural potential, obtaining products with higher value added in demand on the domestic and foreign markets: the creation of conditions for Romania's turning from a net importer into a net exporting country of agri-food products. The importance and emergency of the agricultural production structure change results from the fact that in the period 2001–2007, the deficit of the trade balance of agri-food products amounted to over 8,7 billion Euros, which exceeds by 8,1 times the funds allocated to Romania by EU under SAPARD for seven years, beginning with the year 2000. In the last years, Romania's imports reached up to 70% of the consumption needs in certain products. In order to diminish the food dependence on imports, we consider it necessary to develop the livestock production sector, the production of industrial crops, of vegetables, including the vegetables obtained in hothouses, the fruit production, as well as the organic production, which has very favourable conditions in Romania. A special focus should be laid on the agro-processing industry, for meeting the domestic needs and for changing the foreign agri-food trade structure, which is characterized by extremely high shares of imported processed products. Romania sells live animals and raw agricultural products at very low prices and buys processed products at very high prices." (Popescu, 2009; European Union, Agriculture in the European Union, 2008; European Union, Rural Development in the European Union, 2008; Stiglitz, 2003).

Additionally, to Romania, other authors (Zenka et al, 2015) conducted a research for the agricultural productivity in *Czech Republic*. They declared that "From the perspective of the influence of ownership structure on productivity, the results are in compliance with the findings of Davidova et al. (2003), although their analysis was carried at the firm level. Lower agricultural labour productivity in Czech micro-regions dominated by business companies compared to micro-regions dominated by agricultural cooperatives, can be explained by the lower managerial capacity of business companies compared to the agricultural cooperatives (Davidova and Latruffe, 2007; CSO, 2013; Ministry of Agriculture, 2015a).

The authors did not find any significant relationships between agricultural productivity, on the one hand, and indicators of potential localisation economies (spatial concentration of farms, share of agriculture in regional employment, and employment in the food processing industry). Although relatively high labour productivity was found in metropolitan regions with a high spatial concentration of farms, peripheral rural regions with high farm densities exhibited relatively low labour productivity. This pattern can be caused by the fact that agriculture in such regions represents a relatively attractive area of farming business because of available subventions for ecological farmers. It has been argued that subventions may negatively affect levels of agricultural labour productivity (Giannakis and Bruggeman, 2015; Strelecek and Losová, 2005).

Correspondingly, this finding can illustrate the fact that Czech agriculture has become more extensive and ecological (Vezník and Konecny, 2011; Věžník et al., 2013; Ministry of Agriculture, 2015b). High farm density in less densely populated areas is associated predominantly with a high number of ecological farmers. On the other hand, no statistical relationship between urbanisation rate/population density and farm size structure was found. This finding does not correspond with general expectations that highly urbanised areas will be characterised by a dense network of small farms (Sokolow, 2003; Kofron, 2012; Martinát and Klusácek, 2014; Zenka et al, 2015).

The authors confirmed the positive influence of population density (urbanisation rate) on labour productivity, probably resulting from the higher wages competition in the labour market and an orientation to higher value-added agricultural products. Additionally, labour productivity in metropolitan hinterlands may be pushed up by pressures of the construction development industry on agricultural land (Sklenicka et al., 2013; Porter and Bond, 2008; Ruttan, 2002, Ruttan et al, 1984) as a consequence of uncoordinated suburbanisation.

The focus of this article was to describe and explain, with only a time-limited “snapshot”, the differences in agricultural labour productivity at a micro-regional level for the case of the Czech Republic. The current results confirm the general hypotheses that geographical factors (natural conditions and population density) have significant effects on agricultural labour productivity (Adamopolous and Restuccia, 2014; Vollrath, 2007). Conversely, authors did not confirm the hypotheses concerning the positive influence of internal and external scale economies on agricultural labour productivity. One possible reason for this outcome is the continuing high

levels of internal heterogeneity of agricultural labour productivity in the framework of individual micro-regions. Further research on geographical factors affecting agricultural productivity in the Czech Republic will require farm-level analyses.“ (Zenka et al, 2015).

Other author, namely de Schutter (2011) analysed that “This analysis highlights the importance of long run *technical and structural changes* that underpin economic development and ‘developed’ societies: *food prices, agricultural worker productivity, and global threats to supply/demand balances are fundamental long-term development issues*. Not only are they critically important for poorer children’s and adults’ food security, health and physical and mental development, they affect the global economy and the welfare of rich nations and people. However, the critical role of and *links between agricultural labour productivity, real food prices and incomes, and core development processes* have received very little attention in policy debates in recent years.”

An examination of the extensive academic literature and reports on recent food price rises has found no reference to these linkages. Widespread discussion of agricultural productivity makes no or little reference to labour productivity, and is generally implicitly or explicitly couched in the context of *crop yield (land) productivity*. For example, de Schutter (2011), Foresight (2011), Headey and Fan (2010), IAASTD (2009) and World Bank (2007, 2009, 2012b) make *no mention of the importance of agricultural labour productivity*, and Conforti (2011) includes some discussion of its evolution (Schmidhuber et al., 2011; von Cramon-Taubadel et al., 2011) but not of its significance. Even World Bank (2007) only emphasises the impacts of agricultural labour productivity on growth in more technical boxes, with the main text generally referring more broadly to agricultural productivity impacts, again frequently in the context of crop productivity and yields (Shapouri et al, 2009; Solt, 2012; Dorward, 2013).

The IAASTD (2009) focuses on the *modern agriculture*, which is producing more food per capita than ever before. At the same time, according to estimates from the Food and Agriculture Organization, approximately 821 million people are currently affected by hunger. An additional two billion people are suffering from micronutrient deficiencies, lacking key vitamins and minerals. In 2016, 1.9 billion people were overweight, of these 650 million were obese. Climate change is presenting an enormous new challenge for agriculture while the world population is predicted to increase to 9,7 billion by 2050. Whether clean water, fertile soils, forests, wetlands and other natural resources, as well as the biodiversity of the planet, will be available to future

generations, in a condition that enables them to survive will depend crucially on the way we produce our food and on what we eat. An enormous share of human-induced greenhouse gas emissions results directly or indirectly from agricultural production and the subsequent processing, storage, transport and disposal of food. One-third of the world's population obtains its livelihood from agriculture. Agriculture and food are by far the world's largest business and therefore closely linked to sustainable development. For several decades, the World Bank had seriously neglected investments in the agricultural sector. The IAASTD was hence set up to take stock of global agricultural knowledge and evaluate where and how the World Bank could best invest in the agricultural development of the poorest countries. The aim was to find out which future approaches should be adopted by the 15 international agricultural research centres (CGIAR) administered by the World Bank and which role the controversial technique of genetic engineering should play in feeding the world's hungry (IAASTD, 2009).

The 15 CGIAR Research Centres are independent, non-profit research organizations, conducting innovative research. Home to more than 8,000 scientists, researchers, technicians, and staff, CGIAR research works to create a better future for the world's poor. Each Center has its own charter, board of trustees, director general, and staff. CGIAR Research Centers are responsible for hands-on research programs and operations guided by policies and research directions set by the System Management Board. The 15 centres across the world, as the world's largest global agricultural innovation network concerning the production and labour productivity, CGIAR brings evidence to policy makers, innovation to partners, and new tools to harness the economic, environmental and nutritional power of agriculture.

Also, some authors declared the importance of the environment friendly agricultural production, namely „Fourth, both the agricultural and the industrial, service and knowledge revolutions have been based (inter alia) on fossil fuels for tillage and nitrogen fixation and on increased use of material inputs raising productivity of labour use and displacing labour. However, there is growing evidence and concern about environmental limits on continued high dependence on fossil fuels and materials, about rising prices of energy and material inputs, and about increasing competition between food and energy production (for example Foley et al., 2011; Foresight, 2011; Godfray et al., 2010a; Naylor, 2011)."

My opinion is that, as some other experts and authors summarised in aforementioned literature review, that the technical and structural changes should underpin economic development and

'developed' societies: *food prices, agricultural worker productivity, and global threats to supply/demand balances are fundamental long-term development issues*. Also, the *links between agricultural labour productivity, real food prices and income, and core development processes should be mentioned, due their importance.*

Moreover, I believe that the modern agriculture based on the technological development concerning the weather, clean water, fertile soils, forests, wetlands and other natural resources, as well as the biodiversity of the planet, will be available to future generations. This conception – as experts declared – is relevant to the sustainable development accepted by governments and parliaments in the world-wide side. World Bank had also seriously neglected investments in the agricultural sector. The CGIAR Research Centres are responsible for hands-on research programs and operations guided by policies and research directions set by the System Management Board.

2.3 Price system has influence on the labour productivity for the development of agricultural industry

The price system can influence the income positions of farmers. Dorward, (2011; 2013) wrote that „The common analysis of changes in real prices relative to US CPI, however, *ignores differences between rich and poor consumers in the importance of food in their expenditures and in the composition of their non-food expenditures*. It also ignores changes in expenditure composition as populations grow richer. The apparent price fall is in fact *an inevitable consequence of the use of a price index* in a world dominated by expenditure patterns of people achieving and enjoying economic and real income growth (Dorward, 2013; Wold Bank, 2011). It may therefore provide a reasonable assessment of price changes for less poor populations for whom the CPI used is appropriate, with a low proportion of expenditure on food. It is, however, misleading when used to examine long term food prices changes for poor people whose expenditure patterns are not reflected by the US CPI."(see more detailed in US CPI, 2019).

„Changes in grain prices deflated by GDP/capita for high income countries, low income countries and the world show a similar pattern as the deflation of grain prices using the US CPI (Consumer Price Index), but only show the 2008 spike, not the 2010/2011 spike. This is because 2011 GDP per capita data were not available at the time of writing, and the annual average for

2010 masks the increases in grain prices in late 2010. However, it does show that prices deflated by high income country GDP per capita have fallen more than prices deflated by low income country GDP per capita. This suggests that falls in real food prices have been greater for richer people than for poorer people." (Doward, 2013).

„In summary then, nominal grain prices have risen dramatically since the 1960s, but in real terms they have fallen substantially relative to the prices of other goods and services consumed by richer people. They have fallen substantially relative to the incomes of rich people. There are no readily available indicators of changes more relevant to poor consumers in poor countries, but price falls are less than for rich consumers (see below and Dorward, 2013). There are no clear changes against prices of other agricultural commodities. They have fallen dramatically against oil prices and less dramatically against the prices of fertilisers." (Dorward, 2013; Worlds Bank, 2012a).

However, the relatively rough and ready trial estimation presented here captures a number of important features about real food prices measured in terms of opportunity cost of non-food expenditures allowing for income effects, particularly for the poor (Dorward, 2012; Doward et al, 2004). It also allows for global, regional and country analysis concerned about food insecurity, poverty reduction and economic development and offers substantial advantages over current calculations of 'real prices' deflated by price indices.

Some experts declared that it would be useful if the crop production and cropping production technological system are based on the low-external-input with less fossil energy use (see more detailed in Cruse et al, 2010; Hill et al, 2006). According to the example of Lang (2010) „Fifth, and drawing together previous points, limits and threats to increased labour productivity in food production are threats not only to the ability of the world to feed its growing population and to provide that population with high levels of material consumption and prosperity: they are also a threat to achievement of the fundamental processes on which development is based (as suggested in the first point above) (see more detailed in Lipton-Longhurst, 1989; Lipton, 2003). This raises serious questions about alternative fewer material visions of prosperity based, for example, on greater sharing of services and less material consumption (for example Jackson, 2009) and about the extent to which non-industrial forms of agricultural (such as agroforestry or agroecological, conservation or organic farming) can support developed societies if they require higher labour input per unit output to maintain or raise per hectare yields. Such

approaches are often criticised for having high labour requirements, although this is by no means universal (for example herbicide use in conservation farming reduces weeding labour requirements). These issues raise critical questions not only about global food and agricultural systems and the prospects of poor agrarian economies: they are fundamental to aspirations about standards and modes of living in developed economies too, and about structures of society and economic activity (for example Lang, 2010; Van Der Ploeg, 2010; Weis, 2010).

Also, Binswanger-Mkhize and Morris (2009) declared that "A major long run change affecting food prices has been the historical expansion of the area planted to food crops. Areas under cereals and arable production have changed since 1961 and 2000. Although the accuracy and reliability of some of these figures may be questioned (for example there is a sudden large jump in reported areas under cereals in upper middle-income countries in 1992), there appear to be two consistent patterns of change: First, there is an increasing area under cereals and wider arable production in lower income countries (with increases in cereal areas in low income countries partly at the expense of other crops' share of land). Second, there is a slowly declining area under cereals and wider arable production in higher income countries. Rates of growth (decline) are higher for low (high) income countries in the period from 2000 (although this may not pick up responses to higher 2008 prices)".

However continued expansion of cultivated areas is problematic in most parts of the world due to several kinds of difficulties, as these are follows:

a) environmental and sustainability problems with cultivation in marginal and forested land;

b) shortages of other fertile and well-watered land (for example Hazell and Wood, 2008; Foresight, 2011); and

c) although there is potential for substantial expansion of cultivated areas in parts of sub Saharan Africa (for example Binswanger-Mkhize and Morris, 2009), despite substantial challenges (Binswanger-Mkhize and Morris, 2009; Hazell and Wood, 2008; Hazell et al, 2010).

Also, some authors emphasized that the healthful customs stimulate to create the adequate food consumption with examples for the developing economies, which is also applied for the majority of the food-consumer or the population of each EU Member States. There are, however, some apparent anomalies, such as the very high values for the East Asia Pacific (EAP)

region before 1993. There are substantially more anomalies for FER estimates prior to 1990 and in estimates for some countries (for example Madagascar, Zambia and Cameroon had to be dropped from international examples). There may be a number of explanations for the more extreme values (Dikhanov, 2005; Godfray et al, 2010; Godfray et al, 2010b; Doward, 2013):

- The cost of meeting calorific requirements is calculated using international grain prices. However, there is substantial variation in the extent to which international prices are transmitted to domestic markets, and governments may take specific measures to reduce this to protect domestic consumers when international prices are high.

- Weights accorded to different grains are determined by relative international production and consumption patterns, but these will vary for specific countries.

- In poor agrarian economies with significant numbers of poor food deficit producers, a substantial proportion of their calorific requirements may not be purchased, reducing their vulnerability to price increase (although capital constraints and hungry periods may mean that price increases nevertheless affect them very badly).

- When faced with serious price increases poor people do switch from more diverse diets and reduce their intake particularly of more nutritious food. They also borrow, draw down on savings and sell assets to maintain essential food intake, as well as reduce their non-food expenditures.

- The estimate used of first decline share of consumption in sub-Saharan Africa may well be too low. Raising the income share lowers for sub Saharan Africa across all years, but does not change Africa's pattern of greater variability and less general improvement over time. The principal ways in which the calculations and estimates presented here could be improved would be with:
    - use of domestic rather than international prices;
    - use of country specific weights across different grains (and staple roots and tubers);
    - improved estimates of decile and quintile incomes within and across countries; and

- allowance for consumption of some livestock products as ‘essential’ in less poor countries and among less poor consumers in low income economies (Doward, 2013; see detailed in Lentner et al, 2018; Fábián, 2017).

There are some methods for calculating the real labour productivity accompanying with the price system and food consumption demand. An indicator of real food prices relative to real incomes, having considered possible indicators for national and international setting and monitoring of agricultural development targets, we now consider possible indicators for monitoring food prices. Indicators should comply with the principles for ‘useful’ indicators set out at the beginning of the previous section (they should be relevant, based on sound theory, intuitively meaningful, consistently applicable across time and countries, and use (potentially) available data). In addition, they should attempt to address the major shortcoming of current widespread use of ‘real prices’ relative to retail or manufacturing price indices: their failure to represent the ‘income effect’ of high prices on poor consumers.

The core impact of the ‘income effect’ of food price increases is a reduction in consumers’ incomes available for purchase of non-food goods and services. This is particularly serious for poor people given the limited opportunities they have to substitute cheaper for more expensive foods (since they are already buying cheaper foods) and the large share of their income and expenditure that are typically taken by food expenditures. I therefore propose an indicator, the Food Expenditure Ratio (or FER), which is defined as the expenditure required to meet essential calorific requirements divided by resources available for non-staple food after expenditure on essential calorific requirements or

$$FER = \frac{\text{Essential calorific expenditure}}{\text{Total per capita expenditure - Essential calorific expenditure}}$$

To provide some test of the indicator, data series for CEPAL were constructed first using international grain prices from the World Bank (World Bank, 2012a; World Bank, 2012b) and then (for countries but not regions) using domestic producer prices from FAOSTAT, weighted by production shares (FAO, 2011). Indicators may be presented using absolute estimates (*in kg of cereal equivalent per worker*) or indexed, the former allowing comparison between countries and regions and the latter allowing analysis of changes in productivity within and across countries and regions.

Earlier sections of this disertation have established that staple food prices and agricultural labour force productivity are critical for people's welfare and long-term economic growth and structural change. Value added in the agricultural sector divided by size of the agricultural labour force should then be an appropriate measure of agricultural productivity. Difficulties in choice of price measures to account for changing prices across different agricultural commodities can be addressed by measuring value added in terms of cereal equivalents, by dividing value added by the price of cereals. This sidesteps the pricing problem (provided that equivalent measures are used for current prices of cereals and in value added measures) and simultaneously recognises the fundamental importance of staple food prices relative to all economies, rich and poor, as well as to poor people. We propose, therefore, as a core indicator of agricultural development and its wider contribution to the economies of which it is a part, an indicator we term the Cereal Equivalent Productivity of Agricultural Labour (or CEPAL) where

$$\text{CEPAL} = \frac{\text{Agriculture Value Added}}{\text{Agricultural Workers X Cereal Prices}}$$

Operationalisation of this indicator requires definition and sourcing of each of the variables. This is not, in principle, a difficulty for 'Agriculture Value Added' or for 'Agricultural Workers', for which data are routinely available at country level in the World Bank's World Development Indicators (World Bank, 2011; FAO, 2011). There are more difficulties with cereal prices. Questions arise about the relative desirability and availability of international prices and of domestic prices, about the weighting of different cereals in aggregate prices, and for some countries about the inclusion of non-cereal staples. An argument can be made for using international prices if these differ from domestic prices as a result of government interventions, as under these circumstances international prices may be a better measure of true efficiency prices. However, this will not be the case if prices differ as a result of natural barriers to trade. In either case weighting of different cereals' prices should take account of their relative importance in local consumption, and ideally one would move from prices of staples to prices per kcal from all staples, including root crops, weighted by their calorific share in food consumption." (see more detailed in Cruse et al, 2010).

Also, some experts mentioned that international data base show estimates of CEPAL and indexed CEPAL for selected countries in Asia, Sub Saharan Africa and Latin America, and also

compare estimates using international grain prices with those using weighted domestic producer prices from FAOSTAT. The data set constructed with domestic prices is less complete and shows less variability, but otherwise yields broadly similar patterns as obtained with international prices. CEPAL therefore appears to be a valid and useful indicator for supporting national and international target setting and monitoring, although further work is needed to develop and improve domestic price data. Standardisation in the definition of and data collection on agricultural workers may also need investigation and improvement – agricultural labour productivity may be underestimated in low income countries, for example, where rural people may be classified as agricultural workers but obtain substantial proportions of their incomes from non-farm activities (Haggblade et al., 2010; Reardon, 1998; Schelling, 1995).

From side of the World Bank the experts wrote that „It should be noted here that *productivity per hour worked is not critical for the processes of structural change and development discussed earlier: it is the average productivity per agricultural worker that is critical,* whether fully or partially employed, or indeed unemployed. Increases in productivity per hour worked are not beneficial if they are achieved with rising unemployment levels for agricultural workers displaced, for example, by large scale mechanisation. The World Development Indicator (WDI) provides 'Agriculture Value Added' and 'Agricultural Value Added per Worker at constant USD 2000', from which Agricultural Workers can be calculated. FAOSTAT also provides data on 'Total economically active population in Agriculture'. The two sources have very similar data, though the WDI data appears to have fewer inconsistencies. Data quality is an issue, which we discuss later." (WDI, 2011; WIDER - UNU, 2008).

An important consequence of Hungarian approach to the regulation was that from the early 1990s the budgetary discipline of local governments became lax and their debts started to increase, due to underfunding, weak controlling methodology, and vast investment-development needs (especially after the EU accession). As a result of the state stronger decentralisation of duties (distribution of duties) and the interruptions in public financing, operating deficits became permanent, meaning that decentralised deficit (generated in local governments) became a system-specific factor of public finance as a whole. Another specific feature of the system was that in many cases (especially in the 1990s) settlements transferred their non-operational resources to meet operational expenditures. Problems were aggravated by the fact that debts were incurred in foreign currency after the turn of the millennium. The figure shows how drastically bonds have increased since 2006, but long-term loans, which, again,

were denominated in foreign currency, also started to increase from 2002, thus the crisis of 2007-2008 affected the system of local self-government in Hungary much deeper than in most other OECD countries (Lentner et al, 2018; Fábián, 2017).

Also, some experts declared that while examining internal structural elements, it is natural to see that the GDP ratio of local tax revenues was higher in Hungary than in any other country examined. At the same time, a high increase in local governments' debt took place while levels of local tax revenues were stagnating, or even decreasing. Thus, the phenomenon is atypical, as one of the major resources to repay debts, i.e. local tax revenues decreased in this period compared to the GDP, which exposed the sensitivity of the Hungarian local tax system to economic downturns. Debt accumulation can be explained by the fact that in the budgetary period of 2007-2013 the Hungarian national development policy aimed to provide local governments with a significant share, 15%, of the EU cohesion support granted for this period. The previous government provided the opportunity of taking out resources in the *loan* market. instead of national budgetary aid, to use these development resources, and arranged legally that such investment was accounted for as own contribution, although in reality onerous liabilities were assumed by the local governments. Another notable element of Hungarian decentralisation was the approach to the evaluation of assets, which took place from 2001 to 2003 (Lentner et al, 2018; Fábián, 2017).

To summarize above, the price system and labour productivity correlation is needed for understanding the view of different experts and authors. The difficulty is *ignoring the differences between rich and poor consumers, and their importance for food expenditures, but also for their composition of the non-food expenditures*. The apparent price fall is in fact *an inevitable consequence of the use of a price index.* There are no clear changes against prices of other agricultural commodities. They have fallen dramatically against oil prices and less dramatically against the prices of fertilisers – as experts declared.

It also allows for global regional and country analysis concerned about food insecurity, poverty reduction and economic development and offers substantial advantages over current calculations of ‘real prices’ deflated by price indices. This means that first, there is an increasing area under cereals and wider arable production in lower income countries. Second, there is a slowly declining area under cereals and wider arable production in higher income countries.

The *continued expansion of cultivated areas is problematic in most parts of the world. Also, the environmental and sustainability problems are shortages of other fertile and well-watered land.* The healthful customs stimulate to create the adequate food consumption with examples for the developing economies, which is also applied for the majority of the food-consumer or the population of each EU-member states. The governments may take specific measures to reduce this price increase affect and to protect domestic consumers when international prices are high. Substantial proportion of their calorific requirements may not be purchased. In the time of food price increase poor people do switch from more diverse diets and reduce their intake, particularly no intake of more nutritious food. Also, calculating the real labour productivity is accompanying with the price system and food consumption demand. An indicator of real food prices is relative to real incomes.

An appropriate measure of agricultural productivity should be the ration between the value added in the agricultural sector and the size of the agricultural labour force. *Questions arise* – experts declared - *about the relative desirability and availability of international and domestic prices, about the weighting of different cereals in aggregate prices, and for some countries about the inclusion of non-cereal staples.* Under these circumstances international prices may be a better measure of true efficiency prices. *As international experts declared that the productivity per AWU is not critical for the processes of structural change and development discussed earlier: it is the average productivity per agricultural worker that is critical.*

3. RESEARCH METHODS

The analysis of the dissertation focuses on the correlations and significance between different economic variances based on SPSS in agricultural industrial sector of the selected EU-15 member states. Therefore, the method of the correlation calculation between these selected economic variances in the agriculture is in the core of this research.

The main economic variance in my research is the ***agricultural productivity,*** calculated by Eurostat and easily accessible in their statistical books. "The performance of the agricultural industry can be measured in terms of ***net value added at factor cost,*** which is *GVA* adjusted for the *consumption of fixed capital*, and *subsidies and taxes on production*. It is also known as factor income, as it is the remuneration available for all the factors of production. Factor income in the Economic Accounts for Agriculture (EAA) can be expressed per *full-time labour equivalent (measured in AWUs)* as an index. As such, it is considered as a ***partial labour productivity measure;*** it is a *measure of the net value added* by the *equivalent of each full-time worker in the agricultural industry*. This indicator of performance is measured in real terms (adjusted for inflation) and expressed as an index. It should not be confused with the *total income of farming households* or the *income of a person working in agriculture"* (See detailed in Statistical Books 2018, p. 72).

"To understand the development of this *agricultural productivity measure*, it is first necessary to understand the *development of the agricultural labour* amongst which this remuneration is notionally shared. As detailed in Chapter 2, with so much *part-time, seasonal and unsalaried labour input in agriculture*, the amount of work actually carried out in farming activities is best described when using a unit called the ***Annual Work Unit***. This unit expresses the volume of work carried out in *full-time work equivalents*." (See detailed in Statistical Books 2018, p. 72).

Also "*Over the long-term, the volume of agricultural labour has been in steep and steady decline*, which means that the volume of total agricultural labour used by the agricultural industry contracted in almost all Member States during the period between 2005 and 2017; the sharpest declines were in Bulgaria (an average -7,2 % per year) and Slovakia (-6,1 % per year). This contraction in the agricultural labour force reflected both push and pull factors; there have been *great strides in mechanisation and efficiency on the one hand and, on the other, a wider*

choice of attractive job opportunities in other sectors of the economy. The main exceptions to this general trend were Malta (an increase of +1,6 % per year on average) and Ireland (+0,6 % per year on average). The reduction in the volume of non-salaried labour was more pronounced than for salaried labour at the level of the EU as a whole (-3,2 % per year on average compared with -0,3 % per year). There were higher levels of salaried labour input in Ireland (+5,4 % per year on average), Luxembourg (+4,3 % per year) and Belgium (+3,7 % per year) among others, but sharp declines in Slovakia (-5,7 % per year on average), Greece and Romania (both -3,6 % per year) and the Czech Republic (-3,5 % per year)". (See in detailed in Statistical Books 2018, p. 78)

Naturally the calculation of the *agricultural productivity basically sets up the value of agricultural output*, which has important role in the performance of the EU, in spite that this contributed to the economy of the EU by less share. Namely "the agriculture contributed 1,2 % to the EU's GDP in 2017. *Primary agricultural production* in the EU (henceforth termed 'the *agricultural industry*') is big business, even without considering its importance as the key building block for the downstream food and beverages processing industry. The agricultural industry contributed EUR 183,0 billion towards the EU's overall GDP in 2017. To put this in some context, the contribution of the agricultural industry was slightly more than the GDP of Greece in 2017, the 17th largest economy among the Member States. This contribution is the ***difference*** between the *value of agricultural production* and the *value of various input costs* built up in the *production process, adjusted for taxes and subsidies on products.* It is therefore interesting to look at the structure and composition of the value of this agricultural production and the various inputs used."(See in detailed in Statistical Books 2018, p. 72).

In my dissertation, I focus on the correlations among the economic variances that are considerably influencing changes or improvements on the agricultural productivity. In the SPSS statistical analyse the first five economic variances are OUTPUT171, as Output of the agricultural industry - basic and producer prices; INPUT172, as Own calculation: OUTPUT-GVA = INPUT based on data of Eurostat, Input of the agricultural industry - basic and producer prices; GVA173, as GVA of the agricultural industry - basic and producer prices, PrivIn164, as Private investments, jobs and GVA related to circular economy sectors, Value added at factor cost and the finally fifth economic variances the RIFAWU175, as Real Income Factor per AWU equivalent between 2010-2017 at factor price.

In the SPSS statistical analyse the second five economic variances are GDPGrowth176 = GDP Growth, 2000-2017, Gross domestic product at market prices, Chain linked volumes; AWU20177= Labour force directly employed - AWU in number 1000, in 2017 Farm indicators by agricultural area, type of farm, standard output, legal form and NUTS 2 regions [ef_m_farmleg]; RLProd20178 = Real labour productivity per person, 2010= 100, Labour productivity and unit labour costs [nama_10_lp_ulc], Index of the real income of factors in agriculture per annual work unit,; the Subsidies169= Subsidies 2010-2016, Million Euro, 2010= 100, The difference between an economy's external financial assets and liabilities is the economy's net international investment position, which may be positive or negative. The last, the tenth economic variance is the DIRINV1710= Direct investment in million units of national currencies between 2010-2017.

In addition, the Economic Sentiment Indicator (ESI) - commonly used and accepted in EU - is a composite indicator made up of five sectoral confidence indicators with different weights: Industrial confidence indicator, Services confidence indicator, Consumer confidence indicator, Construction confidence indicator Retail trade confidence indicator. Confidence indicators are arithmetic means of seasonally adjusted balances of answers to a selection of questions closely related to the reference variable they are supposed to track (e.g. industrial production for the industrial confidence indicator). Surveys are defined within the Joint Harmonised EU Programme of Business and Consumer Surveys. The ESI is calculated as an index with mean value of 100 and standard deviation of 10 over a fixed standardised sample period. Data are compiled according to the Statistical classification of economic activities in the European Community, (NACE Rev. 2, 2008; NEWS RELEASE, 2019).

Another indicator accepted in EU and widely used indicator for agricultural development is the Cereal Equivalent Productivity of Agricultural Labour (CEPAL) where

$$CEPAL = \frac{\text{Agriculture Value Added}}{\text{Agricultural Workers X Cereal Prices}}$$

Authors agree on the importance of the agricultural productivity in stimulating economic growth and structural change, but they also highlighted possible threats to agricultural labour productivity caused by environmental constraints or costs in using fossil fuels in agriculture and by limited expansion of agricultural land. It is therefore also appropriate to develop targets

for monitoring land and energy productivity in agriculture. Similar indicators to CEPAL can be constructed by replacing agricultural labour with land and fertiliser use in the CEPAL formula. They therefore define Cereal Equivalent Land Yield (CELY) as

$$CELY = \frac{\text{Agriculture Value Added}}{\text{Agricultural Land X Cereal Prices}}$$

and Cereal Equivalent Productivity of Inorganic Fertiliser (CEPIF)

$$CEPIF = \frac{\text{Agriculture Value Added}}{\text{Inorganic fertiliser use X Cereal Prices}}$$

Below are shown these two indicators by country income groups. As with CEPALs, cereal equivalent land yield rises steadily from low to high income groups, and has generally risen from 1980 to 2010, except for low income countries, with the extent of the rise varying between income groups, and with falls during periods of high cereal prices (in the early and late 90s and in 2008) and from 2004 in high income countries.

A sudden drop in upper middle-income countries' CELY in 1992 appears to be due to an unexplained rise in middle income countries' cereal areas in 1992. Values for CELY are heavily affected by land quality. This is not obvious in the income group comparisons, as there is some averaging of land qualities across countries. However, marked CELY differences across countries – as some countries are able to apply irrigation to obtain two or three crops per year in much of their agricultural land, while in others agriculture may be dominated by extensive low-quality grazing lands. The value of this indicator in cross country comparisons is therefore limited. However, it has considerable value as an indicator of changes in productivity over time within countries, and for regions and the world as a whole (Foley et al., 2011; Foresight, 2011; Godfray et al., 2010b; Pelucha et al, 2013).

The challenge that each country's agriculture across the world is facing is how to get high income countries' high labour and land productivity (shown by high CEPAL and CELY values) without high use of fertiliser which leads to low CEPIF. On the other hand, low income countries are unlikely to achieve high yields and labour productivity with their low rates of fertiliser use – with many crops grown without fertiliser at all, and unsustainable soil mining in

some areas. Low income countries will therefore need higher fertiliser use and lower aggregate fertiliser productivity to raise their yields – though there is scope for improving productivity of existing fertiliser use. Major challenges are faced by lower and upper middle-income countries as these countries are responsible for the majority of the world's fertiliser use but have low fertiliser productivity. These challenges, comparing 2008 global and high income (OECD) countries' CEPAL, CELY and CEPIF with illustrative sustainable targets for these variables.

Also, the other research analysing method mentioned by Kijek (Kijek et al, 2019; Kijek et al, 2016) is that "the wide applicability of total productivity indices in economic analyses is associated with their comprehensive nature resulting from the aggregate analysis of expenditure. According to need, different methods of TFP analysis are applied. Total factor productivity of agriculture in the member states of the EU has been investigated quite extensively, but the studies often focused on a selected group of states (Brümmer et al. 2002) or covered a short period (Čechura et al. 2014). The most commonly applied TFP index is the Malmquist productivity index (Brümmer et al. 2002; Coelli et al. 2005). In turn, alternative productivity indices, e.g. *the Hicks-Moorsteen index or the Färe-Primont index* are rarely mentioned in reference literature (Rahman and Salim 2013). One of the attractive features of the Färe-Primont index is that its increase can be fully attributed to increases in scale and mix efficiency (i.e. economies of scale and scope). For example, the Malmquist index ignores productivity changes associated with changes in scale. Moreover, the Färe-Primont index satisfies an identity axiom and a transitivity test." (see in detailed in Wang et al, 2012; Salmerón and Romero-Ávila, 2015).

Although the precise targets can be debated, the challenge for the agriculture across the globe is how to dramatically raise agricultural labour and land productivity while reducing external input use. This is challenging when high external input use has been a major basis for previous increase in labour and land productivity. Most discussions of the challenges facing world agriculture focus on the need to maintain yields with lower external input use (that is with much higher external input productivity) but pay scant specific attention to the critical challenge of raising agricultural labour productivity (for example Foley et al., 2011; Foresight, 2011; Godfray et al., 2010b; IAASTD, 2009; Naylor, 2011; Pretty et al., 2011).

In my research the above mentioned analyses are not applicable, however, these are mentioned due to their particular relevance to the main objectives of my dissertation.

4. RESULTS AND DISCUSSION

In order to understand the analysis and researching objectives of the study, it is of crucial importance to mention preceding Eurostat research works and statistics. “The agricultural income per AWU, expressed as an index, was +10,9 % higher for the EU-28 in 2017 than the level in 2016 and +24,6 % higher than the level in 2010, continuing the upward trend. (See in detailed in Statistical Books 2018, p. 71). Agricultural income as defined by factor income per AWU rose sharply for the EU-28 in 2017 (+10,9 %). *Agricultural income*, as defined by deflated (*real) factor income per total Annual Work Unit*, for the EU as a whole was +10,9 % higher in 2017 than it was in 2016. This reflected a sharp increase in factor income (+9,6 % in real terms) being notionally shared amongst a reduced (-1,2 %) volume of agricultural labour. There were particularly divergent developments in agricultural income among the Member States in 2017. *The strongest rates of increase were in Denmark (+76,9 % higher than 2016) and Estonia (+67,6 %), reflecting rebounds from lows in 2015 and 2016* to levels that re-surpassed those of 2010”.

Also “there were strong rises in the range of +20 % to +35 % in Germany, Luxembourg, Ireland and Lithuania, often to levels much higher than those in 2010 (the chosen base year). The further rise in agricultural income in Bulgaria (+19,1 % in 2017) means that it has doubled since 2010, *although much of this was due to factor income being notionally shared amongst a much smaller agricultural workforce.”* (See in detailed in Statistical Books 2018, p. 78)

Agricultural factor income per annual work unit increased by +10,9 % to a new high in 2017.

- The value of agricultural output was EUR 432,6 billion in 2017, a year-on-year increase of +6,2 %.

- The EU produced 45,2 million tonnes of meat in 2017, one half of which (51,8 %) was from pigs. It also produced 170,1 million tonnes of raw milk.

- Output volumes of many of the EU's main agricultural products were higher in 2017: there was a +2,8 % rise in cereal output, an increase of +1,7 % in sheep and goats output, a rise of +1,1 % in milk output, and a +0,5 % rise in poultry meat output. There was no change in bovine meat output, but there was a decline (-0,9 %) in the output volume of pig meat.

- *Real terms (deflated) prices for most of the main products were also higher in 2017*: the average milk price jumped +17,1 %, the average for pigs was up +8,7 %, for cereals was +3,0 % higher, for cattle was up +2,2 % and for poultry was also +1,0 % higher. In contrast, the real terms price of sheep and goats continued to decline (-1,4 %) in 2017.

Also "after a sharp fall back from the peak in 2012, *agricultural factor income per annual work unit* partially rebounded (+76,9 %) in 2017.

- The output value of the agricultural industry was EUR 11,1 billion in 2017, representing a year-on-year increase of +10,7 %. About 60 % of this total output value was from pigs, milk and cereals; the output values of each of these rose sharply in 2017 (+9,9 %, +27,1 % and +18,5 % respectively).

- Production of pig meat continued to decline (-2,3 %) away from the recent high in 2011. The real terms price of pigs rose strongly (+7,1 %).

- The production of milk was 5,5 million tonnes in 2017 (up +1,2 %); the national dairy herd was also moderately higher (+1,8 %) in 2017. The average real terms price of milk bounced back towards the level of 2014 (+26,3 %).

- The cultivated area of cereals in 2017 was slightly lower (-1,5 %) than in 2016, but harvested production increased sharply (+9,5 %), mainly due to wheat (+15,1 %) but also rye (+25,3 %, with the cultivated area up +11,8 %). The production of rye was the third highest in the EU. There were higher real terms prices for wheat (+7,2 %) and rye (+7,9 %) in 2017, breaking the recent downward trend."(See in detailed in Statistical Books 2018, p. 78).

The analysis is consisted of two parts. This is due to the limitation of the SPSS statistical system, namely it only allows five economic variances in case of analysing 15-member states. In my study ten economic variances are used for the selected EU-15 member states. It is in my belief that five more economic variances are required in order to get clear results on the economic differences among these member states. Best results are needed for the other analyses for the same selected EU-15-member states. Therefore, *in the first part of this chapter, the* ***first five economic variances*** were used, namely OUTPUT171, INPUT172, PrivInv164 according to the

Component-1 at the „X" Principle line and GVA173, RIFAWU175 according to the Component-2 at the „Y" Principle line based on the data-base of the Table-1. *The second part of this chapter shows the* ***second five economic variances***, namely GDPGrowth176, AWU20177 and RLProd20178 according to the Component-1 at the „X" Principle line and also Subsidies169 and DIRINV1710 according to the Component-2 at the „Y" Principle line based on the data-base of the Table-11. To sum, in below two subchapters it is analysed the economic conditions of the selected EU-15-member states, based on the two groups (five and five each group) economic variances.

4.1 Statistical analyses based on the first five economic variances

In my opinion it can clearly be seen that for this period the EU member states in East Central Europe have realised a considerable growth in field of the agricultural income compared to the results of the other EU member states. The increase of the agricultural income could be due to the growing agricultural productivity in the selected EU-15 member states including East Central European EU member states in this research. The Growth rate of Factor Income per AWU has increased by 25,2% for the period of 2010 and 2017 (2010=100; see Table-2 and Table-3; Eurostat 2018). The *Table-2* shows that the subsidies on the production in agricultural industry were mostly covered for Consumption of fixed capital in share of 86,6% in 2016. Therefore, the agricultural productivity could improve by investing in advanced technologies and equipment.

The *Table-1* summarised the main statistical data base concerning the first five economic variances for the agricultural industry of the selected EU-15 member states between 2010 and 2017 (2010=100). The Output of the agricultural industry and GVA of the agricultural industry are available in the Eurostat data base for all EU member states, therefore the INPUT can be calculated from these economic variances, as OUTPUT-GVA = INPUT by my own calculation. The Private investments concerning the consumption of the fixed capital and the Real Income Factor per AWU equivalent, at factor price can help us to understand the changes of the AWU in this period of 2010-2017.

This calculation method can be relevant to the demand accepted by all EU member states for determining the changes of the real income factor per AWU, therefore the comparison can be

easier among the selected EU member states in this field. Also, the Table-1 shows the selection of the first economic variances into two components and distribution of the selected EU-15 member states into five clusters, as the SPSS statistical system calculates. The selection and clustering of the EU-15-member states in the Table-1 are in detailed coming from other tables based on the SPSS system.

Table 1. *Output, Input, Gross value added, Private investments, Economic accounts for agriculture - agricultural income in the agricultural industry, data based on Eurostat, Million EUR, Production value at basic price, between 2010 and 2017, 2010=100*

Countries/ Economic variances	**OUTPUT171**	**INPUT172**	**PrivInv164**	**GVA173**	**RIFAWU175**
Component		**1**		**2**	
Variances	**1**	**2**	**4**	**3**	**5**
Bulgaria-1	***10,2***	***-7,1***	***22,1***	***41,8***	***126,7***
Czech Republic	24,9	9,7	10	73,6	53,0
Hungary	37	16,4	26,1	81	66,2
Slovakia	26,7	14	10,4	80,4	105,4
Austria-2	***15,2***	***8,6***	***30,1***	***24,8***	***7,0***
Denmark	14,3	12,6	16,5	19	9,9
Greece	6,7	10,4	-36	3,4	-1,4
Italy	14,4	7	5,8	21	32,0
Romania	12,3	8,7	26,5	17	36,6
Slovenia	5,2	3,1	19,1	8,7	-1,6
Estonia-3	***32,6***	***40,2***	***37,1***	***18,3***	***8,0***
Latvia	51	46,5	16,2	64,8	38,2
Poland	30	30,5	19,1	29,4	40,4
Croatia-4	***-24,4***	***-20,4***	***-5,5***	***71,2***	***17,9***
Lithuania-5	***53,8***	***36,6***	***82,3***	***90,7***	***50,0***
EU-15	*20,66*	*14,45*	*18,65*	*43*	*39,2*
EU-28	*15,9*	*11,6*	*10,1*	*21,9*	*25,2*
EU-15 of EU-28, EU-28=100 in 2017	*36,3*	*34,2*	*24,5*	*39,1*	---
Component		**1**		**2**	
Variances	**1**	**2**	**4**	**3**	**5**

Source: Eurostat, 2018[1].

OUTPUT171

Output of the agricultural industry - basic and producer prices, Million EUR, Production value at basic price, 2010= 100, 2010-2017, Eurostat, 2018[2]

[1] https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tag00102&plugin=1
[2] https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tag00102&plugin=1

INPUT172

Own calculation: OUTPUT-GVA = INPUT based on data of Eurostat, Million Euro, Input of the agricultural industry - basic and producer prices, 2010= 100, 2010-2017, Eurostat, 2018.

GVA173

Gross value added of the agricultural industry - basic and producer prices, Million ECU/EUR, Production value at basic price, 2010= 100, 2010-2017, Eurostat, 2018[3].

PrivInv164

Private investments, jobs and gross value added related to circular economy sectors, Value added at factor cost (Million Euro), 2010= 100, 2010-2016, Eurostat, 2018[4].

RIFAWU175

Real Income Factor per AWU equivalent between 2010-2017 at factor price. Economic accounts for agriculture - agricultural income (indicators A, B, C) [aact_eaa06], Index of the real income of factors in agriculture per annual work unit, 2010= 100, 2010-2017, Eurostat, 2018[5].

Component-1: OUTPUT171, INPUT172, PrivInv164

Component-2: GVA173, RIFAWU175

Clusters

Cluster (1): Bulgaria, Czech Republic, Hungary, Slovakia

Cluster (2): Austria, Denmark Greece, Italy, Romania, Slovenia,

Cluster (3): Estonia, Latvia, Poland

Cluster (4): Croatia

Cluster (5): Lithuania

[3] https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tag00056&plugin=1

[4] https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=cei_cie010&plugin=1

[5] http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=aact_eaa06&lang=en

Table 2. *Main Component of agricultural industry in EU-28, in 2010-2016*

Titles	2010	2016	Change 2010-2016 (%) 2010=100%	Share in output value of the agricultural industry, 2016 (%)
	Million Euro			
Output of agricultural industry	**372 902**	**405 008**	**8,6**	**100,0**
Crop output	188 875	210 282	11,3	51,9
Animal output	142 345	158 873	11,6	39,2
Agricultural services	17 693	20 104	13,6	5,0
Secondary activities	23 989	15 750	-34,3	3,9
- Intermediate consumption (input)	*217 309*	*239 355*	*10,1*	*59,1*
Gross value added	**155 593**	**165 654**	**6,5**	**40,9**
- Consumption of fixed capital	69 401	60 803	-5,4	---
- Tax on production		4 877		---
+ Subsidies on production	50 917	52 628	3,4	---
= Factor income	**137 109**	**152 603**	**11,3**	---
Growth rate 2010=100	*100,0*	*11,3*	---	---

Note: Production value at basic price, 2010= 100%

Source: Eurostat, 2019.[6]

Table 3. Main Component of agricultural industry in EU-28, in 2010-2017

Titles	2010	2016	2017	Change 2010-2017 (%) 2010=100 %	Share in output value of the agricultural industry, 2016 (%)
	Million Euro				
Output of agricultural industry	**372 902**	**405 008**	**430 816**	**15,5**	**100,0**
- Intermediate consumption (input)	*217 309*	*239 355*	*242 872*	*11,8*	*56,4*
Gross value added	**155 593**	**165 654**	**187 944**	**20,8**	**43,6**
Growth rate of Factor Income per AWU 2010=100	*100,0*	*11,3*	*25,2*	---	---

Source: Eurostat, 2019.[7]

Note:

- *Volume index for labour costs: Change in Total labour input measured in 1000 AWU (aact_ali01);*
- Correction of the weight for labour costs to cover the family labour costs: the compensation of employees is divided by the share of paid labour also directly available from the EAA (aact_ali01);
- *the **Farm Accountancy Data Network** to estimate the national average depreciation rate;*
- *TFP index is defined as the ratio between an **Output Index** (i.e. the change in production volumes over a considered period) and an **Input Index** (the corresponding change in inputs/factors used to produce them). The* four considered production factors (intermediate inputs, land, labour, capital);

[6] http://ec.europa.eu/eurostat/statistics-explained/index.php/Agricultural_accounts_and_prices

https://ec.europa.eu/eurostat/data/database

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=ef_ogardaa&lang=en

[7] http://ec.europa.eu/eurostat/statistics-

explained/index.php/Agricultural_accounts_and_priceshttps://ec.europa.eu/eurostat/data/database

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=ef_ogardaa&lang=en

Agricultural factor income measures the remuneration of all factors of production (land, capital, labour) regardless of whether they are owned or borrowed/rented and represents all the value generated by a unit engaged in an agricultural production activity. It corresponds to the **net value added at factor cost. The indicator consists of two sub indicators:**
A. Agricultural factor income per annual work unit (AWU). An AWU in agriculture corresponds to the work performed by one person who is occupied on an agricultural holding on a full-time basis. For this indicator, total (paid and unpaid) AWU are used; and
B. The index of agricultural factor income per AWU is already available in Eurostat's Economic Accounts for Agriculture as **Indicator A.** This index is particularly suited for showing developments over time;

Total factor productivity (TFP) compares total outputs relative to the total inputs used in production of the output. As both output and inputs are expressed in term of volume indices, the indicator measures TFP growth (Eurostat, 2018)[8].

The SPSS system provides correlations and significance among the economic variances, which are provided in the Table-4. The correlations among the variances can be strong if the value is more than 0,500 (50,0%), but if the value is close to 0,500, the correlation is considered to be middle. If the value is under 0,500 (50%) the correlation is weak. Naturally if the value of the correlation is close to 1,000 (100%) the correlation is very strong. Based on this, the correlation is very strong between OUTPUT171 and INPUT172.

The correlations are middle strong between following variables, namely between OUTPUT171 and Privinv164 by 0,603 (60,3%); INTPUT172 and Privinv164 by 0,463 (46,3%) and between GVA173 and RIFAWU175 by 0,562 (56,2%). This means that if the OUTPUT171 increases, then the INTPUT172 also increases. Moreover, if the OUTPUT171 increases, then the Privinv164 increases or if the INTPUT172 increases the Privinv164 increases.

The same trend is valid in cases of correlations between GVA173 and RIFAWU175 economic variances. Naturally if one economic variance changes the other economic variance changes in same direction; either increases or decreases dependably on the other variances (Table-4).

The correlations are strong among these variances, because if the input (as intermediate consumption of the agricultural industry in selected EU-15 member states) increases, this stimulates output increase or the opposite to this one. When the output (OUTPUT171) for

[8] http://ec.europa.eu/eurostat/cache/metadata/en/aact_esms.htm
http://ec.europa.eu/eurostat/statistics-explained/index.php/Agricultural_accounts_and_prices#Further_Eurostat_information
http://ec.europa.eu/eurostat/web/agriculture/data/database

example for primary production such as crop output, or animal output, or agricultural services, even the secondary (post-harvest) activities decrease, is resulted as decreasing trends of the input (see in detailed in Table-2). If farmers use less input (INPUT172) for example less fertiliser and pesticide the yields of the primary production as crop or animal output will be less.

In the same time the output and the input have middle strong influence on the private investment changes. Hence, when the private investments increase, the input and output should increase as well, in order to create the efficient production process, finally accompanied with more favourable income position of farmers and their farming households. Based on the calculation methods used by the Eurostat, it is very clear that the GVA has considerable influence on the real income factor per AWU.

According to the results in Table-4, the output neither the input can independently influence the real income per AWU change, but the difference of the output and input, as the GVA can influence the income positions, as income factor of farming household. Naturally the *private investments* including the consumption of fixed capital can stimulate the position of the GVA, but not directly on the changes of the real income factor. Also, it should be mentioned that there is a weak correlation between the OUTPUT171 and GVA173, and its value is 0,389 (38,9%).

Based on Table-4, the significance among the economic variances can be strong if the value is zero “0” or very close to “0”. Based on the results, there is a strong significance between the OUTPUT171 and INPUT172, the value is 0,000. Also strong significance exists between the OUTPUT171 and Privinv164 by value as 0,009, and between the GVA173 and RIFAWU175 by value as 0,015. Moreover, there is an important considerable significance between the INPUT172 and Privinv164 by value as 0,041, and between the OUTPUT171 and GVA173 by value as 0,076.

In the *Table-4* there is a diagonal by value 1,000 in the section of the Correlation and from the diagonal up right and down left, all of the values are the same. Also diagonal by value 0,000 in the section of the Significance and from the diagonal up right and down left, all of the significance values are the same.

Table 4. Correlation Matrix

		OUTPUT171	INPUT172	GVA173	PrivInv164	RIFAWU175
Correlation	OUTPUT171	1,000	**,895**	,389	**,603**	,247
	INPUT172	,895	1,000	,115	**,463**	-,088
	GVA173	,389	,115	1,000	,344	**,562**
	PrivInv164	,603	,463	,344	1,000	,187
	RIFAWU175	,247	-,088	,562	,187	1,000
Sig. (1-tailed)	OUTPUT171		**,000**	**,076**	**,009**	,187
	INPUT172	,000		,341	**,041**	,377
	GVA173	,076	,341		,105	**,015**
	PrivInv164	,009	,041	,105		,252
	RIFAWU175	,187	,377	,015	,252	

Source: Own calculation using SPSS, Eurostat, 2019.

The *Table-5*, namely KMO and Bartlett's Test, shows that the SPSS statistical analyse is showing 0,498 value of KMO, for which value is needed at least for above 0,500 (50%) and also by 0,000 value of significance, making it the best for analysing. This means that the Eurostat statistical data is adequate for analysing, using the SPSS system.

Table 5. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,498
Bartlett's Test of Sphericity	Approx. Chi-Square	40,484
	df	10
	Sig.	,000

Source: Own calculation using SPSS, Eurostat, 2019.

The *Table-6*, as Anti-image Matrices shows the measure of the significance level for each economic variance of the research. Their measures are figures remarked by letter "a" in the diagonal of the Ant-image Correlation of this table. The values of this measure should be more than level of 0,500 (50%) or approximately at about this level. The most important economic variances are Privinv164 by value of 0,757 (75,7%) and GVA173 by value of 0,701 (70,1%), the other two variances are quite satisfactory namely OUTPUT171 by value of 0,478 (47,8%) and INPUT172 by value of 0,424 (42,4%). The RIFAWU175 variance is less than the middle strong level by value of 0,346 (34,6%), but this variance is important for my analyses.

Table 6. Anti-image Matrices

		OUTPUT171	INPUT172	GVA173	PrivInv164	RIFAWU175
Anti-image Covariance	OUTPUT171	,065	-,069	-,065	-,076	-,099
	INPUT172	-,069	,082	,064	,050	,115
	GVA173	-,065	,064	,550	-,037	-,101
	PrivInv164	-,076	,050	-,037	,589	,083
	RIFAWU175	-,099	,115	-,101	,083	,427
Anti-image Correlation	OUTPUT171	**,478[a]**	-,944	-,341	-,390	-,590
	INPUT172	-,944	**,424[a]**	,301	,227	,612
	GVA173	-,341	,301	**,701[a]**	-,066	-,209
	PrivInv164	-,390	,227	-,066	**,757[a]**	,165
	RIFAWU175	-,590	,612	-,209	,165	**,346[a]**

a. Measures of Sampling Adequacy (MSA)

Source: Own calculation using SPSS, Eurostat, 2019.

The *Table-7*, namely Communalities show the measure of the importance of each economic variance in my research, therefore from point of view of the aims of my researches the most important variances as OUTPUT171 by value of 0,935 (93,5%), the INPUT172 by value of 0,915 (91,5%) and the RIFAWU175 by 0,805 (80,5%) also the other two variances are important for my research accepted by SPSS statistical system.

Table 7. Communalities

	Initial	Extraction
OUTPUT171	1,000	,935
INPUT172	1,000	,915
GVA173	1,000	,765
PrivInv164	1,000	,586
RIFAWU175	1,000	,805

Extraction Method: Principal Component Analysis.

Source: Own calculation using SPSS, Eurostat, 2019.

The *Table-8*, as the Total Variance Explained by two components including five economic variances by value 80,116 in percent, as Initial Eigenvalues Cumulative. The two variances provide 80,116% of the all research results.

Table 8. Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,583	51,657	51,657	2,583	51,657	51,657	2,338	46,763	46,763
2	1,423	28,460	**80,116**	1,423	28,460	80,116	1,668	33,353	80,116
3	,546	10,917	91,033						
4	,413	8,252	99,285						
5	,036	,715	100,000						

Extraction Method: Principal Component Analysis.

Source: Own calculation using SPSS, Eurostat, 2019.

The *Table-9*, as Rotated Component Matrix shows the structure of two components with their economic variances concerning the agricultural industry of the selected EU-15 member states. The first component is at the principle line "X", which component includes three economic variances, namely OUTPUT171 by its value 0,940 (94%), the INPUT172 by its value 0,946 (94,6%) and the Privinv164 by the value 0,710 (70,1%).

Table 9. Rotated Component Matrix[a]

	Component	
	1	2
OUTPUT171	**,940**	,225
INPUT172	**,946**	-,143
GVA173	,236	**,842**
PrivInv164	**,710**	,287
RIFAWU175	-,007	**,897**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.

Source: Own calculation using SPSS, Eurostat, 2019.

Component-1: OUTPUT171, INPUT172, PrivInv164
Component-2: GVA173, RIFAWU175

The second component is at the principle line "Y", which component includes two economic variances, namely GVA173 by the value 0,842 (84,2%) and RIFAWU175 by value 0,897 (89,7%). The value of the each variance should be the highest one in the line of each variance, which value can determine its position at the principle line, therefore in the coordinate system or by the other name as score. The principle line "X" is the horizontal line in the score, but the other principle line "Y" is the opposite line for the line "X" by 90 degree in right angle.

4.2 Factor analyses for input, output, private investments, gross value added and real income factor for annual working unit

The importance of the score (coordinate system) that this visually shows or applies the positions of the selected EU-15 member states in the score by value of economic variances based on the statistical data according to the EU-15 member states. Therefor the values of economic variances show the measures of the correlations among economic variances as economic characters of the selected EU-15 member states in the score (see Figure-1).

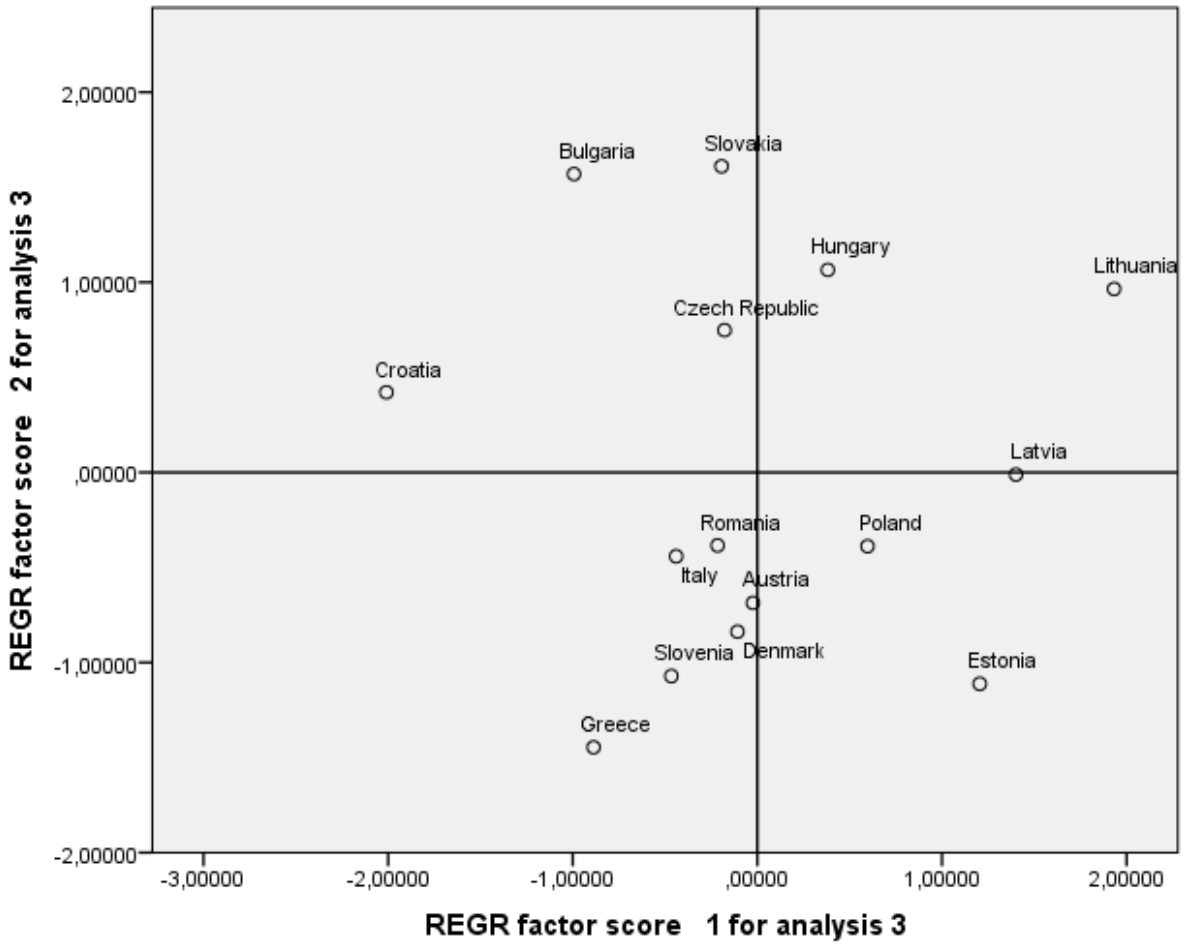

Figure 1. REGR Factor score 1 and 2 in cases of EU-15 selected Member States
Source: Own calculation using SPSS, Eurostat, 2019.

Component-1: OUTPUT171, INPUT172, PrivInv164

Component-2: GVA173, RIFAWU175

In the first session or quarter of the score (see Figure-1) there are several EU member states, namely Hungary, Lithuania and Latvia. Economic variances of the Component-1 including the OUTPUT171, INPUT172 and PrivInv164 (Private investment) are laying on the principle line "X", while the economic variances of the Component-2 including the GVA173 (Gross value added) and RIFAWU175 (Real income factor for Annual working unit) are laying on the principle line "Y".

Therefore this means that in these countries or EU member states of this quarter of the score generally the OUTPUT171, INPUT172 and PrivInv164 (Private investment) are increasing or little decrease and also the GVA173 (Gross value added) and RIFAWU175 (Real income factor for Annual working unit) of the "Y" line are increasing or little decrease.

*In case of **Hungary** the output, input and the private investment on the "X" line have increased, but the GVA and the real income factor per AWU have increased more than the increasing trend of the other three economic variances on "X" line. This means that the little moderate increase in field of private investment in Hungary could have generated three times more increase in case of the GVA and two and half time more increase of real income factor for AWU for the same time period. In this period the first biggest increase of the GVA was in Lithuania by 90,7% increase and Hungary was the second member state and third member state was by 80,4% after Hungary at very directly. The average increasing level of GVA in EU-15 was 43%, while in EU-28 this rate was only 21,9%.*

This result was very attractive for the EU-15 and for these three member states of this quarter of the score. In this quarter ***Lithuania*** reached 53,8% increase in field of the output, which was the first highest level increase in all of the EU-28, where the average level of increase was 15,9%, while in EU-15 selected member states was 20,66% even more than the average of EU-28. Lithuania reached the third biggest increase in field of input after Latvia and Estonia. Lithuania have implemented the highest level in increase of private investment by 82,3% in selected EU-15 member states of which the average increase was 18,65% more than 10,1% of increase of EU-28 for the reached period since 2010. These very attractive results of Lithuania have generated 90,7% increase in field of GVA therefore 50,0% in field of real income factor per AWU for the same period. In spite that this real income increase was moderate in cases of EU-15, this was higher than the average level of EU-15, of which was 39,2%, but result of Lithuania was two time more than the real income growth of the EU-28, which had 25,2%.

The results of *Lithuania* in fields of these five economic variances provided proof that how much this member state had relative backwardness from the highest advanced level of the EU-28 and also the intensive private investment could generate considerable increase in field of real income factor for AWU. In Lithuania the first important aim was increasing and stimulating the more intensive private investment and only after that the increase of real income factor generated by intensive investment. The first aim was the increase in field of the private investment and only after that the second aim was the growth in the real income factor. This order and rule can keep the efficient and sustainable agricultural production growth by using advanced technology either in Lithuania or in EU-15 and EU-28. The naturally the agricultural production should be concentrated more in order to increase the efficient level of the agricultural production. Because more yield can be produced per each unit of the production cost or input by using advanced technology and techniques even equipment based on the improving innovation extending knowledge of farmers.

In this quarter of the score there is a member state, namely Latvia, which member state has realised *positive considerable increase* mostly in field of input and GVA. After Lithuania the second was ***Latvia*** in field of growth of output by 51% within EU-15 member states. This considerable growth of output was based on the strong concentrated increasing trend of input with efficient using input resources by 46,5% increase, which was the top of input increase in cases of EU-15 and EU-28. In EU-28 the input growth rate was 11,6%, opposite of which the Latvia realised 4,5 times more growth. Latvia could have realised this considerable growth mostly by increasing input as *Intermediate consumption (input)*, which was resulted by missing considerable increasing private investment. It can be declared that Latvia mostly increased output of its agricultural production industry by extensive methods and not intensive investments by using more advanced mechanical instruments or means. Because of Latvia could increase the output therefore this member state increased its GVA of agricultural industry by 64,8% in the fifth position after Lithuania, Croatia, Slovakia and Czech Republic within EU-15. Because of the use of human resources as workers in agricultural industry has been considerable, therefore their real income factor for AWU should increase, which was 38,2% for researched period since 2010.

In the second session or quarter of the score (see Figure-1) there are several EU member states, namely Bulgaria, Czech Republic, Slovakia and Croatia. The economic variances of the

Component-1 including the OUTPUT171, INPUT172 and PrivInv164 (Private investment) are laying on the principle line "X", therefore in these EU member states of this quarter of the score generally the OUTPUT171, INPUT172 and PrivInv164 (Private investment) are *decreasing or little increasing*, while the economic variances of the Component-2 including the GVA173 (Gross value added) and RIFAWU175 (Real income factor for Annual working unit) are laying on the principle line "Y" are remaining in increasing or little decreasing trends similarly to the first quarter of the score.

In cases of ***Slovakia*** and ***Czech Republic*** EU member states in this quarter the economic variances, namely OUTPUT171, INPUT172 and PrivInv164 (Private investment) are increasing moderately comparably to these one of other four member states in the first quarter. Somehow the private investment activities has been going on increasing at low level, about 10% since 2010, therefore the output of agricultural industry of two countries also was at low level, namely by between 24,9% and 26,7%, but the real income factor per AWU has considerably been increasing by 53% in Czech Republic and 105,4% in Slovakia. Also GVA of both countries increased by highly level as 73,6% in Czech Republic and 80,4% in Slovakia. This means that two countries could ensure the highly level increase of GVA173 by the low-level increase of input by 9,7% in Czech Republic and 14% in Slovakia.

In case of Czech Republic the relative highly concentrated land and the earlier more mechanized agricultural industry could contribute to decrease the *Intermediate consumption (input)* of the agricultural production. The low level of input could ensure the strong increasing trend of GVA by 73,6% and considerable increase for the real income factor per AWU, namely 53%. In spite that in Slovakia the input and output increased little more than Czech Republic and therefore the GVA increased by 80,4% in Slovakia, the Slovak real income factor has increased mostly by two times than in Czech Republic. The increase of GVA was not so different between cases of two countries, but increase of their real income factor was quietly different, because this was in Czech Republic by 53%, while in Slovakia this was 105,4% (Table-1 and Eurostat, 2017 and 2018). This income difference can be explained by the different measure of taxes in two countries.

In case of Slovakia the possible of less competitiveness in agricultural industry can occur, because the higher real income factor per AWU was resulted mostly by national tax policy and not more using advanced technology by increasing private investment. The competitiveness can

mostly set up on based on the investment concerning the highly developed advanced technology and not simply income increase. Naturally the EU harmonization policy allows the more independence for the EU member states in field of tax policy, but the agricultural policy should be common including the price and subsidy systems. Probably the more favourable tax policy contributed to increasing real income factor in Slovakia, than in Czech Republic.

In case of ***Bulgaria***, this member states have decreased input for agricultural industry by 7,1% since 2010 and also increased the private investment by 22,1%, but the investment activities did not compensate enough the decreasing trend of the input, therefore the output of the country was at low level, mostly half of the average output increase of the selected EU-15 member states of my dissertation. In spite that the agricultural industry of Bulgaria provided less output increase, this country could implement 41,8% increase in field of GVA and increase by 126,7% in field of real income factor per AWU, which more by four times than the average level of the real income factor in selected EU-15-member states and more by five times than average level of the EU-28 in the same period.

This considerable increase of real income factor in Bulgaria partly realised by increasing private investment and probably favourable tax policy for farmers. Also it can be true that Bulgaria had mostly less level of the results in field of private investment, GVA and real income factor comparably to the level of these field of the other EU member states.

In ***Croatia*** all of three economic variances as output, input and private investment has considerably decreased by 24,4%, 20,4% and 5,5%, therefore this country has a negative decline in field of agricultural industry within EU-28 and selected EU-15 member states in the researched period. Only in Greece the private investment decreased by 36% against 5,5% in Croatia. In spite that Croatia implemented the worst results in field of agricultural industry within EU-28, the GVA increased by 71,2%, which was the fifth best result in EU-15, after Lithuania by 90,1%, Hungary by 81%, Slovakia by 80,4% and Czech Republic by 73,6%. Also the result of the GVA was mostly more by 1,5 times than the average level of the EU-15 and by three times more than average level of the EU-28 member states (see Table-1; Figure-1).

This contradiction result of agricultural industry in Croatia was resulted by the possible earlier over-production, which was demanded for decreasing. The real income factor per AWU very moderately increased by 17,9%, which was less than the average level of either EU-28by 25,2%

or EU-15 by 39,2%. The low level of real income factor in Croatia was resulted that the subsidies were depended on the private investment for Consumption of fixed capital, therefore because the private investment decreased in Croatia, the subsidies also decreased, which finally led to decrease the real income factor. The decrease of the real income factor resulted by output and private investment decreases could not be compensated by favourable tax policy for farmers to increase their incomes (Table-1; Table-2; Eurostat, 2018). For example, the all of the amount covered for Consumption of fixed capital, as private investment was 60,8 billion euro in 2016 in EU-28 and in the same time the subsidies was 52,6 billon euro, which compensated the 86,5% of all Consumption of fixed capital, as private investment. Naturally the subsidies on the production should compensate cost of the private investment and not to increase the real income factor per AWU.

In the third session or quarter of the score (see Figure-1) there are two EU member states, namely Estonia and Poland. The economic variances of the Component-1 including the OUTPUT171, INPUT172 and PrivInv164 (Private investment), which are in*creasing or little decreasing* similarly to the first quarter of the score, while the economic variances of the Component-2 including the GVA173 (Gross value added) and RIFAWU175 (Real income factor for Annual working unit) are decreasing or little increasing trends.

In ***Estonia*** three economic variances namely output, input and private investment at line "X" have considerably increased more than in Poland, but opposite to this trend in Poland the GVA and real income factor at line "Y" have increased more than in Estonia for the researched period. Therefore, Poland has a better position than in Estonia in the third quarter of the score. The biggest difference was between two-member states in field of real income factor, because in Estonia the real income factor has increased by 8%, while in Poland the increase of the income per AWU was 40,4% as by five times more than in case the first country.

The agricultural industry of Estonia has less competitiveness comparably to one of Poland. In Estonia increasing rate of private investment was 37,1%, as two times more than in ***Poland*** namely by 19,1%, also the increase of the input was higher by one third, namely 40,2% than in Poland, where this was 30,5%. In spite that this more ambition increasing trend in two fields Estonia could only implement increase 32,6% by little more in field of output than in Poland, namely 30%. Also based on the less increase in fields of input and private investment in Poland, the Polish agricultural industry has realised considerable increasing trend by 29,4% in GVA

opposite to trend as 18,3% in Estonia. In Estonia the real income factor per AWU has increased only by 8%, while the real income increased by 40,4% in Poland since 2010. This means that in Estonia the considerable private investment could not probably be efficient, and additionally to this private investment, the input as intermediate consumption was at level of so highly increasing rate accompanying with little increase of the GVA. Therefore, in Estonia the considerable increasing rate was but less efficient private investment and so highly increasing rate in input with less GVA increasing rate, even under level of the EU-28, led to unfavourable increasing rate of the real income factor per AWU.

In Poland the land use concentration could also contribute to the considerable increasing rate in field of the real income factor per AWU, which could make possibility to realise efficient private investment, mostly better mechanization than in Estonia. In Poland in spite that the increasing rate in input was considerable, Poland could achieve mostly the same increasing trend in both of output by 30% and GVA by 29,4%. Partly the efficient private investment and partly the increasing rate in GVA resulted in considerable increase rate in field of real income factor. The increasing rate of subsidies on production in Poland was higher by 22,4% than 1,2% in Estonia, because of more efficient private investment was realised in Poland than in Estonia (se e Table-1 and Table-11, Eurostat, 2018), while in Poland the favourable tax policy could not play more important role for increasing real income factor than in Slovakia and Bulgaria, where the real income factor mostly increased by 2-3 times more than in Poland.

In the fourth session or quarter of the score (see Figure-1) there are several EU member states, namely Austria, Denmark Greece, Italy, Romania and Slovenia. The economic variances of the Component-1 including the OUTPUT171, INPUT172 and PrivInv164 (Private investment), which are *decreasing or little increasing* similarly to the second quarter of the score, while the economic variances of the Component-2 including the GVA173 (Gross value added) and RIFAWU175 (Real income factor for Annual working unit) also are decreasing or little increasing trends similarly to the third quarter of the score.

Generally, it is clear that the highly developed EU-member states of this quarter, namely Austria, Denmark and Italy have about 15% increase in field of output, which is mostly equal with middle average level of EU-28, but clearly less than the 20,66% at the average level of output for the selected EU-15.

Greece has had the worst and the lowest decreasing level in field of the private investment by 36% in the selected EU-15-member states for the researched period. Also, the not so highly increasing level of input by 10,4% in this period contributed to less increasing level of the output, which was the second lowest after Slovenia in EU-15. Consequently, in Greece these negative results of the agricultural industry led to the very low increasing level of the GVA by 3,4%, which was the lowest level in EU-15. This economic process led to the lowest changing level of the real income factor per AWU by decreasing 1,4%.

The reason of the unfavourable agricultural industry of Greece is the luck of capital. The agricultural production concentration in Greek agricultural industry was at very low level, therefore the capital accumulation was very weak with less using advanced technology and techniques resulting considerable decrease of output, which lead to the decreasing trend for the competitiveness of the Greek agricultural industry and the farmers. The less output resulted in less price incomes and unfavourable income conditions for farmers, therefore the less price income ensures for future continuous luck of capital and weak capital power for the following negative prosperity. The farmers and population of the rural areas of Greece will continuously be poor or poorer and rural areas cannot keep the original population in their regions. Therefore, the domestic population migration can be stronger in the future. The possible rural tourism is alone, which is not enough to ensure quite satisfactory income to remain for the local – rural population in village areas.

The second lowest decreasing level of the real income factor for the AWU has been in ***Slovenia*** by decreasing trend 1,6% for the period of 2010 and 2017. This result occurred in this country, in spite that the private investment has increased by 19,1%, which was higher than the average increasing level of the EU-15 by 18,65% and mostly double than in EU-28 by 10,1%. Also, Slovakia could keep at lower level the increasing trend of the intermediate consumption as input by 3,1% less than in Greece by 10,4%. The considerable increase in field of private investment and the lowest level of the input made possibility for Slovenia to get more than two times increase in GVA by 8,7%. But these better positions of Slovenian agricultural industry were not enough to increase the real income factor, because this decreased by 1,6/ more than the level of Greece. These agricultural economic conditions of Slovenia provided proof, which shows the low-level measure efficiency and productivity of the private investment and generally the agricultural industry in Slovenia.

In ***Italy*** some difficulties of the agricultural industry could be the similar as these were in Slovenia and Greece, namely the low-level increase in fields of the private investment and input, which the private investment was even one third of the Slovenian investment. But the increasing rate of the output of Italian agricultural industry was higher by three times than one of Slovenia. Therefore, Italy could realise better increase rate of its GVA by 21%, also more than two and half times more than the level of the GVA of Slovenia, which this last one was by 8,7%. Italy could realise better income positions comparably to average increasing level of real income factor per AWU of Slovenia and EU-28, which this last one was 25,2%, because Italy could efficiently realise the private investment and keep the input as cost of the agricultural industry at low-level increase, therefore the output could increase closed to the average level of the EU-28 accompanying with increasing level of GVA by 21%, which also was closed to the average level of the EU-28. These agricultural results led to 32% increasing level of the real income factor per WAU in Italy. This highly level increase of real income factor could also be realised by highly level of price income, which partly was resulted by highly level price of basic food and agricultural basic products in Italy.

In this quarter of the score farmers of ***Romania*** had only higher increasing level of real income factor per AWU opposite to the other five EU-member states by 36,6%. This was resulted by partly originally low level of the real income factor comparably to the EU-28 and partly highly level increasing private investment 26,5% accompanying with adequate subsidies on the production. Generally, the highest increasing level of the economic or agricultural industrial growth not only in those countries, where the advanced technology and developed economic level can ensure, but in those countries, where the backwardness was considerable comparably to the average level of EU-28. Romania can be an example for this last one. Also, Romania could keep the low increasing level of the input by 8,7%, therefore the level of the output could increase by 12,3% in this period, which was not far from the level of the EU-28, namely 15,9%. It can be declared that in those cases, when the increasing level of the input is less than the increasing level of the output, therefore the GVA will increase (Bulgaria, Czech Republic, Hungary, Slovakia, Austria, Denmark, Italy, Romania, Slovenia, Latvia, Lithuania). Because the average increasing level of the output in EU-15 increases more than the input, the GVA considerably increases. In case of EU-28, the output increases more than the input, therefore the GVA also increases, but this increase less than the one of EU-15, because the increase of output of EU-15 more than one of EU-28 (Table-1).

When the increasing level of the input is more than the increasing level of the output, therefore the GVA will less increase (Greece, Estonia). If the increase level of the private investment accompanying with its efficiency is considerable, this one can also increase the GVA, even if the level of input decreases (Bulgaria, Poland, Croatia).

Also, it can be declared that if the private investment considerably increases more than the increase of GVA (Slovenia, Estonia, Austria), or their increasing trends are closed to each other (Denmark), this leads to the considerable decreasing or little increasing trends of the **real income factor per AWU**.

But if the private investment decreases more (Croatia) or increases less than the GVA (Bulgaria, Czech Republic, Hungary, Slovakia, Italy, Latvia, Poland), therefore the real income factor per AWU increases. Also, the average increasing level of the private investment less increases than the GVA in cases of the EU-15 and EU-28-member states, therefor the **real income factor per AWU** increases.

In case of EU-28, the private investment increases less than the GVA, therefore the **real income factor per AWU** also considerably increases, but this increase less than the one of EU-15, because the increase of private investment of EU-15 more than one of EU-28 (Table-1; Table-3).

Generally, the measure of the **subsidies on production** is depending on the measure of the private investment by the other words, consumption of fixed capital at level of the EU-28, which has an important influence on the change of the real factor income per AWU.

Therefore, these subsidies can only be provided for farmers if subsidies are covered about 88% for extending and improving the production by using new technologies or creating the new advanced infrastructure for the production process, for example buildings, service network for improving agricultural techniques and equipment or innovation for the increasing knowledge for farmers and labour force in agricultural industry (Table-11; Table-2).

Sometimes it can happen, if the GVA and the subsidies on the production less increase than real income factor per AWU increased, this can be resulted by the favourable tax policy at national economic level, which is not common and not unified based on the EU's harmonization policy.

The tax policy remained within the national frame or scheme in each EU member state, in spite that the other policies, as agricultural policies, agricultural price policy and subsidy policy for the farmers or even the duty and single market condition are common. (Bulgaria, Slovakia, Italy, Lithuania, Denmark,). In Romania the subsidies on production was at very highly level (sew Table-1 and Table -11), which allow the moderate increasing growth rate of the real income factor per AWU.

In *Austria and Denmark*, the agricultural industry is mostly highly developed comparably to the EU-28 and international developed level. The increasing level of the real income factor per AWU in cases of both of them are very similar to each other, namely 7% in Austria and 9,9% in Denmark.

In ***Austria*** the increasing level of the input is at very low level by 8,6%, while the increasing level of the output is 15,2% and because the level of the input was at low level, the GVA could increase at quietly highly level by 24,8%. In spite that this increase of GVA was enough at highly level in Austria the real income factor per AWU was at moderately low level by 7%. This had reason because the increasing level of the input including the AWU or labour force input was at low level and also the private investment increased at highly level by 30,1%, which withdrew considerable capital power from the side of the income positions of the labour input to the side of the private investment, therefore it can declare that the future increase for the income position was kept back little in order to realise more increase for the interest of improvement and development for the advanced agricultural industry. This means that for the interest of the future economic prosperity the country should keep back increasing the standard of life for shorter time period. In order that the country could become quietly developed, and this economic aim can be ensuring realised, therefore the above-mentioned economic arrangement should be followed.

Similarly, to Austria, this process can be followed in case of ***Denmark***, where also the real income factor for AWU increased at low level comparably to the EU-28, where the real income increased by 25,2%, in spite that not all of the EU member states can be titled as highly developed countries. Also, it can be seen that in spite that in Denmark the increasing rate of private investment was only by 16,5% less than in Austria and the input increased by 12,6% more than in Austria, and also the GVA less increased by 19%, the real income factor could increase little more than in Austria. Mostly the difference between levels of real income factor

of both of countries were not considerable, but this difference could probably be created by the tax policy, which was more favourable in Denmark than in Austria.

Within this country-group of the fourth quarter of the score Austria achieved the best economic results mostly by 30,1% in field of increasing rate for the private investment with low level increase of input and real income factor against the other economies in this session of the score.

Within the selected EU-15-member states Bulgaria reached the highest increasing rate in field of real income factor and the second was Slovakia by 105,4% and the third country was Hungary by 66,2%. Also, the lowest level of increasing rate of real income was in Greece and in Slovenia, a decrease by -1,4%. In field of private investment, the biggest increasing rate was in Lithuania, Estonia and Austria (see Table-1). These data concerning the fast-economic growth in selected EU-28-member states show that the developing trend continuously and consequently focuses on the Baltic region, Visegrad-4-member states of the EU and Bulgaria, Austria from point of geographical distribution. Naturally the economic positions for the EU member states are depending mostly on the increasing trend of private investment and GVA.

In spite that in the EU at present not the subsidies completing or complementary are forced for the farmers, as it was early, but the subsidies on the production are accepted, therefore the subsidies aim at improving the production technology and to decrease the production as it was after the agricultural reform of 1992 in EU-12. In that time the agricultural price suddenly decreased, resulting in income damage for farmers of the EU, therefore the policy makers decided to compensate partly these income damages for farmers. The agricultural price decrease was favourable for the interests of the consumers on the single market of the EU and this decrease aimed at decreasing the agricultural production to decrease the negative influences of the over agricultural production on the price system and the supply-demand balance of the agricultural products.

At present in the EU subsidies on the production aims at strengthen the market competitiveness of farmers of the EU against the agricultural competitors of the world economy by renewing the technology turning to the advanced one, in order that the farmers of the EU can have more competitive position either in the world market or in the single market. The possible competitive advantage including the innovative technology for farmers in EU can ensure more competitiveness than the complementary subsidies for the longer time. In this case also policy

makers of the EU focus on the decreasing the standard of the life for farmers by substituting increase of this one for the technological development. This new agricultural conception has resulted in decreasing number of farmers in the EU and concentrating the agricultural production within a smaller number of farming households. This trend can also be followed by the actual data base of EU.

Also, it can be mentioned that the new EU member states mostly including the Visegrad-4 states could realise more economic growth either at national economic level or the agricultural industrial level. In spite that of the private investment of the selected EU-15 shared about one quarter of the all EU-28 namely by 24,5%, but their GVA share about 40% of all EU-28 was by the end of the 2017. In spite that the increase of their input was 14,45% more than 11,6% of the average level of the EU-28, but also increase of their output, namely 20,66% was higher than one of the EU-28, namely 15,9% (see Table-1). The shares of the input belonging to EU-28 and selected EU-15 are not considerable different in the analysed period.

Based on the statistical analyses and data base the selected EU-15-member states can be clustered into five clusters, in which case the clusters include the following member states, as it follows (Figure-2; Figure-3; Eurostat, 2019):

Cluster (1): Bulgaria, Czech Republic, Hungary, Slovakia
Cluster (2): Austria, Denmark Greece, Italy, Romania, Slovenia
Cluster (3): Estonia, Latvia, Poland
Cluster (4): Croatia
Cluster (5): Lithuania

This structure can be seen in the Table-10 and Figure-2 and Figure-3. The first column of the Table-10 shows the structure of clusters by member states in case of 5 clusters seen above and the second column of this table shows the structure of clusters by member states in case of 4 clusters country. The other columns show clusters with states in cases of a smaller number of clusters. The figures according to the member states show that each state according to which cluster. Because of the five clusters were given by me in the SPSS statistical system, the five clusters are important for selected EU-15-member states in this research.

Table 10. Cluster Membership

Case	5 Clusters	4 Clusters	3 Clusters	2 Clusters
1:Bulgaria	1	1	1	1
2:Czech Republic	1	1	1	1
3:Denmark	2	2	2	2
4:Estonia	3	3	3	1
5:Greece	2	2	2	2
6:Croatia	4	4	2	2
7:Italy	2	2	2	2
8:Latvia	3	3	3	1
9:Lithuania	5	3	3	1
10:Hungary	1	1	1	1
11:Austria	2	2	2	2
12:Poland	3	3	3	1
13:Romania	2	2	2	2
14:Slovenia	2	2	2	2
15:Slovakia	1	1	1	1

Source: Own calculation using SPSS, Eurostat, 2019.

The same cluster-structure can be followed and visually seen in the Figure-2 and Figure-3, which also is according to the cases of five clusters. Generally, it is not useful to calculate a greater or smaller number of clusters than five one, because in those cases the clustering system cannot be followed clearly or logically based on the difference among member states of each cluster according to the economic variances of the EU member states.

It is important that the cluster system is according to the data-base of the Table-1 with the five economic variances written in this table, namely the Component-1: OUTPUT171, INPUT172, PrivInv164 and the Component-2: GVA173, RIFAWU175. Because these five economic variances are not enough for my researching work, therefore as I mentioned at the beginning I needed to use the other five economic variances for the statistical analyses in order to extend clearly the economic difference among selected EU-15-member states based on using the other five economic variances, namely the Content-1: at the „X" Principle line: GDPGrowth176, AWU20177, RLProd20178 and the Content-2: at the „Y" Principle line: Subsidies169, DIRINV1710 (Table-11). The following chapters of my dissertation will describe and analyse the correlations and significance among these other new economic variances among the selected EU-15-member states.

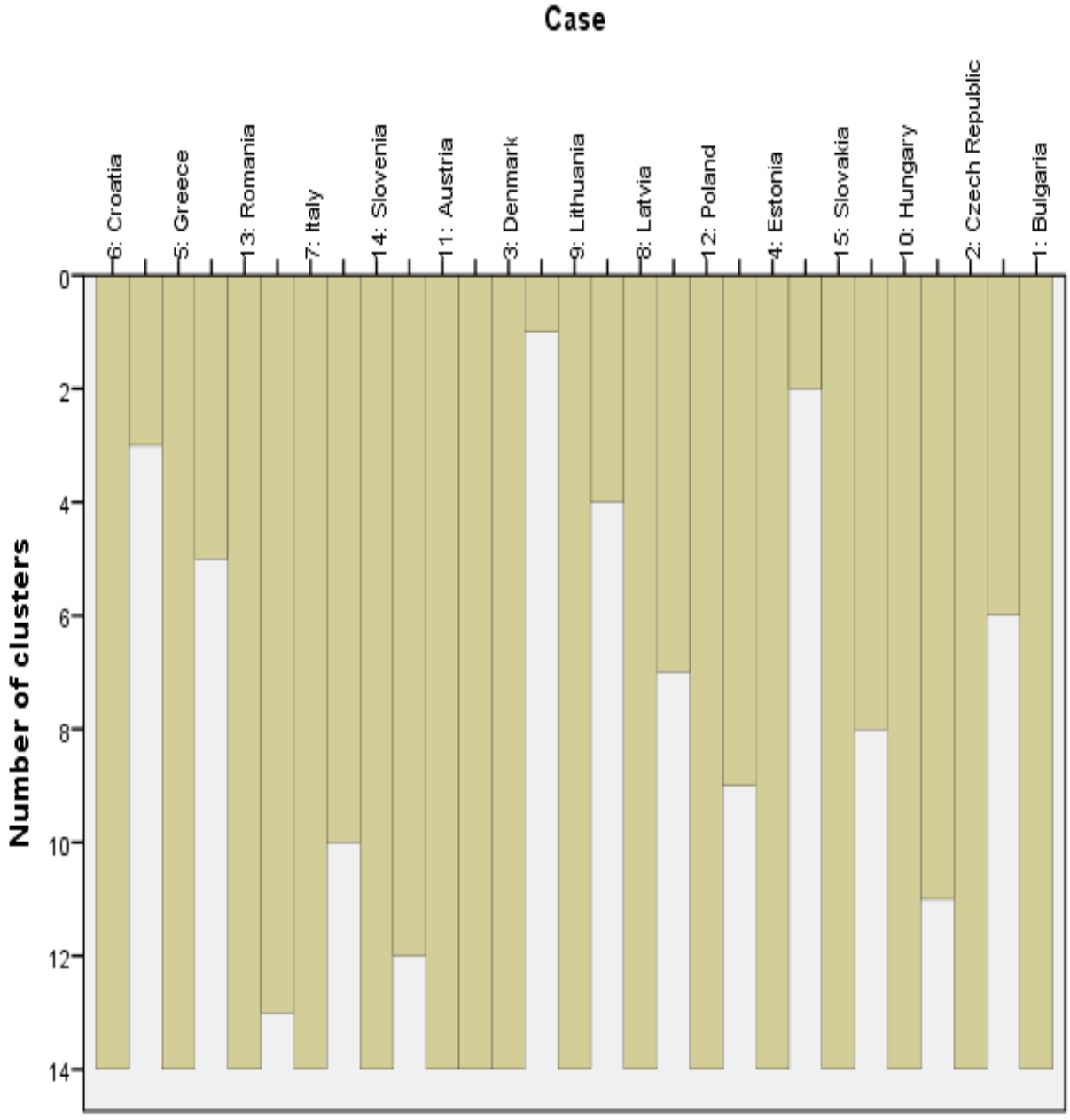

Figure 2. Number of clusters in cases of EU-15 selected Member states
Source: Own calculation using SPSS, Eurostat, 2019.

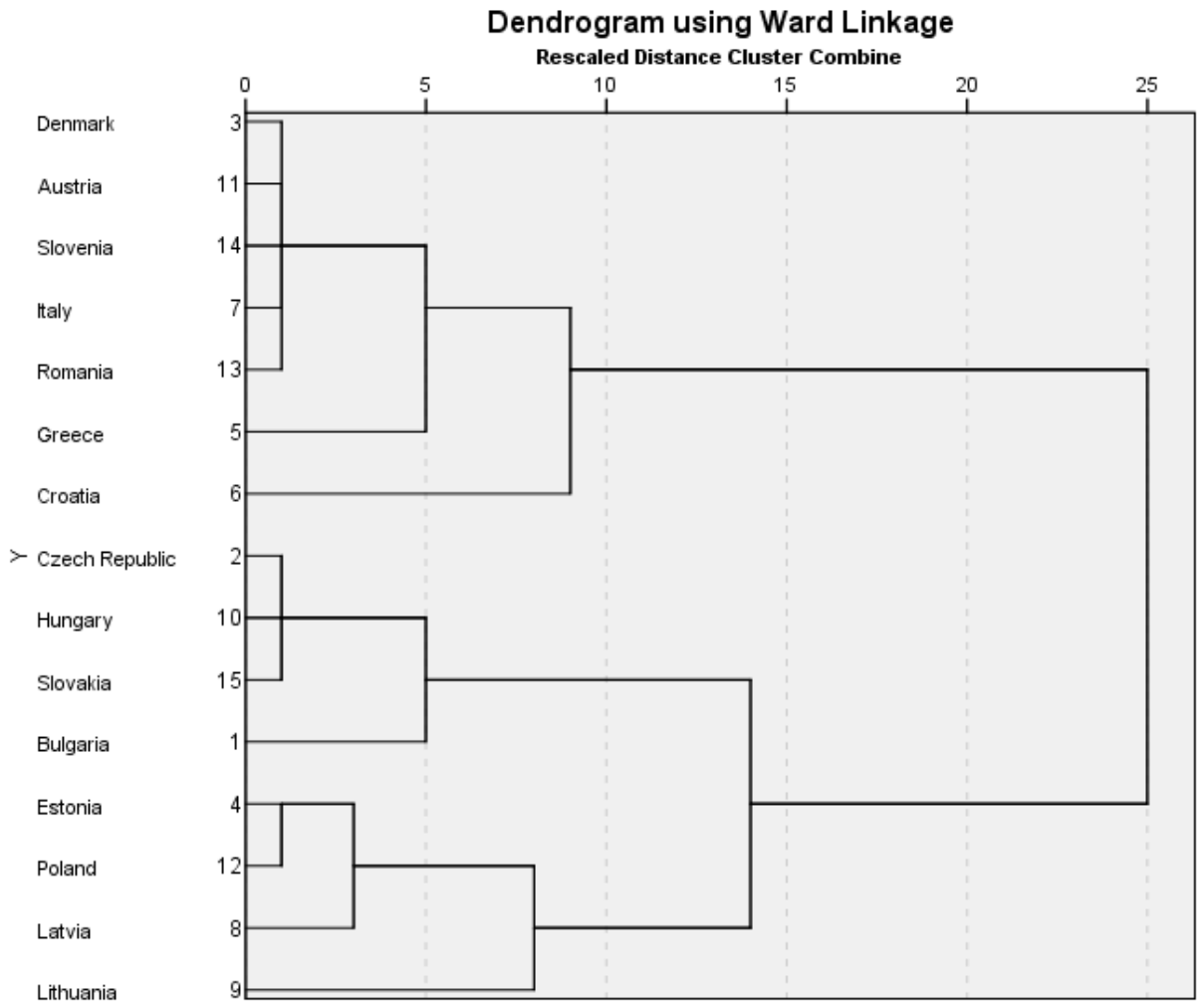

Figure 3. Dendrogram using Ward Linkage. Rescaled distance cluster combine, number of clusters in cases of EU-15 selected Member States

Source: Own calculation using SPSS, Eurostat, 2019.

Cluster (1): Bulgaria, Czech Republic, Hungary, Slovakia

Cluster (2): Austria, Denmark Greece, Italy, Romania, Slovenia

Cluster (3): Estonia, Latvia, Poland

Cluster (4): Croatia

Cluster (5): Lithuania

4.3 Statistical analyses based on the second five economic variances

In *the first part of this chapter* the statistical analysis was going on about the earlier first five economic variances, namely OUTPUT171, INPUT172, PrivInv164, GVA173, RIFAWU175, which variances were needed for understanding how the correlations and significance were among these selected EU-15-member states. These analyses emphasized the strong correlations among private investment with GVA and main effects on the changing of the real income factor for AWU in the selected states in this research.

In *the second part of this chapter* there are some other new economic variances in agricultural industry of the selected EU-15-member states were in the centre of my scientific research, where these second *five economic variances*, namely GDPGrowth176, AWU20177 (Labour force directly employed - Annual Working Unit in number 1000 in 2017) and RLProd20178 (Real labour productivity per person) according to the Component-1 at the „X" Principle line and also Subsidies169 and DIRINV1710 (Direct investment in million units of national currencies between 2010-2017) according to the Component-2 at the „Y" Principle line based on the data-base of the Table-11 and Table-17 concerning Rotated Component Matrix.

According to the *Table-12* concerning the correlation matrix, which shows that the strong correlations were:

- between the GDPGrowth176 and the RLProd20178 (Real labour productivity per person); and
- there is a middle strong correlation between AWU20177 (Labour force directly employed – in number of Annual Working Unit) and the RLProd20178 (Real labour productivity per person).

Table 11. GDP Growth 2007-2017, Labour force directly employed - annual working unit in number 1000 in 2017, Real labour productivity per person, 2010=100, Subsidies 2010-2016, Million EUR in 2010=100, and Direct investment in million units of national currencies between 2010-2017 in percent, 2010=100, in agricultural industry of the selected EU-15-member states.

Countries/ Economic variances	**GDPGrowth176**	**AWU20177**	**RLProd20178**	**Subsidies169**	**DIRINV1710***
Component	**1**			**2**	
Variances	**6**	**7**	**8**	**9**	**10**
Austria-1	***110,4***	***101,74***	***102,5***	***-5,6***	***124,5***
Bulgaria	116,5	248,02	119,1	73,8	-23
Czech Rep	116,2	103,27	109,9	6,9	-31,2
Denmark	111,6	49,48	106,6	-4,2	41
Estonia	130,2	19,88	111,2	1,2	-79
Hungary	117,3	391,73	102,7	3,6	-2,5
Latvia	127,0	76,86	120,9	16	-73
Lithuania	128,3	148,35	118,1	-14,6	-40,4
Slovakia	120,8	46,69	110,5	12,5	-24,6
Greece-2	***82,8***	***448,22***	***94,0***	***-14,5***	***-65,2***
Italy**	99,7	874,95	98,3	16,7	-10
Croatia-3	***105,6***	***159,36***	***109,9***	***730***	***-14,5***
Poland-4	***125,4***	***1649,4***	***118,4***	***22,4***	***-42,3***
Romania	129,8	1587,65	137,1	160	-64,7
Slovenia-5	***110,3***	***79,97***	***107,4***	***45,5***	***-311,8***
EU-15	115,5	5 984,87	111,1	69,98	
EU-28	110,7	9 362,88	105,8	3,4	
EU-15 of EU-28, EU-28=100 in 2017		66,40			
Component	**1**			**2**	
Variances	**6**	**7**	**8**	**9**	**10**

Source: Eurostat, 2018

* In case of negative value of the balance of the direct investment between foreign investment and the national investment, which means that the deficit increases. The negative balance of this, means that the foreign investment more than the national one.

** In Italy the positive Balance of International Investment Position decreased

Content-1: „X" Principle line: GDPGrowth176, AWU20177, RLProd20178

Content-2: „Y" Principle line: Subsidies169, DIRINV1710

Note of the Table:

GDPGrowth176

GDP Growth, 2000-2017, Gross domestic product at market prices, Chain linked volumes, index 2010=100.

AWU20177

Labour force directly employed - annual working unit in number 1000, in 2017, Farm indicators by agricultural area, type of farm, standard output, legal form and NUTS 2 regions [ef_m_farmleg]

RLProd20178

Real labour productivity per person, 2010= 100, Labour productivity and unit labour costs [nama_10_lp_ulc], Index of the real income of factors in agriculture per annual work unit.[9]

Subsidies169

Subsidies 2010-2016, Million EUR, 2010= 100, The difference between an economy's external financial assets and liabilities is the economy's net IIP, which may be positive or negative.

DIRINV1710

Direct Investment in million units of national currencies between 2010-2017, in percent, 2010 = 100, [tipsii12], IIP = international investment position, Balance of Foreign Direct Investment and Domestic National Investment, International Direct investment in million units of *national currencies* between 2010-2017, in percent, 2010 = 100.

Clusters:

Cluster (1): Austria, Bulgaria, Czech Republic, Denmark, Estonia, Hungary, Latvia, Lithuania, Slovakia

Cluster (2): Greece, Italy

Cluster (3): Croatia

Cluster (4): Poland, Romania

Cluster (5): Slovenia

[tipsii12] - Direct investment - annual data, million units of national currency

Short Description: The international investment position (IIP) is a statistical statement that shows at a point in time the value and composition of:

-financial assets of residents of an economy that are claims on non-residents and gold bullion

[9] http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nama_10_lp_ulc&lang=en

held as reserve assets; and
-liabilities of residents of an economy to non-residents.[10]

The difference between an economy's external financial assets and liabilities is the economy's net IIP, which may be positive or negative.

According to the functional category, the cross-border financial positions are classified as:

1. For the assets - Direct investment; Portfolio investment; Financial derivatives and employee stock options; Other investment and Reserve assets;
2. For the liabilities - Direct investment; Portfolio investment; Financial derivatives and employee stock options and Other investment.

The financial positions are further classified according the different instruments. The data on direct investment are expressed in million units of national currency. The indicator is based on the Eurostat data from the Balance of payment statistics, these data are quarterly reported to the ECB by the EU Member States. Definitions are based on the IMF Sixth Balance of Payments Manual (BPM6).[11]

In the Table-12 these strong and middle strong correlations can be mentioned, because the GDP growth can make influences on the real labour productivity, because the more increase of GDP - including also the other economic sectors additionally to the agricultural industry - can stimulate more developing trend of the real labour productivity. Also, the more growth of the real labour productivity means that the value produced by average of the working unit or AWU in agricultural industry can provide more value in agricultural sector, which added to the whole amount of the GDP at national level or level of each EU-member state. There is a strong correlation between both of them.

Also, there is a middle strong correlation between AWU20177 and the RLProd20178 because the labour force in number of AWU can make an efficient labour separation by more specialization, and therefore, this can strengthen the growing trend of the real labour

[10] https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tipsii12&plugin=1

[11] https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tipsii12

productivity per person (RLProd20178). Naturally if the companies of the agricultural industry increased their owned real labour productivity, this means they can increase production value per AWU; therefore, they can decrease the directly employed labour force in number of AWU. Even these companies can extend their employment by their increasing price income. There is a mutual correlation between two economic variances (Table-12, Eurostat, 2018).

Table 12. Correlation Matrix

		GDPGrowth176	AWU20177	RLProd20178	Subsidies169	DIRINV1710
Correlation	GDPGrowth176	1,000	,127	**,777**	-,132	-,049
	AWU20177	,127	1,000	**,412**	,014	-,002
	RLProd20178	,777	,412	1,000	,142	-,145
	Subsidies169	-,132	,014	,142	1,000	,017
	DIRINV1710	-,049	-,002	-,145	,017	1,000
Sig. (1-tailed)	GDPGrowth176		,326	**,000**	,319	,431
	AWU20177	,326		**,064**	,481	,498
	RLProd20178	,000	,064		,306	,304
	Subsidies169	,319	,481	,306		,476
	DIRINV1710	,431	,498	,304	,476	

Source: Own calculation using SPSS, Eurostat, 2019.

Also, the significance is the same strong as correlations among three economic variances mentioned above. The Table-13 shows that the value of the KMO is middle weak, namely 0,331 or 33,1% and the significance is 0,065 or 65%, which is enough middle strong among five economic variances in this session or chapter of the dissertation.

Table 13. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,331
Bartlett's Test of Sphericity	Approx. Chi-Square	17,457
	df	10
	Sig.	,065

Source: Own calculation using SPSS, Eurostat, 2019.

The Table-14 concerning the anti-image matrices, of which table the second part, namely anti-image correlations figures of the diagonal remarked by “a” shows the measure for explain of each economic variance in the research, by the other words how each economic variance is explained for owned strengthen in the research and the statistical analyses. If the value is over 0,500 or 50%, the explain is strong explain or if it is under the line of 0,500 (50%) but somehow

the value is closed to this 0,500, the value shows middle strong explain for these economic variances, for example in cases of the GDPGrowth176 by the value of 0,369 (36,9%) and RLProd20178 by value of 0,393 (39,3%). The other economic variances were weakly explained in the research.

Table 14. Anti-image Matrices

		GDPGrowth176	AWU20177	RLProd20178	Subsidies169	DIRINV1710
Anti-image Covariance	GDPGrowth176	,277	,175	-,212	,206	-,085
	AWU20177	,175	,693	-,216	,162	-,102
	RLProd20178	-,212	-,216	,227	-,189	,105
	Subsidies169	,206	,162	-,189	,785	-,095
	DIRINV1710	-,085	-,102	,105	-,095	,947
Anti-image Correlation	GDPGrowth176	**,369**[a]	,400	-,844	,442	-,165
	AWU20177	,400	,263[a]	-,543	,220	-,126
	RLProd20178	-,844	-,543	**,393**[a]	-,448	,225
	Subsidies169	,442	,220	-,448	,077[a]	-,110
	DIRINV1710	-,165	-,126	,225	-,110	,182[a]

a. Measures of Sampling Adequacy(MSA)

Source: Own calculation using SPSS, Eurostat, 2019.

But in the *Table-15* concerning the communalities not two but three economic variances played important role, because their values were more than 0,800 (80%) in these cases, namely additionally to two variances mentioned above the third economic variances was Subsidies169, which had also important role for researches and analyses of my study. The subsidies on the production in agricultural industry were measured for the about 87% of covering the consumption of fixed capital in 2016 (Table-2; Eurostat, 2018).

Table 15. Communalities

	Initial	Extraction
GDPGrowth176	1,000	**,804**
AWU20177	1,000	,363
RLProd20178	1,000	**,922**
Subsidies169	1,000	**,843**
DIRINV1710	1,000	,086

Extraction Method: Principal Component Analysis.

Source: Own calculation using SPSS, Eurostat, 2018

Naturally it does not mean that the other two economic variances within these five variances could not be important, but the difference among the economic variances can be measured in

cases of their influences on the general economic agricultural industry of the selected EU-15-member states. The *Table-16* provides a proof that the all of these five economic variances based on the Table-11 became important for my research and scientific analyses summarised by Total Variance Explained 60% based on the Initial Eigenvalues Cumulative in percent. This means that the analyse can be logical by these other second five economic variances in the Table-11 additionally to the economic variances of the Table-1.

Table 16. Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1,954	39,087	39,087	1,954	39,087	39,087	1,910	38,207	38,207
2	1,064	21,270	**60,358**	1,064	21,270	60,358	1,108	22,151	60,358
3	,993	19,856	80,214						
4	,867	17,335	97,550						
5	,123	2,450	100,000						

Source: Own calculation using SPSS, Eurostat, 2019.

The *Table-17* shows the Rotated Component Matrix, which selected the five economic variances into two components, where the first component applied at the principle line "X" and the second component applied at the principle line "Y" based on the values of variances in column. Therefore, by the value of GDPGrowth176, AWU20177 and RLProd20178 are for the component of line "X" and by the value of Subsidies169 and DIRINV1710 for the component of line "Y". Generally, the different Tables-14,15 and Table-17 emphasized that the value belonging to the DIRINV1710 (direct economic variance is weak and its correlations with the other economic is middle weak or weak connections).

Table 17. Rotated Component Matrix[a]

	Component	
	1	2
GDPGrowth176	**,772**	-,456
AWU20177	**,578**	,169
RLProd20178	**,953**	-,115
Subsidies169	,232	**,888**
DIRINV1710	-,134	**,261**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.

Source: Own calculation using SPSS, Eurostat, 2018

„X" Principle line: GDPGrowth176, AWU20177, RLProd20178

„Y" Principle line: Subsidies169, DIRINV1710

Naturally the international Direct investment in million units of *national currencies* between 2010-2017 has played important role in the whole economic activities and the performance of the selected EU-15-member states, but role of the IIP in the EU-15 concerns to the statistical statement that shows at a point in time the value and composition of the financial assets of residents of an economy that are claims on non-residents and gold bullion held as reserve assets, and liabilities of residents of an economy to non-residents (see Table-11). In case of the agricultural industry in the EU-15-member states the direct international investment comparably to the role of the other economic variances was not significant or not strong as the different statistical data of tables of Eurostat proofed. But because the direct international investment could generally have important economic play and role in the performance of the EU-15, therefore this economic variance became part of the research.

Table 18. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
GDPGrowth176	15	82,80	130,20	115,4600	12,90813
AWU20177	15	19,88	1649,40	399,0380	542,47009
RLProd20178	15	94,00	137,10	111,1067	10,61094
Subsidies169	15	-14,60	730,00	69,9800	187,89929
DIRINV1710	15	-311,80	124,50	-41,1133	90,59272
Valid N (listwise)	15				

Source: Own calculation using SPSS, Eurostat, 2019.

The *Table-18* by its title as Descriptive Statistics shows the roles and places for the values of different economic variances in order to compare their positions based on the minimum and maximum values, mean and standard deviation. In this case the compare for the values of different economic variances was marginal to overview the biggest or the smallest differences among the variances and the general average values of each variance of the EU-15-member states. The Table-19 by its title as Case Processing Summary show that the scientific analyses covered all of the data concerning the EU-15-member states and no any were missing in this research.

Table 19. Case Processing Summary[a]

Cases					
Valid		Missing		Total	
N	Percent	N	Percent	N	Percent
15	100,0%	0	0,0%	15	100,0%

a. Squared Euclidean Distance used

Source: Own calculation using SPSS, Eurostat, 2019.

4.4 Factor analyses for GDP growth, labour force directly employed, real labour productivity, the subsidies and balance of the International Direct Investment and national-domestic investment

Figure 4 shows distribution of the selected EU-15-member states into four quarters based on the changing economic variances of the member states. If the economic variances increase or decrease, these changes determine position of the member states in quarters of the score. *In this first quarter* of the score at the „X" Principle line there are economic variances, namely the GDPGrowth176, AWU20177 and RLProd20178, which means that the Labour productivity and unit labour costs based on the index of the real income of factors in agriculture per annual work unit. All of these three economic variances, are increasing or less decreasing. At the „Y" Principle line there are two variances, namely the Subsidies169 and DIRINV1710. Therefore, the member states which economic variances are increasing or less decreasing, are to be found in this first quarter of the score.

Generally, the share of the number of AWUs (AWU20177) in percent of the total population of each member state in the research was important, because the AWUs produced the food for all of the population in the selected EU-member states. In this case, the share of AWU number was 1,8% of the total population of the EU-28- member states and 3,17% of the total population of the EU-15- member states by the end of the 2017. In Romania the share of AWU was 8,1% of the total population , which is the highest quantity in the selected EU-15-member states. The second biggest share of the AWU number at national level as percent of the total population was 5,2% in Lithuania.

The smallest share of the AWU as percent of the total population was 0,86% in Denmark, 0,9% in Slovakia and 0,97% in Czech Republic by the end of 2017. These countries had most favourable conditions, as the share of the AWU number was at the lowest level. This data shows

how the agricultural industry was concentrated and how the usage of agricultural inputs and land plots were concentrated. The level of the mechanization and technical equipment supply also contributed to decrease the AWU number and to increase the level of the production efficiency and profitability. The last one means better income for the agricultural industry in selected EU-15-member states (Table-11; Eurostat 2018 and own calculation).

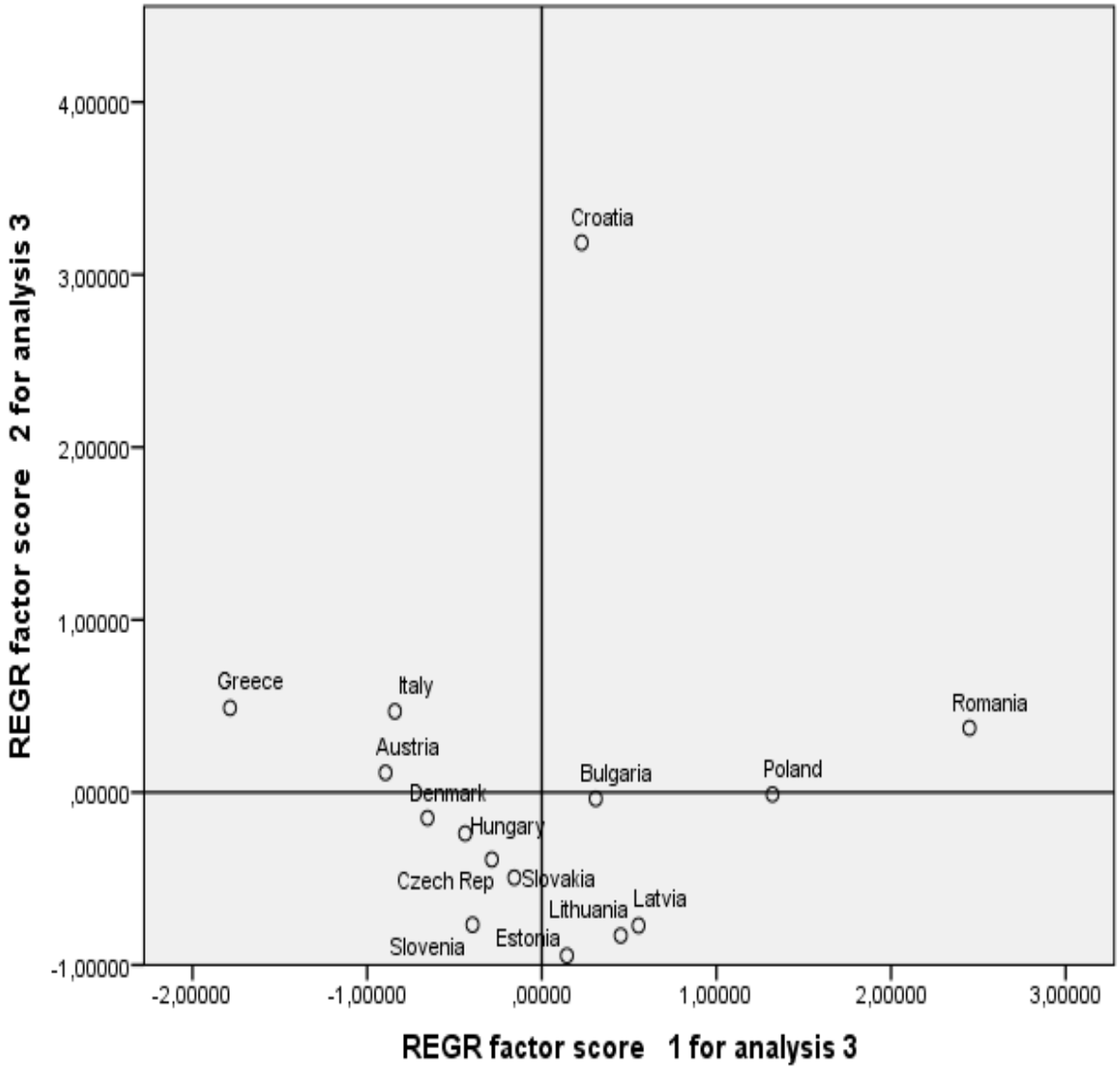

Figure 4. REGR Factor score 1 and 2 for analysing in cases of EU-15 member states

Source: Own calculation using SPSS, Eurostat, 2019.

„X" Principle line: GDPGrowth176, AWU20177, RLProd20178

„Y" Principle line: Subsidies169, DIRINV1710

In the *first quarter of the score* there are four EU- member states, namely Croatia, Romania, Poland and Bulgaria. In this session ***Croatia*** had a moderate increase of GDP by 5,6%, about one third of the average level of the selected EU-15-member states, while the real labour productivity per person (RLProd20178) increased by 9,9%, which is slightly lower than the average level of the EU-15 and by 1,5 times more than the average level of the EU-28. In Croatia the GDP growth could create good opportunity for agriculture development, therefore the real labour productivity could increase. The DIRINV1710 (Balance of International Direct investment and national-domestic investment in million units of *national currencies* between 2010-2017, in percent, 2010 = 100, [tipsii12], as IIP = international investment position) was higher than the national investment position. Negative balance value between foreign investment and the national investment means that the deficit increases. It means that the foreign investment is more than the national one and the balance is difference between these two. Therefore, it is more favourable for one national economy and agricultural industry if this balance is negative.

FDIs in ***Croatia*** were intensive in this sector, which resulted with the highest increase of subsidies by 730% in this period, subsidies mainly used for the consumption of fixed capital. Therefore, the increase of the FDI brought more advanced technology in Croatia, which stimulated development of the real labour productivity and increase of the national GDP growth in the agricultural industry. Subsidies on production in Croatia provide a proof of technological improvement due to FDI.

In Croatia, the number of AWU 159,36 thousand, for a country with more than 4 million population, is a very high for example when compared to AWU in Italy, in the second quarter of the score, where this number was 874,95 thousand, for a country with more than 60 million population. In Croatia the share of the AWU was 3,8% of the total population, while in Italy this share was only 1,5% of the total population (Eurostat, 2018).

In this first quarter of score, following two countries had biggest population; ***Poland*** with 38 million and ***Romania*** with 19,6 million. These two countries have considerably less population than Italy, a country of 60 million inhabitants. In spite the big population, Italy has share of AWU number of only 1,5% (875 thousand), while in Romania this share was 8,1% of the total population (1588 thousand AWUs) and in Poland this share was 4,3% of the total population

(1649 thousand AWUs). Both, Romania and Poland have almost two times more AWU number than Italy.

Compared, Poland has almost same country size in km^2 as Italy, but AWU number of Poland was two times more. It is worth mentioning that the geographical position in Italy is less favourable than in Poland, because of more mountain area and less arable lands in Italy than in Poland. In spite the fact that in Poland the AWU number was 4,3% of total population and less than Romania (8,1%), the Italian agricultural industry was more successful and competitive compared to Romania and Poland. In Romania and Poland, 3,24 million AWU produced the food and agricultural products for the population of both countries, which is little less than number of the population in Italy, where only 875 thousand AWU is one fourth of both countries.

Generally, in those EU-member states, where the share of AWU number is at level of about the 4% of the population the agricultural industry cannot be successful nor internationally competitive. Solution for this issue is concentration of the agricultural production and usage of inputs, including the labour force, in order to increase the competitiveness of agricultural industry of all of the selected EU-15-member states. This should be accompanied with improved mechanization and application of advanced technical equipment. Countries with low AU are: Romania (8,1%), Lithuania (5,2%), Poland (4,3%), Greece (4,2%), Hungary (4,0%), Latvia (3,95%), Slovenia (3,9%), Croatia (3,8%), Bulgaria (3,49%). The most competitive agricultural industry has Austria, Italy, Denmark, Czech Republic, Slovakia and sometimes Estonia. In CEE member states, the agricultural industry is growing, providing a good opportunity for decreasing their backwardness from the average level of the EU-28.

Poland was the sixth member state from the selected EU-15-member states, where the DIRINV1710 economic variance, as balance of the direct investment (foreign and national investment), was the sixth biggest and largest foreign investments were realised in the researched period from 2010. The foreign direct investments in Poland had very important influence on the increase of the real labour productivity by 18,4% and the GDP growth by 25,4%. The increase of the subsidies on the production was by 22,4%, which also made considerable influence on the intensity of the FDI.

Romania had significant foreign investment, with 64,7 in million units in the national currency, which stimulated increase of the real labour productivity by 37,1%; this is by two times more than Poland. Romania had GDP growth rate increase by 29,8%. But the GDP growth was just slightly higher than the GDP growth of Poland, with 25,4%. This means that Romania had better real labour productivity in agriculture than Poland. But the more increase of the IIP in Romania impacted the increase of real labour productivity in agricultural industry, which led to high increase of the subsidies by 160% on the production including, consumption of fixed capital. Compared to the rest of the EU countries, this was extreme increase, as in EU-15 selected states subsidies on production increased by 70% and 3,4% in case of the EU-28 member states.

In spite the considerable increase of the subsidies on the production in Romania and the fact that biggest part of these were allocated for modernization of the agricultural mechanization and advanced technology, the number of the AWU has not considerably decreased since 2010. AWU remained at level of 1587,65 thousand by the end of this period. The number of AWU in Romania had share 8,1% of the total population, while the number of AWU in Poland had only 4,3% of the total population. This indicates that the Roman agricultural industry not that competitive compared to the rest of the countries. In my opinion if in any of the EU-member state that has share of the AWU number between 3%-4% or higher of the total population, its agriculture could not be competitive at international level.

In Croatia the subsidies on the production has increased by 730%, which significantly higher than in Romania. However, the amount of the subsidies was not as high as in case of Romania. In Croatia the subsidies were often allocated for covering natural disasters, such as drought and the damage caused by these. This means that Croatian farmers were not in a position to allocate the subsidies for extending the agricultural mechanization and highly developed advanced technologies.

The last EU-member state of this quarter of the score is ***Bulgaria,*** which had considerable activity of the international investment position. This contributed to increase the real income productivity in the agricultural industry by 19% since 2010. Also, similarly to the increasing rate of the real labour productivity, GDP growth was 16,5% for this period. The subsidies also increased significantly, by 73,8%, which could stimulate the foreign investors to strengthen their investment position, because with their investment investors could obtain subsidies. These

subsidies could ensure fixed trend of agricultural development on a longer run. In spite the fact that the GDP growth rate was moderate in comparison with the other EU-15-member states, still Bulgaria's GDP growth of 16,5%, was ranked higher than the EU-28 average.

In Bulgaria the share of the AWU of the total population was also at high level compared to the other EU countries, hence its agriculture is less competitive for this period of 2010-2017. Bulgaria also has had the same challenges as Romania for this period, namely considerable backwardness of the agricultural industry compared to the developed countries of EU-28. Even though Bulgaria had considerable and intensive growth rate, this was not sufficient to reach the advanced EU-28 countries.

In the *second quarter of the score* at the „X" Principle line the economic variances, GDPGrowth176, AWU20177 and RLProd20178 (Real labour productivity per person) are decreasing or less increasing in the EU-member states of this quarter. At the „Y" Principle line two variances, namely the Subsidies169 and DIRINV1710 (Balance of the International Direct investment and national-domestic investment in million national currency, in percent, 2010= 100), are increasing or less decreasing similarly to the first quarter.

In the second quarter of the score there are three EU- member states, namely Greece, Italy and Austria. In spite that the differences among these EU-member states of this quarter are very obvious, the trends of changes of the economic variances are similar. The GDP growth rate was decreasing mostly in Greece by 17,2%, which had the worst and decreasing trend in the GDP. In Italy this decreasing trend was 0,3% and it was mostly stagnating in the researching period. In spite that in Austria the GDP growth has increased by 10,4% for this period, and this rate was equal with GDP growth rate of the average level of the EU-28-member states (10,7%), this growth compared to the EU-15 average lower, where the growth is 15,5%. Therefore Austria appears in this quarter of the score.

The strong correlation means that the growth of real labour productivity of agricultural industry can increase the production of the agricultural industry, and it can furthermore contribute for GDP growth of a member state. GDP growth provides better economic and technological background for developing the agricultural production by producing machines, chemicals and equipment in order to increase the consumption of fixed capital. As stated before, the

connection between these two economic variances is mutual, therefore it is strong and these two variances cannot be isolated from each other.

In case of these three countries (Austria, Italy and Greece), there is a strong correlation between the GDP growth (GDPGrowth176) and real labour productivity (RLProd20178) in agricultural industry, namely in figure 0,777 (77,7%) (see in detailed in Table-12 Eurostat, 2018). In case of Greece, the decrease of GDP growth was biggest drop among the selected EU-15-member states, but also the real labour productivity decreased by 6%, representing lowest figure among the EU-15. In Italy as the GDP growth decreased, the real labour productivity also decreased by 1,7%. In EU-15 country group there were only two member-states, these last ones, where the GDP growth and the real labour productivity decreased, where in the rest EU-15-member states these two economic variances have increased for the examined period. In Austria the GDP growth increased and the real labour productivity has also increased by 2,5%, but this result was below the average increasing level of this economic variance in EU-15 and EU-28, where in EU-28 the average level was 5,8% rate higher than in Austria.

In Austria the real labour productivity had lower increasing rate compared to the EU-28, but this does not mean that Austria does not have enough advanced technologies. This lower increase was due to the fact the Austria is already very much developed and further development can be more difficult compared to the EU-28. Those countries, which are less developed in terms of agricultural real labour productivity, could realise more intensive developing trend than countries having high developed productivity. In general, at present the low cost labour force of selected EU-member states in Central East Europe can be less productive than one of Italy, Austria and Denmark if the advanced technology cannot be accompanying with agricultural industry and production. International competitiveness of the agricultural industry cannot be realised achieved without advanced technology based on the international qualified assurance standard and ISO (international standard organization) accepted by international agreement.

There is a middle strong correlation between the real labour productivity (RLP20178) and the number of the AWU, as labour force directly employed in agricultural industry (AWU20177) by 0,412 (41,2%). This means that if the real labour productivity increases, this can lead to future decrease of the number of the AWU. In any way the real labour productivity can only develop based on the technological development, because this developing process can lead to

decrease of the number of the AWU and will stimulate surplus labour force of agricultural industry to the other economic sectors, as industry or services.

The other two economic variances, namely subsidies on the production in agricultural industry (Subsidies169) and the direct investment in balance of the foreign direct investment and investment financed by domestic-national financial resources (DIRINV1710), do not have any significant correlation, because the technical-technological development determines the labour productivity and not the resource of the capital to be invested. Technical development has considerable role for improving the labour productivity and not the subsidies on the production. The main issue is not the financial resources either foreign or national or even subsidies coming from the common financial budget of the EU or the national governmental budget. The basic element in any way is the *technological development*, on which the real labour productivity can develop on a longer run, which stimulates decrease of the number of AWU. Finally, the GDP growth can be realised by the technological development. Financial resources are crucial for the technological developmen, which can be of various nature. In spite that the following two economic variances, namely Subsidies169 and DRIINV1710 don't have strong or weak correlations between each other and with other variances, these financial resources are important future agriculture technological development.

Austria, within the selected EU-15-member states had the largest amount of domestic financial resources for the direct investment and more than the foreign financial resources in the field of agricultural industry. This balance between the national and foreign financial resources for the investment has increased to the level of 124,5 million EUR between 2010 and 2017. This large amount of the financial resources was allocated for investment, hence the private investment has increased by 30% for the researched period (see Table-1 and Table-11, Eurostat, 2018). This figure was three times more than the average level of its in EU-28, and more than two times compared to the average level of the EU-15-member states. The subsidies on the production decreased by 5,6%.

In Italy the subsidies on the production, compared to the Austrian case, was in a more favourable state, because the investment increased, resulting with for more consumption of fixed capital. Also, looking into the balance between the national and foreign financial resources to cover the cost of the direct investment, FDI resources were more available than national. Therefore the value is negative, namely 10% in Italy (Table-11). The subsidies on the

production has increased by 16,7% in Italy, because the FDI for fixed capital consumption were higher than the domestic investments in Austria in the same period. The FDI was more dominant and for more investments aiming at increasing consumption of fixed capital in Italy than in Austria.

However, the real labour productivity decreased in Italy, while in Austria it increased little more than in Italy. In Austria, the small increase of the real labour productivity can be followed by the share of the AWU number, which increased by 1,16% of the total population, which is less than in Italy. In Austria, the agricultural production was more concentrated therefore more productive for the real labour force than in Italy.

In Greece the national economic conditions developed in a less favourable direction, compared to the other two countries of this quarter of the score. This was mostly because the GDP growth declined, which ranked Greece to the last place among the selected EU-15 -member states. In spite that the FDI was more ambitionally active by negative balance as 65,2 million EUR from 2010 than the national-domestic direct investment, the FDI realization was not as expected and it finally decreased by 36% (Table-1). Also, subsidies on the production for consumption of fixed capital sharply decreased by 14,5%. Only in Lithuania the subsidies on the production decreased almost the same as in Greece, by 14,6%. Other variances are also showing the Greek difficulty when trying to reach international competitiveness. Namely, the real labour productivity decreased by 6%, which resulted by 4,2% share of AWU number from the total population.

To summarize, in Greece, the declining trends of GDP growth, the real labour productivity, subsidies on the production and private investment, not-concentrated agriculture all together had negative economic impact and ranked Greece at the bottom of the selected EU-15 and EU-28 member states. The focus should be to concentrate the agricultural production by investment for subsidies on the production, decreasing the AWU number and to develop the real labour productivity within the farming system at household level. The more advanced mechanisation should be realised, because technological advancement is crucial for the improving the agricultural industry and increasing the international competitive level of Greece on the single market of the EU-28 and the international markets.

The GDP growth should also increase in Greece, as this could ensure better economic background for the national agricultural industry, and will improve the credit stand-point in order to increase the private investment of farmers. These investment activities ensure firther more job possibilities for the rural population. From this, the other economic sectors can benefit, as this increased investment in the agriculture sector can generate opportunity for producing mechanical equipment and machines, or chemicals. The mutual connection among different economic sectors of this country can strengthen the role of the agricultural industry.

In the *third quarter of the score* at the „X" Principle line the economic variances, namely the GDPGrowth176, AWU20177 and RLProd20178 (Real labour productivity per person) are increasing or less decreasing in the EU-member states of this quarter similarly to the first quarter. At the „Y" Principle line two variances, namely the Subsidies169 and DIRINV1710 (International Direct investment), are decreasing or less increasing.

In the third quarter of the score there are three EU- member states, namely ***Latvia, Lithuania*** and ***Estonia***. In these new EU member states, there are some common characteristics of the economic variances. The economic variances at line "X" are increasing in these member states, namely the GDP growth increased more than the average level of GDP growth increase of the EU-28 by 10,7% and by 15,5% in EU-15. The GDP growth increase was 27% in Latvia, 28,3% in Lithuania and 30,2% in Estonia. The GDP growth increase was stimulated by the increase of the real labour productivity, which was between 11,2% and 20,9% in cases of three member-states (see Table-11).

The FDI were more than the financial resources of the national domestic companies, which means that the domestic lack of capital and the favourable national economic policy of these three countries made positive impact on the foreign investors to realise FDI inflow into these countries. Based on this, the balance of capital supply for investments turned to the side of foreign investors. In case of Estonia the direct investment was 79 million units of the foreign investors. In Estonia increased FDI resulted in increase of the real labour productivity in agricultural industry by 11,2%. FDI had also impact on the whole economy, which can be demonstrated by the GDP growth increase by 30,2% (DIRINV1710 = Balance of the International Direct investment and national-domestic investment in million national currency, in percent, 2010= 100).

GDP growth increase of Estonia was highest among EU-15-member states, which also could provide a proof, that in spite the moderate increase of the real labour productivity, GDP growth rate increased. This also shows that developing only the agricultural real labour productivity is not enough to stimulate increasing GDP growth rate. GDP growth can be achieved also by development of other economic sectors as well. The importance of the role of the agricultural industry can be different among the EU-15-member states. In some cases the real labour productivity in agricultural industry cannot create significant GDP growth increase, because the development of other economic sectors has more important role and their economic strengthen is more considerable, than the role of agricultural industry. Estonia is an example where the other economic sectors have bigger and stronger role than one of agriculture for the GDP growth increasing rate. In Estonia also this can be proofed by the small share of the AWU number as 1,5% of the total population.

But in some other cases the agricultural industry and its real labour productivity can have more impact on the GDP growth increase. For example, in case of Latvia the real labour productivity in agricultural industry increased by 20,9% more than in case of Estonia. The GDP growth rate of Latvia increased considerably more compared to EU-15 and EU-28, but little compared to Estonia, namely by 27%. In Latvia and Lithuania, the real labour productivity of agricultural industry contributed for increased GDP growth more than in Estonia (see Table-11).

In cases of Lithuania the real labour productivity in agricultural industry increased by 18,1% more than in Estonia. GDP growth rate of Lithuania increased considerably compared to EU-15 and EU-28, but little less than in Estonia, namely by 28,3%. The AWU number of Lithuania was three times more than in Estonia, namely about 5,2% of the total population. It is clear that in cases of Latvia and Lithuania, that these countries increased and developed the real labour productivity in decreasing trend more than in Estonia, but they also had worse GDP growth increase rate than Estonia. *In Latvia and Lithuania, the real labour productivity of agricultural industry contributed to higher GDP growth increase rate than in Estonia* (see Table-11).

In these Baltic EU-member states, FDI had considerable impact for development of the real labour productivity and mechanical and technological development, but within three Baltic EU-member states Estonia reached 79% more FDI than the national-domestic investment. But most of the FDI was not used for consumption of the fixed capital, therefore the subsidies on production in agricultural industry increased only by 1,2%. In Latvia, that had similar amount

of FDI realisation as Latvia, the FDI was used for investment in agriculture, therefore the real labour productivity in agricultural industry increased more in Estonia and also the subsidies on production in agriculture increased by 16%.

In *Lithuania* the FDI was 40,4% and it was higher than in Latvia and Estonia. FDI contributed for development of real labour productivity in agricultural industry accompanied with increasing GDP growth rate. But the FDI investment in the agriculture was less than in Latvia, therefore subsidies on the production decreased by 14,6% and the share of the AWU number remained at level of 5,2% of the total population (see Table-11).

In the *fourth quarter* of the score at the „X" Principle line the economic variances, namely the GDPGrowth176, AWU20177 and RLProd20178 are decreasing or less increasing in the EU-member states of this quarter similarly to the second quarter. At the „Y" Principle line two variances, namely the Subsidies169 and DIRINV1710, are decreasing or less increasing similarly to the third quarter.

In the fourth quarter of the score there are five EU- member states, namely Denmark, Hungary, Czech Republic, Slovakia and Slovenia. In this session ***Slovenia*** has had the biggest amount of FDI among the selected EU-15-member states since 2010, where FDIs increased by 311,8%. The minus sign means that the balance of the FDI and the national domestic investment was negative, because of higher foreign investment than national domestic one in national currency, but in percent from the level of results in 2010 until the end of 2017 (2010=100). Generally, in Slovenia the FDI was significant and stimulated increase of the real labour force in agricultural industry by 7,4%, which contributed GDP growth rate increase by 10,3%. Naturally the direct investment (DIRINV1710) aims at increasing investment not only in agricultural sector, but also in the other sectors. But the FDI resulted such investment, which were concerning the increasing consumption of the fixed capital, therefore the subsidies on production in agricultural industry increased by 45,5% since 2010.

In **Austria**, the national domestic investment based on the national financial resources increased by 124,5% – one and quarter times more since 2010. The value of this increasing rate is positive, because this increase has happened in field of the national investment and not in field of foreign one. But in Austria their investment activities focused mostly on other economic sector out of the agricultural industry, therefore the real labour productivity increased only by 2,5% less than

in Slovenia, despite that fact that the GDP growth in these two countries was the same. Also, in Austria subsidies on the production have decreased by 5,6%, because the investment was mostly realised in other economic sectors. There are two marginal values in the selected EU15 member states; one is Slovenia by increase of foreign direct investment and the other one is Austria by increase of national-domestic investment. In spite that Slovenia realised considerable development in the agricultural industry, the large share of the AWU number remained as 3,9% of the total population, while in Austria this share was low, namely 1,16%.

Czech Republic has a better position, because real labour productivity increased by 9,9% more than the one of Slovenia. Also, the balance of FDI and national-domestic increased, where the negative balance means that the foreign investment was more than the national one and has increased by 31,2% since 2010. This contributed to better labour productivity in agricultural industry and higher GDP growth increase by 16,2% than in Slovenia, where the GDP growth rate increase was by 10,3%. In Czech Republic only small amount of the FDI were realised in agriculture and this resulted in lower increase of subsidies on production for consumption of fixed capital in agriculture, by 6,9%. The economic growth of agricultural industry in Czech Republic kept the level of the AWU number low, namely 0,97% of the total population. This share was the second smallest among the selected EU-15-member states.

The third member state of this fourth quarter was ***Slovakia***, where the balance of the foreign and national domestic investment was negative and has increased by 24,6% since 2010, because of increased FDI. Also, the real labour productivity increased by 10,5%, which also contributed to GDP growth increase by 20,8%, which is an excellent result in EU-15 and EU-28 member states. Slovakia had good result of the AWU number, as 0,9% of the total population, which is less than Austria. Also, the subsidies on the production for consumption of fixed capital increased by 12,5% which is two times more than Czech Republic.

In those cases when the FDI has strongly increased during the examined period and the GDP growth increase was higher than the increase of the real labour productivity of agriculture, then most of the FDI were realised in other economic sectors and not in agriculture (Austria, Estonia, Hungary, Lithuania, Slovakia). But when the real labour productivity of agriculture increased more than (Romania, Bulgaria, Croatia) or closed to increase of the GDP growth rate (Denmark, Czech Republic, Latvia, Italy, Poland, Slovenia) and subsidies on production concerning the consumption of fixed capital in consequence of the strong activity of FDI, therefore most likely

the FDIs were realized in agricultural industry. **Greece** in not belonging into any of these three groups of the developing trends, because it realised a considerable decline in the economic growth, in real labour productivity and in the subsidies on production.

In ***Hungary*** the balance of the foreign and national-domestic investment has increased by 2,5% since 2010, which were realised mostly in other economic sectors and not in agricultural industry. Therefore, the GDP growth rate increased by 17,3%, which is more than the average level of the EU-28, where this figures amounted for 10,7% and 15,5% in the selected EU-15-member states. The FDI and the domestic Hungarian investors did not focus on the agricultural development enough, therefore the real labour productivity in agricultural industry has increased by 2,7% since 2010 and the subsidies on production for investment of consumption of the fixed capital increased only by 3,6%. In Hungary the challenge of the agriculture is that the number of land owners is very high, about 2,6 million land owners, and the share of the AWU number is 4,0% of the total population. Because of the high number of the landowners and AWU, and the low concentration of arable land usage and farming system, the real labour productivity can stagnate in a longer run. This can easily lead to lower level of the competitiveness of the Hungarian agricultural industry and also worse income position of farmers and farming households. Therefore, this can lead to less capital accumulation for the possible investment in agricultural sector. Therefore, the Hungarian agricultural industry has a significant challenge to concentrate the agricultural production and to achieve more advanced mechanization and use modern techniques and equipment.

The smaller number of the landowners can be reasonable, because the confusion or interest conflicts among the land-owners and land-users can be wider and increasing the gap among their economic interests, which will lead to more damages for those small-scale farmers, who are living and employed in agricultural production and obtaining their incomes from selling their agricultural output.

Denmark was similar to the agricultural conditions of Austria, because the balance of the foreign and national-domestic investment has been strong to the side of the national investment side by 41% since 2010. However, this was only one third of the Austrian national investment, as 124,5% (see Table-11; Eurostat 2018). Only two countries, namely Austria and Denmark from the selected EU-15, had more national domestic investment than the FDI. Also, in Denmark the investors, either foreigners or national, focused more on the other economic

sectors than the agricultural industry, therefore subsidies on production in field of consumption of fixed capital has decreased by 4,2% less than in Austria since 2010.

The real labour productivity has increased by 6,6% in Denmark, while in Austria it increased by 2,5%. The GDP growth rate of Denmark was higher by more than one percent than in Austria, 11,6% in Denmark and 10,4% in Austria. This means, that in spite that national domestic investment has increased by three times more in Austria (by 124,5%), Denmark realised higher GDP growth increase. The number of AWU in Denmark was 0,86% of the total population and lower than in Austria, where it amounted for 1,16% of the total population. But the difference between these two EU-member states was significant, as the number of AWU in Austria was 101,74 thousand, while in Denmark it was 49,48 thousand in Denmark, which is half than one of Austria.

In Denmark the cooperative system helped the farming system and farming household scheme to concentrate using agricultural input and land-use in order to increase the profitability, production productivity and real labour productivity at very high level. This country's agriculture is characterized with advanced mechanization, which keeps the income and international competitiveness position stable in a long run for all co-operative members. The Danish farming co-operative system is an example how to create well-functioning vertically integrated product channel based on the co-operative system. ARLA-Foods Cooperative is an example with starting point from the soil of the arable land to the consumers' table, for agricultural and food products through the basic agricultural and food production, food manufacturing industry, the whole trading and retail trading steps directly to the consumers.

The cooperative system should not be regarded as a private company for one unit of basic production, purchasing and selling. The co-operative system is based on the single independent, or individual producers as farmers, while a private company normally is not consisting of independent producers. Usually a private company is one producer, which cannot share more than 30% of one kind of product or product group market organization based on the Law of Competitiveness in EU.

The last part of this chapter shows the clustering the EU-15-member states into four quarters of the score or coordinate system in the section. In the first section the first five economic variances provide the selecting methods for EU-15-member states in the first Component-1: output, input

and private investment of agricultural industry (OUTPUT171, INPUT172, PrivInv164) and in the second Component-2: GVA and real income factor per AWU equivalent (GVA173, RIFAWU175) (see Table-1). In the second section the second five economic variances provide the selecting methods for EU-15-member states in the first Component-1: GDP growth, Labour force directly employed - AWU in number, real labour productivity per person, GDPGrowth176, AWU20177, RLProd20178 and in the second Component-2: subsidies 2010-2016, million EUR, 2010= 100, and Direct Investment in million units of national currencies (Subsidies169, DIRINV1710). In each selecting method the EU-15 member states were selected to four quarters based on the score and the score visually shows the distance among member states based on the values of economic variances belonging to member states.

But in the case of the second five economic variances (Table-11) the Table-20, namely Cluster Membership shows the clustering systems in different methods based on the number of clusters selecting the EU-15-member states.

Table 20. Cluster Membership

Case	5 Clusters	4 Clusters	3 Clusters	2 Clusters
1:Bulgaria	1	1	1	1
2:Czech Rep	1	1	1	1
3:Denmark	1	1	1	1
4:Estonia	1	1	1	1
5:Greece	2	2	2	1
6:Croatia	3	3	2	1
7:Italy	2	2	2	1
8:Latvia	1	1	1	1
9:Lithuania	1	1	1	1
10:Hungary	1	1	1	1
11:Austria	1	1	1	1
12:Poland	4	4	3	2
13:Romania	4	4	3	2
14:Slovenia	5	2	2	1
15:Slovakia	1	1	1	1

Source: Own calculation using SPSS, Eurostat, 2018

In the Table-20, in cases of the 2 Clusters the EU-15 member states in such two clusters/groups, where there are only member states namely Poland and Romania in the second cluster. But in the cases of 5 clusters Romania and Poland are also together in one group, but this is fourth cluster and Croatia is in the third cluster and Slovenia is in the fifth cluster. The biggest cluster

is the first one including 9 EU-member states. This last case for the clustering can be followed in the Figure-5 and Figure-6 based on the Dendrogram using Ward Linkage in cases of the EU-15 member states, by own calculation using the SPSS (Eurostat, 2018) according to the SPSS statistical analyses. Naturally the EU-15 member states are selected into any each cluster based on their economic characters as economic variances, how the economic variances are similar or different for member states.

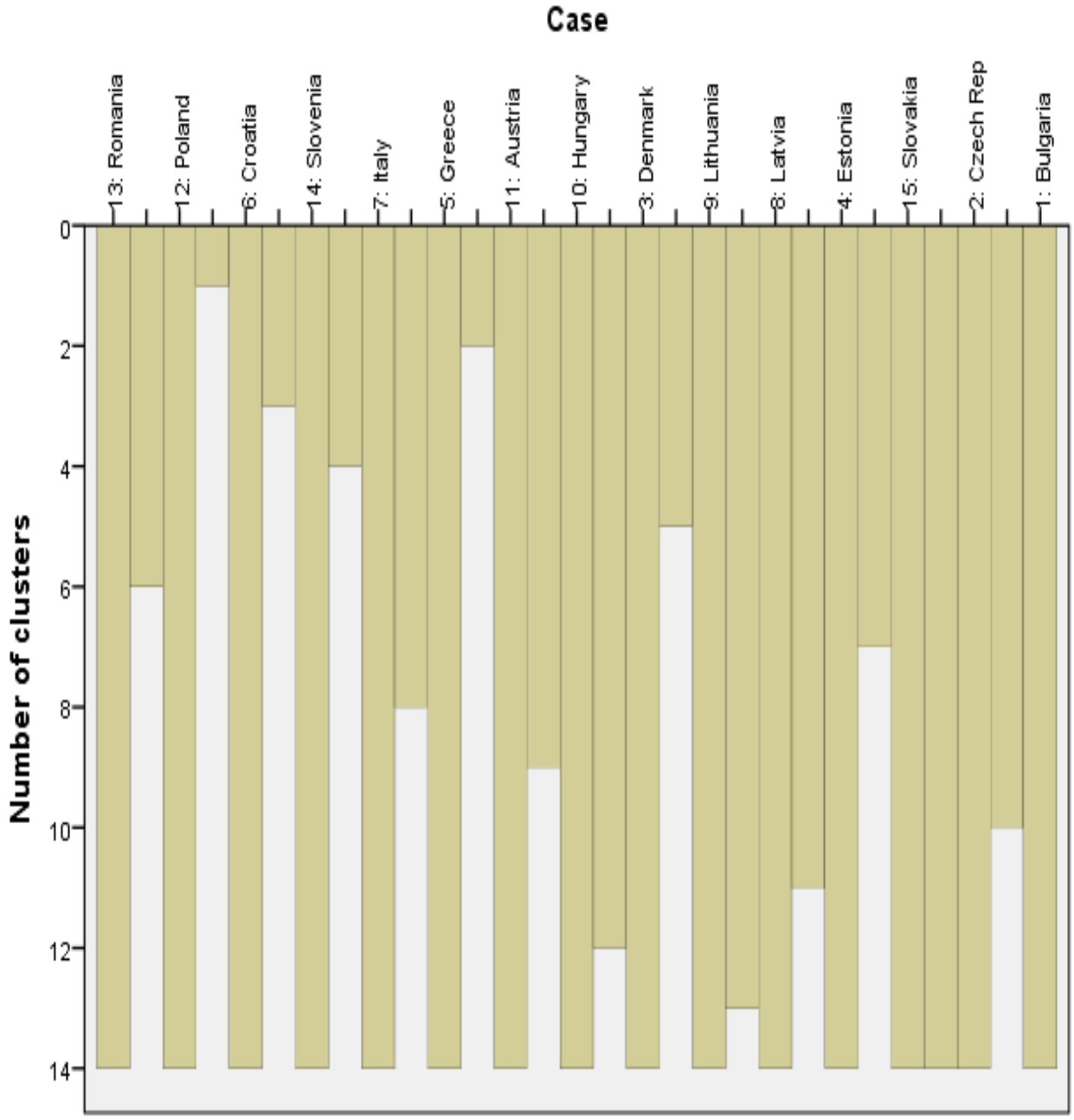

Figure 5. Number of clusters in cases of the EU-15 Member States

Source: Own calculation using SPSS, Eurostat, 2019.

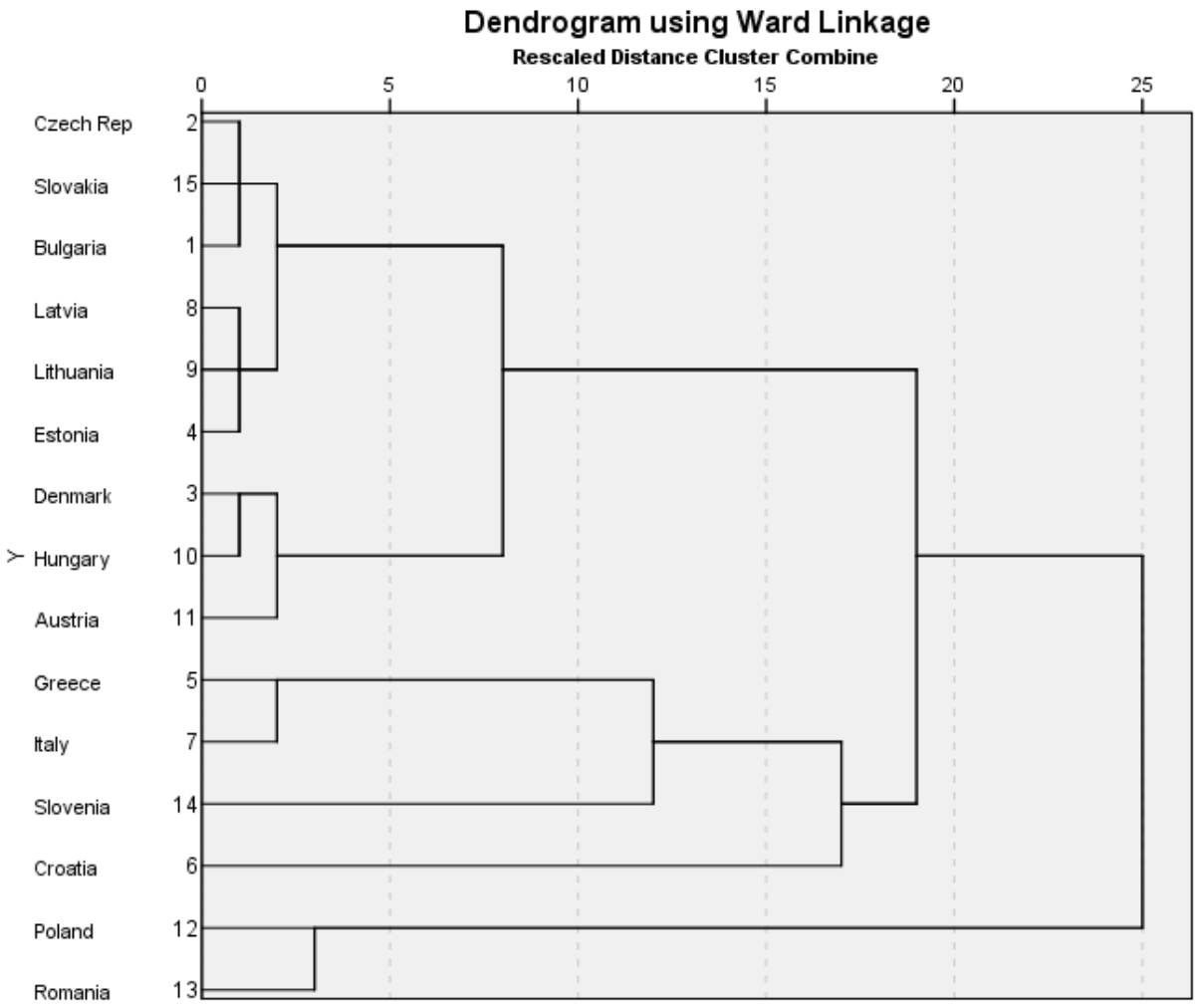

Figure 6. Dendrogram using Ward Linkage in cases of the EU-15 Member States
Source: Own calculation using SPSS, Eurostat, 2019.

Clusters:

Cluster (1): Austria, Bulgaria, Czech Republic, Denmark, Estonia, Hungary, Latvia, Lithuania, Slovakia;

Cluster (2): Greece, Italy;

Cluster (3): Croatia;

Cluster (4): Poland, Romania; and

Cluster (5): Slovenia.

4.5 The main findings of the statistical analyses for the selected EU-15-Member States

1) The correlations among the variances are considered strong if the value is more than 0,500 (50%); if the value is close to 0,500, the correlation is middle and if the value is under 0,500 (50%) the correlation is weak. Naturally if the value of the correlation is close to 1,000 (100%) the correlation is very strong. Based on this, the correlation is very strong between OUTPUT171 and INPUT172.

The correlations are middle strong in between following variances, namely between OUTPUT171 and Privinv164 by 0,603 (60,3%), between INTPUT172 and Privinv164 by 0,463 (46,3%) and between GVA173 and RIFAWU175 by 0,562 (56,2%). This means that if the OUTPUT171 increases, then the INTPUT172 and Privinv164 will also increase. Consequently, if the INTPUT172 increases then the Privinv164 will also increase.

The same trend is valid between the correlation of GVA173 and RIFAWU175. Naturally if one of these economic variance changes , then the other economic variance will change in the same direction depending on the other variance (Table-4).

2) In case of **Hungary** the output, input and the private investment on the "X" line have increased, but the GVA and the real income factor per AWU have increased more than the increasing trend of the other three economic variances on "X" line. This means that the little moderate increase of private investment in Hungary could generate three times more increase in case of the GVA and two and half times more increase of real income factor for AWU for the same time period. In this period the first biggest increase of the GVA was in Lithuania by 90,7% increase, while in Hungary was the second member state and third member state was by 80,4% after Hungary at very directly. The average increasing level of GVA in EU-15 was 43%, while in EU-28 this rate was only 21,9%.

3) The results of **Lithuania** provide proof how much this member state has relative backwardness compared to the higher ranked EU-28 countries. The results also show how intensive private investment could generate considerable increase of real income factor for AWU. In Lithuania the most important objective was increasing and stimulating intensive private investment. Once this is achieved, this investment increase will generate increase of real income factor. This order and rule will result in efficient and sustainable agricultural production

growth by using advanced technology, both in Lithuania or in any other EU-15 and EU-28 country. Naturally, the agricultural production should be concentrated to increase the efficient level of the agricultural production. By using more advanced technology and techniques, and by extending the knowledge of farmers the yield per production cost or input will increase.

4) In case of **Slovakia** lower competitiveness in agricultural industry can be due to the higher real income factor per AWU. This was as a result of the national tax policy, but also because of low usage of advanced technology, while the private investment increased. The competitiveness can mostly increase based on the increased investment in advanced technology and not simply by income increase. EU harmonization policy gives more independence to the EU member states in their tax policy. However, the agricultural policy should be common including the price and subsidy systems. Probably the more favourable tax policy contributed to the increase of the real income factor in Slovakia, which was not the case than in Czech Republic.

This considerable increase of real income factor in **Bulgaria** was partly realised by increased private investment and probably by the favourable tax policy for farmers. Also, it is visible that Bulgaria had lower level of private investment, GVA and real income factor compared to the other EU member states.

5) The low real income factor in **Croatia** was as a result of the fact that the subsidies were dependent on the private investment for consumption of fixed capital. Therefore as the private investment decreased in Croatia, the subsidies also decreased, which finally led to decrease in the real income factor. The decrease of the real income factor, as result of output and private investment decrease, could not be compensated by favourable tax policy for farmers in order to increase their incomes (Table-1; Table-2; Eurostat, 2018). For example, the amount distributed for consumption of fixed capital, as private investment was 60,8 billion EUR in 2016 in EU-28. At the same time the subsidies amounted for 52,6 billon EUR, which compensated the 86,5% of all consumption of fixed capital, as private investment. Naturally the subsidies on the production should compensate the cost of the private investment and not to increase the real income factor per AWU.

6) The reason of the unfavourable agricultural industry of **Greece** is lack of capital. The agricultural production concentration in Greek agricultural industry was at very low level,

therefore the capital accumulation was very weak with low usage of advanced technology. This led to decrease of output and decreasing trend of the competitiveness of the Greek agricultural industry and the farmers. The low output resulted in low price incomes and unfavourable income conditions for farmers. Low price income in future creates state of continuous lack of capital and weak capital power, hence negative prosperity. The farmers and rural population in Greece will continuously be poor or poorer and rural areas cannot keep the original population in their regions. Therefore, the domestic urban migration can increase in the future. Possibility of rural tourism will not be sufficient to ensure satisfactory income to keep the rural population in village areas.

7) It can be concluded that when the input increase is lower than the output increase, the GVA will increase (Bulgaria, Czech Republic, Hungary, Slovakia, Austria, Denmark, Italy, Romania, Slovenia, Latvia, Lithuania). Due to the fact that the average output in EU-15 increases more than the input, the **GVA** considerably increases.

In case of EU-28, the output increases more than the input, therefore the GVA also increases, but this increase less than the one of EU-15, because the increase of output of EU-15 more than one of EU-28 (Table-1).

When the input increases more than the output increase, the GVA will increase less (Greece, Estonia). Increased private investment activity, accompanied by efficient investment, will result with increase of the **GVA**, even if the level of input decreases (Bulgaria, Poland, Croatia).

8) Also, it can be concluded that if the private investment considerably increases and more than the GVA increase (Slovenia, Estonia, Austria), or their increasing trends are closed to each other (Denmark), this will lead to considerable decrease or little increase of the **real income factor per AWU**.

But if the private investment decreases more (Croatia) or increases less than the GVA (Bulgaria, Czech Republic, Hungary, Slovakia, Italy, Latvia, Poland), the real income factor per AWU will increase. Also, the average increasing level of the private investment increases less than the GVA in cases of the EU-15 and EU-28-member states, therefor the **real income factor per AWU** increases.

In case of EU-28, the private investment increases less than the GVA, therefore the **real income factor per AWU** also considerably increases, but this increase is still lower than the increase of EU-15. This is because the private investment in EU-15 is higher than in EU-28 (Table-1; Table-3).

9) Generally, the **subsidies on production** are dependent on the measure of the private investment, namely consumption of fixed capital at level of the EU-28, which has an important influence on the change of the real factor income per AWU.

Therefore, these subsidies can only be provided for farmers if about 88% of the subsidies are used for extending and improving the production by using new technologies or creating new advanced infrastructure for the production process. This for example can be buildings, service network for improving agricultural techniques and equipment or innovation for the increasing knowledge for farmers and labour force in agricultural industry (Table-11; Table-2).

Sometimes it can happen, if the GVA and the subsidies on the production increase less than the real income factor per AWU increase, this can be as a result of favourable tax policy at national economic level, which is not common and not unified based on the EU harmonization policy. The tax policy remained within the national frame of each EU member state, in spite that the other policies, as agricultural policies, agricultural price policy and subsidy policy for the farmers or even the duty and single market condition are common. (Bulgaria, Slovakia, Italy, Lithuania, Denmark,). In Romania the subsidies on production were at very high level (sew Table-1 and Table -11), which allow moderate growth rate of the real income factor per AWU.

10) In spite that this increase of GVA was significantly high in **Austria**, the real income factor per AWU was at moderately low level at 7%. This is due to increased level of the input including the AWU or labour force input was at low level and also the private investment increased at high level by 30,1%. This created considerable capital power from income perspective of the labour input to the side of the private investment, therefore it can be concluded that the future increase of the income position will have to stagnate in order to show more significant interest for improvement and development to achieve modern and advanced agricultural industry. This means that for the interest of the future economic prosperity the country should continuously increase the living standard on short-term period. In order for the country to become developed, the above-mentioned economic arrangement should be followed.

11) Table-12 shows strong and middle strong correlations. The GDP growth can influence the real labour productivity, because the more the GDP increases - including also the other economic sectors additionally to the agricultural industry – the more will the real labour productivity increase. Consequently, higher growth of the real labour productivity means that the value produced by AWU in agricultural industry can provide more value in agricultural sector, which added to the whole amount of the GDP at national level or level of each EU-member state. There is a strong correlation between both of them.

12) Also, there is a middle strong correlation between AWU20177 and the RLProd20178 because the labour force in number of AWU can make an efficient labour separation by more specialization, and therefore, this can strengthen the growing trend of the real labour productivity per person (RLProd20178). Naturally if the companies of the agricultural industry increased their owned real labour productivity, this means they can increase production value per AWU, therefore they can decrease the directly employed labour force in number of AWU. Moreover, these companies can extend their employment by their increasing price income. There is a mutual correlation between two economic variances (Table-12, Eurostat, 2018).

13) The share of the number of AWUs (AWU20177) in percent of the total population in each member state is important because all AWU produced the food for the total population in the selected EU-member states. Some imported food products could be calculated more than the national domestic food production. In this case, the share of AWU number was 1,8% of the total population of the EU-28- member states and 3,17% of the total population of the EU-15-member states by the end of the 2017. In Romania the share of AWU was 8,1% of the total population, and this was highest share of the population within the selected EU-15-member states. The second biggest share of the AWU number at national level in percent of population was 5,2% in Lithuania.

14) The smallest share of the AWU in percent of the national population was 0,86% in Denmark, 0,9% in Slovakia and 0,97% in Czech Republic by the end of 2017. The most favourable conditions were in those EU-member states, where the share of the AWU number was at the lowest level in percent of the population. This data shows how the agricultural industry was concentrated and how the usage of agricultural inputs and land plots were concentrated. The level of the mechanization and technical equipment supply also contributed

to decrease the AWU number and to increase the level of the production efficiency and profitability. The last one means better income for the agricultural industry in selected EU-15-member states (Table-11; Eurostat 2018 and own calculation).

15) FDIs in ***Croatia*** were intensive in this sector, which resulted with the highest increase of subsidies by 730% in this period, subsidies mainly used for the consumption of fixed capital. Therefore, the increase of the FDI brought more advanced technology in Croatia, which stimulated development of the real labour productivity and increase of the national GDP growth in the agricultural industry. Subsidies on production in Croatia provide a proof of technological improvement due to FDI.

16) Generally, in those EU-member states, where the share of AWU number is at level of about the 4% of the population the agricultural industry cannot be successful nor internationally competitive. Solution for this issue is concentration of the agricultural production and usage of inputs, including the labour force, in order to increase the competitiveness of agricultural industry of all of the selected EU-15-member states. This should be accompanied with improved mechanization and application of advanced technical equipment. Countries with low AU are: Romania (8,1%), Lithuania (5,2%), Poland (4,3%), Greece (4,2%), Hungary (4,0%), Latvia (3,95%), Slovenia (3,9%), Croatia (3,8%), Bulgaria (3,49%). The most competitive agricultural industry has Austria, Italy, Denmark, Czech Republic, Slovakia and sometimes Estonia. In CEE member states, the agricultural industry is growing, providing a good opportunity for decreasing their backwardness from the average level of the EU-28.

17) The number of AWU in Romania had share 8,1% of the total population, while the number of AWU in Poland had only 4,3% of the total population. This data shows large number of AWU in Romania. Therefore, the Romanian agriculture is not competitive at international level. In my opinion if in any of the EU-member state that has share of the AWU number between 3%-4% or higher of the total population, its agriculture could not be competitive at international level.

18) In **Bulgaria** the share of the AWU of the total population was also at high level compared to the other EU countries, hence its agriculture is less competitive for this period of 2010-2017. Bulgaria also has had the same challenges as Romania for this period, namely considerable backwardness of the agricultural industry compared to the developed countries of EU-28. Even

though Bulgaria had considerable and intensive growth rate, this was not sufficient to reach the advanced EU-28 countries.

19) In **Austria** the real labour productivity had lower increasing rate compared to the EU-28, but this does not mean that Austria does not have enough advanced technologies. This lower increase was due to the fact the Austria is already very much developed and further development can be more difficult compared to the EU-28. Those countries, which are less developed in terms of agricultural real labour productivity, could realise more intensive developing trend than countries having high developed productivity. In general, at present the low cost labour force of selected EU-member states in Central East Europe can be less productive than one of Italy, Austria and Denmark if the advanced technology cannot be accompanying with agricultural industry and production. International competitiveness of the agricultural industry cannot be realised achieved without advanced technology based on the international qualified assurance standard and ISO (international standard organization) accepted by international agreement.

20) There is a middle strong correlation between the real labour productivity (RLP20178) and the number of the AWU, as labour force directly employed in agricultural industry (AWU20177) by 0,412 (41,2%). This means that the real labour productivity increases, which can lead to future decrease of the number of the AWU. In any way the real labour productivity can only develop based on the technological development. Technological development can decrease the number of the AWU and can stimulate surplus labour force of agricultural industry to the other economic sectors, as industry or services sectors.

21) In **Italy** the subsidies on the production, compared to the Austrian case, was in a more favourable state, because the investment increased, resulting with for more consumption of fixed capital. Also, looking into the balance between the national and foreign financial resources to cover the cost of the direct investment, FDI resources were more available than national. Therefore the value is negative, namely 10% in Italy (Table-11). The subsidies on the production has increased by 16,7% in Italy, because the FDI for fixed capital consumption were higher than the domestic investments in Austria in the same period. The FDI was more dominant and for more investments aiming at increasing consumption of fixed capital in Italy than in Austria.

22) GDP growth increase of **Estonia** was highest among EU-15-member states, which also could provide a proof, that in spite the moderate increase of the real labour productivity, GDP growth rate increased. This also shows that developing only the agricultural real labour productivity is not enough to stimulate increasing GDP growth rate. GDP growth can be achieved also by development of other economic sectors as well. The importance of the role of the agricultural industry can be different among the EU-15-member states. In some cases the real labour productivity in agricultural industry cannot create significant GDP growth increase, because the development of other economic sectors has more important role and their economic strengthen is more considerable, than the role of agricultural industry. Estonia is an example where the other economic sectors have bigger and stronger role than one of agriculture for the GDP growth increasing rate. In Estonia also this can be proofed by the small share of the AWU number as 1,5% of the total population.

But in some other cases the agricultural industry and its real labour productivity can have more impact on the GDP growth increase. For example, in case of **Latvia** the real labour productivity in agricultural industry increased by 20,9% more than in case of Estonia. The GDP growth rate of Latvia increased considerably more compared to EU-15 and EU-28, but little compared to Estonia, namely by 27%. In Latvia and Lithuania, the real labour productivity of agricultural industry contributed for increased GDP growth more than in Estonia (see Table-11).

23) In **Austria**, the national domestic investment based on the national financial resources increased by 124,5% – one and quarter times more since 2010. The value of this increasing rate is positive, because this increase has happened in field of the national investment and not in field of foreign one. But in Austria their investment activities focused mostly on other economic sector out of the agricultural industry, therefore the real labour productivity increased only by 2,5% less than in Slovenia, despite that fact that the GDP growth in these two countries was the same. Also, in Austria subsidies on the production have decreased by 5,6%, because the investment was mostly realised in other economic sectors. There are two marginal values in the selected EU15 member states; one is Slovenia by increase of foreign direct investment and the other one is Austria by increase of national-domestic investment. In spite that Slovenia realised considerable development in the agricultural industry, the large share of the AWU number remained as 3,9% of the total population, while in Austria this share was low, namely 1,16%.

24) In those cases when the FDI has strongly increased during the examined period and the GDP growth increase was higher than the increase of the real labour productivity of agriculture, then most of the FDI were realised in other economic sectors and not in agriculture (Austria, Estonia, Hungary, Lithuania, Slovakia). But when the real labour productivity of agriculture increased more than (Romania, Bulgaria, Croatia) or closed to increase of the GDP growth rate (Denmark, Czech Republic, Latvia, Italy, Poland, Slovenia) and subsidies on production concerning the consumption of fixed capital in consequence of the strong activity of FDI, therefore most likely the FDIs were realized in agricultural industry. **Greece** in not belonging into any of these three groups of the developing trends, because it realised a considerable decline in the economic growth, in real labour productivity and in the subsidies on production.

25) The agriculture is now characterized by having high number of landowners and AWU, less concentration of arable land and farming system. Therefore the real labour productivity can consequently be little extending for longer period, it can also stagnate. This condition can easily lead to decreased competitiveness of the **Hungarian agriculture** and also worsen income positions of farmers and farming households. Furthermore, this can lead to less capital accumulation for investment in agricultural sector. Hungarian agriculture is facing a large challenge to concentrate the agricultural production and to use more advanced mechanization, modern techniques and equipment.

26) In **Denmark** the cooperative system helped the farming system and farming household scheme to concentrate using agricultural input and land-use in order to increase the profitability, production productivity and real labour productivity at very high level. This country's agriculture is characterized with advanced mechanization, which keeps the income and international competitiveness position stable in a long run for all co-operative members. The Danish farming co-operative system is an example how to create well-functioning vertically integrated product channel based on the co-operative system. ARLA-Foods Cooperative is an example with starting point from the soil of the arable land to the consumers' table, for agricultural and food products through the basic agricultural and food production, food manufacturing industry, the whole trading and retail trading steps directly to the consumers. The cooperative system should not be regarded as a private company for one unit of basic production, purchasing and selling. The co-operative system is based on the single independent, or individual producers as farmers, while a private company normally is not consisting of independent producers. Usually a private company is one producer, which cannot share more

than 30% of one kind of product or product group market organization based on the Law of Competitiveness in EU.

This chapter provides an overview of the economic conditions of each EU-member state based on ten different economic variances selected to five-five variances in order to determine the similarities and difference among the EU-15 selected Member States. This type of analyse is required to apply the SPSS statistical system. The SPPS can exactly describe the economic differences among states by figures and calculations. In the next chapter, is presented a summary of the statistical analyses concerning the selected EU-member states.

5 CONCLUSION AND RECOMMENDATION

The selected EU-15 Member States are faced with some challenges. One of these challenges is the low number of AWUs (AWU20177) as percentage of the total population of each member state in this research. This is important because the AWUs produced total food consumption in the selected Member States.

In this case, the share of AWU number was 1,8% of total population of the EU-28- member states and 3,17% of total population of the EU-15 Member States by the end of the 2017. In Romania the share of AWU was 8,1% of total population, a country with highest level in the share of the population within the selected EU-15 Member States. The smallest share of the AWU in percent of the national population was 0,86% in Denmark, 0,9% in Slovakia and 0,97% in Czech Republic by the end of 2017. In those Member States, where the share of AWU number is as high as about 4% of the population, the agricultural industry cannot be successful or internationally competitive. Possible solution is *concentration of the agricultural production* and use of inputs including the labour force, in order to increase the competitiveness of agricultural industry.

Based on the above-mentioned analyses for the agricultural industry it can be concluded that the competitiveness of the selected EU member states is less competitive compared to the competitors of the world economy. This is mainly because the farm structure of these countries is very diversified. This is the case for the agricultural sector of Romania and Poland. Lower competitiveness is valid for all EU-28 when these are compared to the agricultural sector of the US. The solutions for overcoming this challenge are summarized below:

- increase the level of the mechanization for larger farm size;
- qualified skills demand should be closed to the internationally accepted technological developed level;
- increase the input efficiency;
- increase the labour force efficiency in this sector;
- strong cooperation among the producers of the agricultural basic materials, manufacturing industry, whole traders and retail traders;
- development of infrastructure and logistic networks among them;
- maintaining low level of central governmental debt in GDP, especially when increasing subsidies for farmers, house hold farming family system.

Generally, the main goal of the selected EU-15-member states is to increase their competitiveness of the agricultural industry globally. Therefore, the input and output should increase by private investments, with possible FDI and decreasing number of the AWU. In order to achieve this, it is important for farmers to develop the real labour productivity, accompanied with increase of the real income factor per AWU and to obtain the subsidies for increased investment in fixed capital.

6 NEW SCIENTIFIC RESULTS

The new scientific results are summarized below, as a reflection to the hypotheses mentioned in the beginning of the dissertation. The summary is as follows:

1) The correlations among the variances can be middle strong if the value is more than 0,500 and close to 0,500; if the value is below 0,500 (50%) then the correlation is weak. If the value of the correlation is close to 1,000 (100%), or more than 0,900, then the correlation is very strong. Based on this, the correlation is very strong between OUTPUT171 and INPUT172. This means that if the OUTPUT171 increases then the INTPUT172 will also increase.

2) The correlation is middle strong in between following variances; namely between OUTPUT171 and Privinv164 (Private Investment) by 0,603 (60,3%) and between INTPUT172 and Privinv164 by 0,463 (46,3%). Also, if the Privinv164 increases then the OUTPUT171 and the INTPUT172 will also increase.

3) The correlation is middle strong between Gross Value Added (GVA173) and Real Income Factor per Annual Working Unit (RIFAWU175) by 0,562 (56,2%). Naturally if one of these economic variance changes , then the other economic variance will change in the same direction depending on the other variance (Table-4).

In case of *Hungary* the output, input and the *private investment* on the "X" line have increased, but the *GVA* and the *real income factor per AWU* have increased more than the trend of the other three economic variances on "X" line. This means that the little moderate increase of the private investment in Hungary could generate increase of input and output and three times more increase of the *GVA*, which led to two and half times more increase of *real income factor for AWU, than the GVA* for the same time period. In this period the first biggest increase of the GVA was in Lithuania by 90,7% increase, which led to increase of the real income factor by 50%, while in Hungary the GVA173 increased by 81,0% and RIFAWU175 increased by 66,2%. The average increasing level of GVA in EU-15 was 43% and RIFAWU175 was 39,2%, while in EU-28 this GVA173 rate was only 21,9% and real income factor increased by 25,2%.

4) Strong and middle strong correlations exist between *GDP growth (GDPGrowth176)* and the *real labour productivity (RLProd20178),* because the *GDP growth* can influence the *real labour productivity (RLProd20178).* The more the GDP increases - including also the other economic sectors additionally to the agricultural industry – the growth stimulates developing trend of the real labour productivity. Also, more growth of the real labour productivity means that the value produced by AWU in agricultural industry can provide more value in agricultural sector, which added to the whole amount of the GDP at national level or at the level of each selected EU-member state. There is a strong correlation between both of them.

5) The *FDI (DIRINV1710)* has strongly increased for the researched period, but the *GDP growth* increase was more than the increase of *the real labour productivity* of agriculture, therefore, most likely the FDIs were realized in other economic sectors than in agricultural industry (Austria, Estonia, Hungary, Lithuania, Slovakia). But when the real labour productivity of agriculture increased more than (Romania, Bulgaria, Croatia) or closed to increase of the GDP growth rate (Denmark, Czech Republic, Latvia, Italy, Poland, Slovenia) and subsidies on production concerning the consumption of fixed capital in consequence of the strong activity of FDI, therefore most likely the FDIs were realized in agricultural industry.

7 SUMMARY

The study analyses the main developing trends and differences in agricultural industry of the selected EU-15 Member States in Central-East Europe for the period of 2010 and 2017. These EU Member States are Estonia, Latvia, Lithuania, Poland, Czech Republic, Slovakia, Hungary, Romania, Bulgaria, Slovenia, Croatia, Italy, Greece, Austria and Denmark.

The analyse focuses on the *real income factor per AWU* in the selected EU-15 Member States based on the Eurostat database. The main economic issue is the *real labour productivity* concerning the private investment based on the *balance of the foreign direct investment and the national domestic investment* accompanied with *subsidies* covering mostly the consumption of the fixed capital. The *real labour productivity* has also correlation with *number of AWU* and the *GDP growth* rate. The *private investment* has strong correlations with *output* and *input*. Also, the *GVA* has stronger correlation with output and the real income factor per AWU. In this study, the SPSS research methods were used to evaluate the robustness of the correlations among the economic variances.

There is a considerable difficulty for the selected EU-15 Member States. Namely in the majority of the EU-15, the share of the number of AWUs (AWU20177) was more than 4% of the total population of each member state in this research. This is important because the AWUs produced total food consumption in the selected Member States. Because of the high level of the AWU number in all member states, the international competitiveness of the agricultural industry of these member states decreased, risking losing their market positions.

In those Member States, where the share of AWU number is at level of about 4% of the total population, the agricultural industry cannot be successful or internationally competitive. Possible solution for this issue is *concentration of the agricultural production* and usage of inputs, including the labour force in order to increase the competitiveness of agricultural industry.

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APPENDIX

Table 8.1: EU-28

Farms and farmland			
Farmland (utilised agricultural area)	**2016**	172 967	thousand hectares
Farms (agricultural holdings)	**2016**	*10 467 760*	number
Very small farms (with < EUR 8 000 of standard output)	**2016**	*67.6 %*	share of all farms
Family farms (with > 50 % of regular labour from family members)	**2016**	94.7 %	share of all farms
Farmers			
Employment in agriculture	**2016**	*4.2 %*	share of total employment
Persons employed in agriculture	**2016**	9.720.600	number
Young farmers (under 40 years old)	**2016**	*10.6 %*	share of all farm managers
Female farmers	**2016**	*28.5 %*	share of all farm managers
Farmers with full agricultural training	**2016**	9.1 %	share of all farm managers
Economic performance of agriculture			
Contribution of agriculture to Gross Domestic Product	**2017**	1.2 %	share of GDP
Gross value added (at basic prices)	**2017**	188 460	EUR million
Value of agricultural output (production value at basic prices)	**2017**	432 602	EUR million
Value of crop output	**2017**	218 918	EUR million
Value of animal output	**2017**	176 883	EUR million
Agricultural factor income per annual work unit (Indicator A)	**2017**	*+10.9 %*	change 2017/2016
Agricultural production			
Cereals	**2017**	310 058	thousand tonnes
Root crops	**2017**	:	thousand tonnes
Permanent crops	**2017**	64 827	thousand tonnes
Fresh vegetables	**2016**	72 879	thousand tonnes
Raw milk	**2017**	*170 120*	thousand tonnes
Bovine meat	**2017**	*7 803*	thousand tonnes
Pig meat	**2017**	*23 362*	thousand tonnes
Poultry meat	**2017**	c	thousand tonnes
Forestry			
Forest and other wooded land	**2015**	181 918	thousand hectares
Persons employed in forestry and logging	**2015**	*488 530*	working units
Gross value added (at basic prices)	**2014**	*25 836*	EUR million
Roundwood (in the rough)	**2016**	*458 165*	thousand cubic metres
Fisheries			
Fishing fleet	**2017**	1 571 784	gross tonnage
Persons employed in fishing and aquaculture	**2017**	:	number
Total catches	**2015**	5 145 542	tonnes live weight
Total aquaculture production (volume)	**2015**	*1 259 833*	tonnes live weight
Total aquaculture production (value)	**2015**	*4 128*	EUR million