

Dynamics of Concentration in Gross Domestic Product achieved in Romania's Agriculture

Agatha POPESCU
University of Agricultural Sciences and Veterinary Medicine, Bucharest, Romania,
E-mail address: agatha_popescu@yahoo.com

Valentin SERBAN
University of Agricultural Sciences and Veterinary Medicine, Bucharest, Romania,
E-mail address: srbn.valentin@yahoo.com

Correspondence should be addressed to: Agatha POPESCU; agatha_popescu@yahoo.com

* Presented at the 38th IBIMA International Conference, 23-24 November 2021, Seville, Spain

Copyright © 2021. Agatha POPESCU and Valentin SERBAN

Abstract

The paper analyzed the concentration degree in Gross Domestic Product obtained in agriculture in the territory of Romania. For this purpose, the data provided by National Institute of Statistics available for the period 2009-2018 were taken into consideration and four concentration indices: Herfindahl-Hirschman Index, Normalized Herfindahl-Hirschman Index, Gini-Struck Index and Concentration Coefficient were calculated. The obtained results proved low values of the concentration indices reflecting a relative uniformity among the eight microregions of Romania in producing GDP from the agricultural sector. However, a slight increasing trend of the values of concentration indices was noticed in four regions of development: South Muntenia, South East region, West region and South West Oltenia, in other three micro regions: North West, Center, and North East was noticed a slight decreasing trend, while Bucharest-Ilfov microregion is atypical for agriculture being small and including the capital. However, a few deviations appeared across the years during the analyzed interval, but being insignificant. Knowing the actual state of GDP produced in agriculture at the national and regional level is a useful tool for setting up the future development strategy which has to be adapted to the local needs. It is also a basis in allotting the EU funds for increasing productivity, efficiency and competitiveness in agriculture and rural areas.

Keywords: Agriculture, Gross Domestic Product, Concentration, Romania.

Introduction

Agriculture plays an important role in Romania's economy ensuring food for the population and raw materials for the processing industry, jobs and income for the rural population, products for export and contribution to the economic growth and GDP as affirmed Mackie (1964), Kjeldsen-Kragh (2007) and Meijerink, G. and Roza (2007).

The value of agricultural production and GDP obtained in agriculture is different from a region to another due to the geographical disparities, agricultural land (surface, soil quality and structure), water resource, specificity of climate factors (temperatures, precipitations, extreme meteorological phenomena (drought, hail, huge rains, floods, frost, storms, fires etc) which could favor or produce damages and losses, number and average size of the farms and their profile, crop structure, technologies applied, fixed and working capital, labor force and its qualification, capacity of absorbing investments and the EU funds allotted for sustaining the implementation of Common Agricultural Policy reforms and the achievement of the objectives of National Plan for Agriculture and Rural Development as mentioned by Nitescu and Dobre-Baron (2018).

Cite this Article as: Agatha POPESCU and Valentin SERBAN, Vol. 2021 (35) "Dynamics of Concentration in Gross Domestic Product achieved in Romania's Agriculture", Communications of International Proceedings, Vol. 2021 (35), ISBN: 978-0-9998551-7-1, ISSN: 2767-9640. Article ID 38123021.

More than this the agricultural output is a sum of the contribution of the three sectors: vegetal, animal and services. The huge difference between vegetal and animal sectors which becomes larger and larger year by year has led to an unbalanced agricultural output with a deep impact on gross value added and gross domestic product created in agriculture as mentioned Andrei and Popescu (2014).

This unbalanced development agriculture of agriculture is the cause of the reduced profitability, as to produce more value added it is needed to process raw materials and much better to transform vegetal products into animal products as found in his research Grigoras (2016a, 2016b). Integration in agriculture could be the best alternative to bring the two main sectors into balance and to create more gross value added and increase contribution of agriculture to GDP as affirmed Grigoras (2017).

Therefore, GDP created in agriculture depends of a large range of factors, which are reflected in the territorial disparities as found in their studies Popescu (2015b) and Popescu and David (2015).

Identification and analysis of the territorial disparities by region of development in Romania could be made based on GDP in agriculture in order to establish the future strategy for the development of a sustainable, competitive and performing agriculture, friendly with the environment and which has to ensure food safety both at the national level and in the territorial profile as mentioned Ionescu et al (2019).

The analysis of the degree of concentration/disparsity of the economic phenomena is achieved by using a complex of methods, among which the most frequently utilized are: Herfindahl-Hirschman Index established by Herfindahl (1959) and completed by Hirschman (1964), Normalized Herfindahl-Hirschman Index as described by Hayes et al (2021), Gini Struck Index as established by Gini et al (1955) and used by Farris (2010), Concentration coefficient set up by Brown (1994), Lorenz Curve as described by Gastwirth (1971) and other methods as presented by Van Egeraat et al (2015).

In Romania there are some studies regarding the degree of concentration and regional disparities based especially on GDP as provided by Popescu (2017a), GDP/capita, labor productivity, life expectancy as mentioned by Antonescu (2010) and Goschin (2015), market as studied by Savoiu et al (2010), tourism as shown by Popescu (2016b), entrepreneurship as researched by Nica et al (2018) and territorial inequalities and convergence as studied by Antonescu (2020).

But, just a few studies approached the territorial concentration and disparities by regions of development in agriculture regarding various aspects such as: role of agriculture in the convergence process as studied by Postoiu and Busega (2015), concentration farms cultivating maize as studied by Popescu (2015a), pork production as researched by Popescu (2016a), apple production as shown by Popescu (2017b), agro-tourism as described by Popescu (2018), labor productivity as researched by Popescu (2019).

In this context, the paper aimed to present an analysis on the dynamics of GDP achieved in agriculture by microregion of development in order to quantify the disparities or concentration in the territory using the main indices: Herfindahl-Hirschman Index, and Normalized Herfindahl-Hirschman, Gini-Struck Index and Concentration Coefficient.

This analysis is justified by the fact that knowing the disparities regarding GDP in the territory, the application of CAP in Romania could be carried out through an unitary vision and the EU funds allotted to sustain agriculture in its way to performance and competitiveness to be entirely used and diminish the discrepancies from a region to another.

Materials and Methods

Data collection

The data used in this study regarding GDP in agriculture at the national and territorial level were collected from National Institute of Statistics database for the period 2009-2018 for which the data were officially available till present.

In Romania, there are four macroregions of development and eight microregions, which are the main administrative and territorial structures which assure the economic development, and in this research work, it was decided that the analysis to be done by microregion of development.

From a methodological point of view, there were used:

Fixed basis Index: $I_{FB(\%)} = (X_n/X_1) \times 100$, where: X_n is the value of the variable in the year n and X_1 , the value of the variable in the year 1.

The GDP values are expressed in the national currency named RON. According to National Bank of Romania, the exchange rate was the following in the year 2009: 1 Euro = RON 4.1892 and 1 USD = RON 2.9779 and in the year 2018: 1 Euro = RON 4.6572 and 1 USD = RON 3.9685.

Structural index, $S\%$, was used for reflecting the weight of GDP created in agriculture by microregion of development in Romania's GDP.

Graphical representations were used to visualize the trends of the calculated indicators and understand much better their evolution.

Comparisons were made to establish the differences/disparities among regions of development.

For establishing the degree of concentration/disparities, the research was based on specific indices, recognized as being the most utilized for this purpose. It is about: Herfindahl-Hirschman Index, Normalized Herfindahl-Hirschman, Gini-Struck Index and Concentration Coefficient.

Herfindahl-Hirschman Index, HHI , is defined as a common measure of market concentration, but it is often used for studying disparities regarding other aspects.

Originally developed by Hirschman in 1940s, the index was used by Herfindahl in his version in 1959, and finally recognized by its current name since 1964.

Herfindahl-Hirschman Index (HHI) was established as the sum of the squared shares of the micro-regions of development according to the formula:

$$HHI_j = \sum_{i=1}^n g_i^2 \quad (1)$$

where:

HHI_j = the territorial concentration of the j variable, respectively GDP created in agriculture and $i = 1, 2, 3, \dots, n$, representing the eight microregions of development; g_i = the share of each region in the total j indicator taken into consideration at the national level. g_i was calculated based on the formula:

$$g_i = X_{ij}/X_j \quad (2)$$

where:

X_{ij} is the value of the j indicator in the i region and X_j is the value of the indicator j at the country level, including the values for all the 8 regions.

The HHI values have been interpreted as follows: $HHI < 0.01$ reflects a high uniformity for the j variable among regions; $HHI < 0.15$ reflects an unconcentrated status of the j variable; HHI between 0.15 and 0.25, that is: $0.15 < HHI < 0.25$ reflects a moderate concentration of the j variable; $HHI > 0.5$ reflects a high concentration, meaning large disparities among regions for the j variable

However, in this case, the HHI values vary between 0.125, when all the 8 regions have the same share and there are no inequalities in the territory among regions and $HHI = 1$, when the j indicator is supposed to be concentrated in only one region.

When HHI increases from a year to another in the chronological series, we may affirm that it is a trend of concentration and attenuation of the territorial disparities.

The use of HHI has the advantage that it is based on just a simple method of calculation, but it also has the disadvantage that it hides the variation in size and number of the regions.

Herfindahl-Hirschman Index Normalized, HHI^N , was calculated with the formula:

$$HHI^N = (H_j - 1/n) / (1 - 1/n) \quad (3)$$

Gini-Struck Coefficient (GSC) was used to reflect the spatial disparities among regions taking into consideration the HHI values and the number of regions according to the formula:

$$GSC_j = \sqrt{\frac{n \sum_{i=1}^n g_i^2 - 1}{n-1}} \quad (4)$$

The GSC values vary between 0 and 1, $GSC \in [0, 1]$.

The interpretation of the GSC values is the following one: $GSC = 0$ shows that there are no differences among regions, that is, it is a perfect equity regarding the dispersion of the j indicator in the territory; $GSC > 0.3$ means a relative concentration of the j indicator; $GSC > 0.5$ reflects a high concentration of the j indicator in the territory; $GSC = 1$ reflects a perfect inequality among regions.

Concentration Coefficient (CC) is built up and represent an adjusted alternative for GSC_j , taking into account the number of regions in order to eliminate the variations among them, as shown by the formula:

$$CC_j = [n/(n-1)] GSC_j \quad (5)$$

The obtained results were tabled and then correspondingly interpreted. At the end of the study, the main ideas resulting from this research were highlighted.

Results and Discussions

Brief statistics on Romania's agriculture

-*Agricultural area*- 14.63 million ha that is 61% of the country area.

-*The distribution of agricultural land by microregion*: North West 14.1%, Center 12.9%, North East 14.6%, South East 15.9%, South Muntenia 16.7%, Bucharest-Ilfov 0.7%, South West Oltenia 12.3%, and West 12.8%.

-*Agricultural production value*: in the year 2018, RON 86.34 million at the country level, of which: NV 12.2%, C 10.3%, NE 15.7%, SE 17.7%, S Muntenia 18.9%, Bucharest Ilfov 1.4%, SV Oltenia 12.4%, and W 11.4% as calculated based on the data from National Institute of Statistics (2021).

-*Output of agricultural industry at basic and producer prices*, Euro 18,553.7 million in the year 2018 as shown by Eurostat (2021a).

-*Gross value added in agricultural industry at basic prices*, in 2018: Euro 8,328.45 million.

-*Total labor force input in agriculture in 2018*: 1,474 1,000 AWU (annual work units) as mentioned by Popescu (2019) and Eurostat (2021b).

-GDP in agriculture increased by +79.2% from RON 530.8 Billion in 2009 to 951.7 Billion in 2018.

- The share of GDP in agriculture in Romania's GDP registered a decline from 6.1% in 2009 to 4.3% in 2018 as shown by Popescu (2020) and National Institute of Statistics (2021).

Agriculture is the main occupation in the rural areas of Romania, where about 44% of the population is living.

Romanian agriculture is of a subsistence and semisubsistence type, running in small sized agricultural holdings of about 3.7 ha/farm in average, which are dominant. The share of the family farming is over 97%, and in consequence the average performance is lower than in other EU countries, but, taking into account the large cultivated area, in some cases, total production like in case of cereals grains and sunflower oilseeds is high and Romania is among the top producing countries in the EU.

Farm size in terms of standard output is the smallest in the EU.

Evolution of GDP in Romania's agriculture. In the period 2009-2018, GDP produced in agriculture increased from Lei 32.37 Billion in 2009 to Lei 41.22 Billion in 2018, meaning a surplus of + 27.3%. Romania's GDP increased by 79.26 % in the same interval from Lei 530.89 Billion in 2009 to Lei 951.17 Billion in 2018.

However, from a year to another, the indicator level had a sinuous evolution, depending on many factors. As a result, the share of GDP produced in agriculture declined from 6.1% in 2009 to 4.3% in 2018 (Fig. 1).

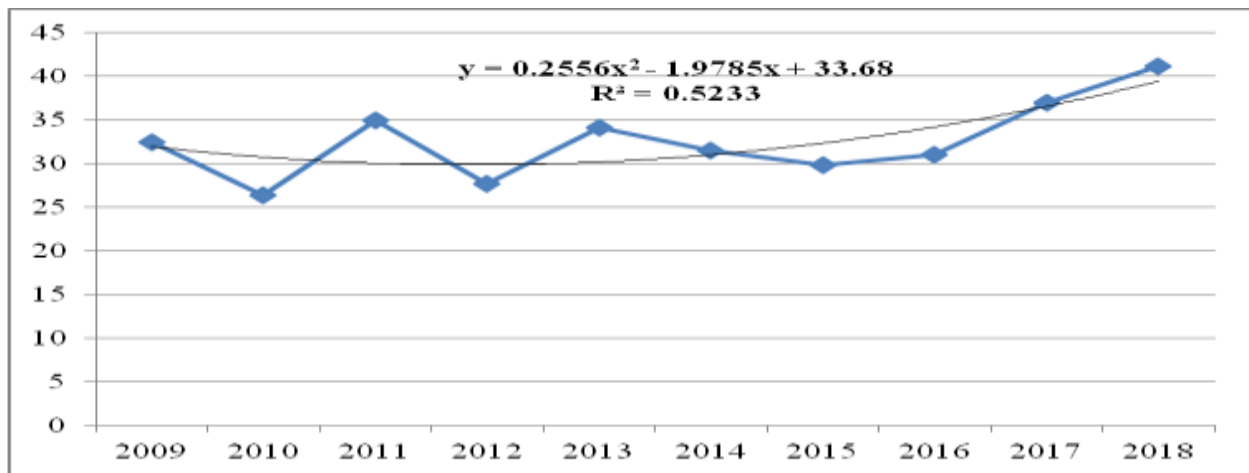


Fig. 1. Dynamics of GDP in Romania's agriculture, 2009-2018 (Lei Billion current prices)

Source: Own design based on the data from National Institute of Statistics (2021).

Evolution of GDP by micro-region

Among the eight micro-regions there are some differences in GDP value. The curves presented in Fig. 2 reflects the following situation: South Muntenia region occupies the top position, being followed by South East region and North East. These are the regions with the highest GDP produced in agriculture.

Also, another group of regions is formed of: South West Oltenia, North West, West and Center, where the values of GDP are lower compared to the first group of regions.

Finally, far away from all the regions, it is Bucharest-Ilfov which is an atypical area due to the fact it includes the capital of the country, and agriculture is a field of less importance compared to other economic branches, and in consequence its contribution to GDP (Fig. 2).

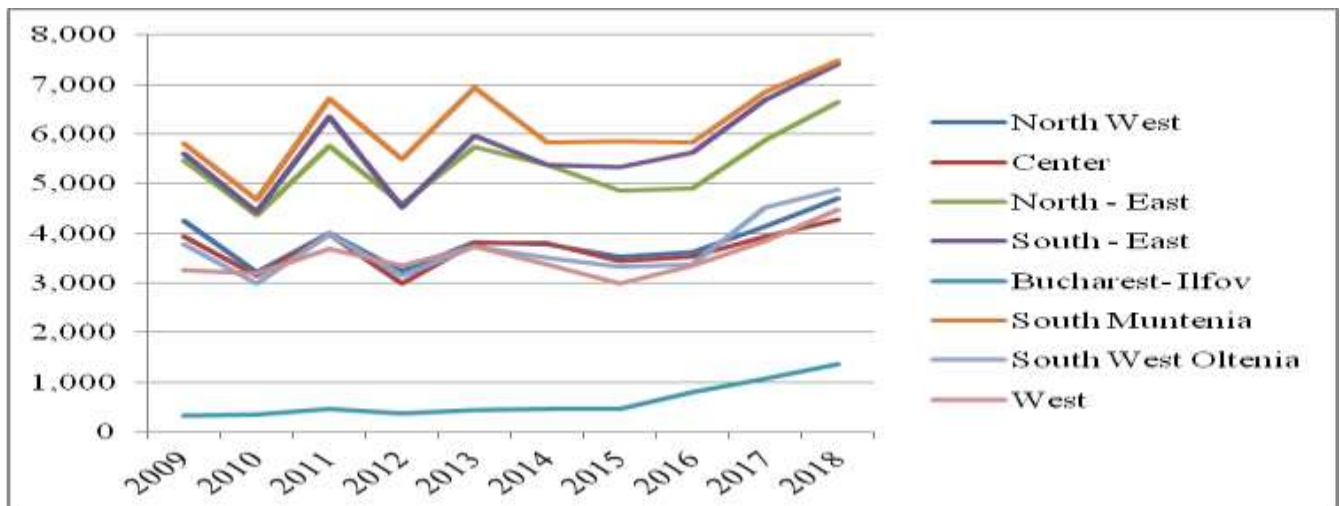


Fig. 2. Dynamics of GDP in Romania's agriculture by micro-region, 2009-2018 (Lei Billion current prices)

Source: Own design based on the data from National Institute of Statistics (2021).

Analysis of the concentration degree of GDP produced in agriculture by region of development

(a) Herfindahl-Hirschman Index, HHI

The value of HHI for GDP in agriculture had different levels by region.

The highest HHI was registered in South Muntenia, followed by South East region, West region and South West Oltenia. In these macroregions, the HHI recorded a slight increase in the interval 2009-2018. This is explained by the fact that these

regions are the most suitable microregions for agriculture, here it is obtained the highest production. There is a trend of a slight concentration of GDP produced in agriculture in these microregions.

In North West, Center, and North East microregions, HHI value registered a declining trend, which reflects that GDP obtained in this macroregions has a reduced concentration and the disparities compared to the other four regions increased. As Bucharest Ilfov microregion has not a high contribution to GDP in agriculture it was not taken into consideration (Fig. 3).

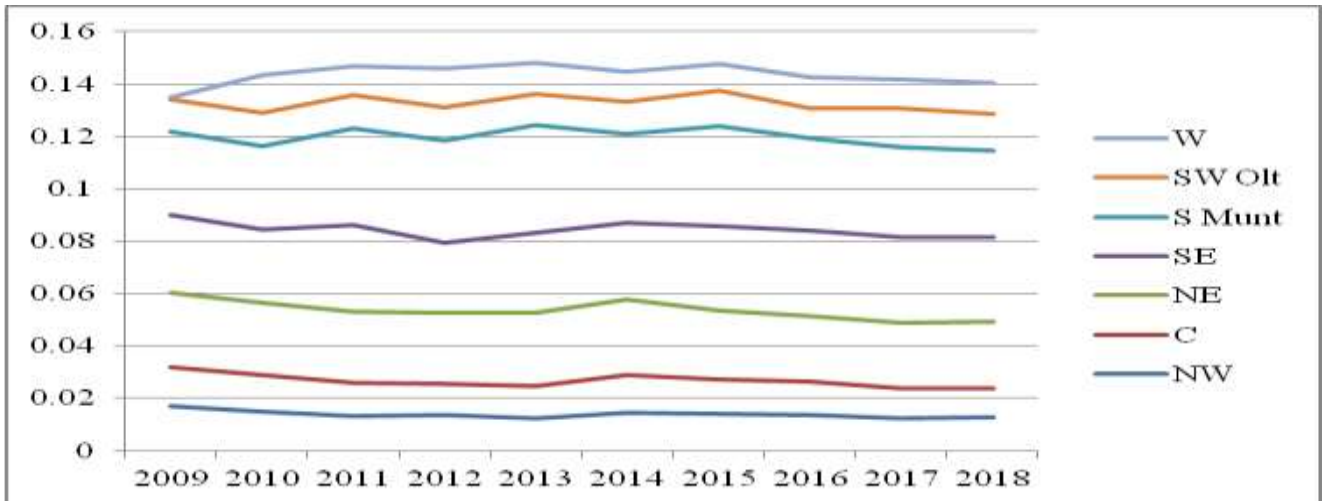


Fig. 3. Herfindahl-Hirschman index for GDP in agriculture by microregion, Romania, 2009-2018

Source: Own design and calculation based on the data from National Institute of Statistics (2021).

At Romania's level, the degree of concentration of GDP produced in agriculture, in terms of HHI, varied between HHI = 0.1352 in 2009 and HHI = 0.1414 in 2018, reflecting a slight growth.

However, after a period of growth during the first four years of the analysis, HHI of GDP in agriculture reached the peak of 0.1542 in the year 2013, but after that, HHI decreased to 0.1414 as mentioned for 2018.

All the values of HHI are below 0.15 in almost all the analyzed years, reflected the lack of concentration of GDP obtained in agriculture, except the year 2013 when HHI had a higher value than 0.15, more exactly 0.1542. But this was an exception, and the value was very close of the threshold 0.15 (Fig. 4).

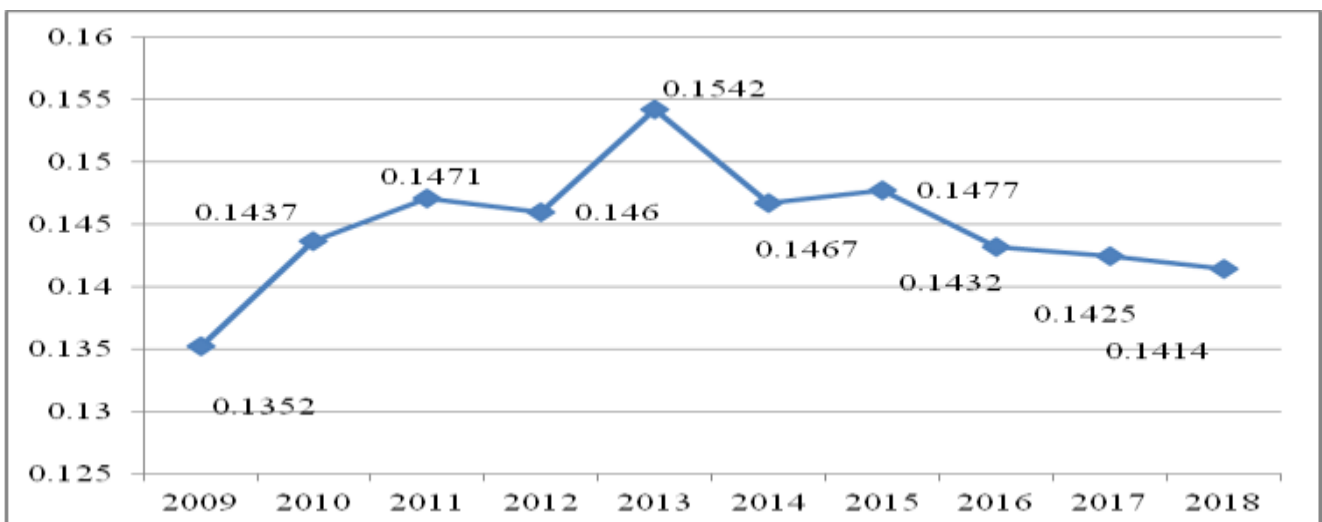


Fig. 4. Herfindahl-Hirschman Index for GDP in agriculture, Romania, 2009-2018

Source: Own design and calculation based on the data from National Institute of Statistics (2021)

The fluctuations up and down could be explained by the climate conditions closely linked to agricultural production and price volatility. In the favorable years for agriculture, production is higher and the price is smaller, due to demand/offer ratio. In the less favorable years, production is lower and price usually is higher as the demand exceeds the supply.

(b) *Normalized Herfindahl-Hirschman Index, HHI N* registered values which emphasize the growth of GDP concentration but by small steps within the microregions South Muntenia, South East region, West region and South West Oltenia. Also, slight fluctuations were noticed from a year to another, which showed a low tendency of concentration.

The lowest HHI N values were recorded in North West, Center, and North East microregions, where the index values had also a decreasing tendency.

By microregion, GDP concentration degree reflected an increasing trend in the period 2009-2018 from HHI N = 0.0114 in 2009 to HHI N = 0.0187 in 2018. A peak of this indicator accounting for 0.0333 was noticed in the year 2013, but then the values varied up and down till 2018 (Fig. 5).

The values of HHI N are higher than the ones of HHI and the discrepancies among microregions look to be relatively small.

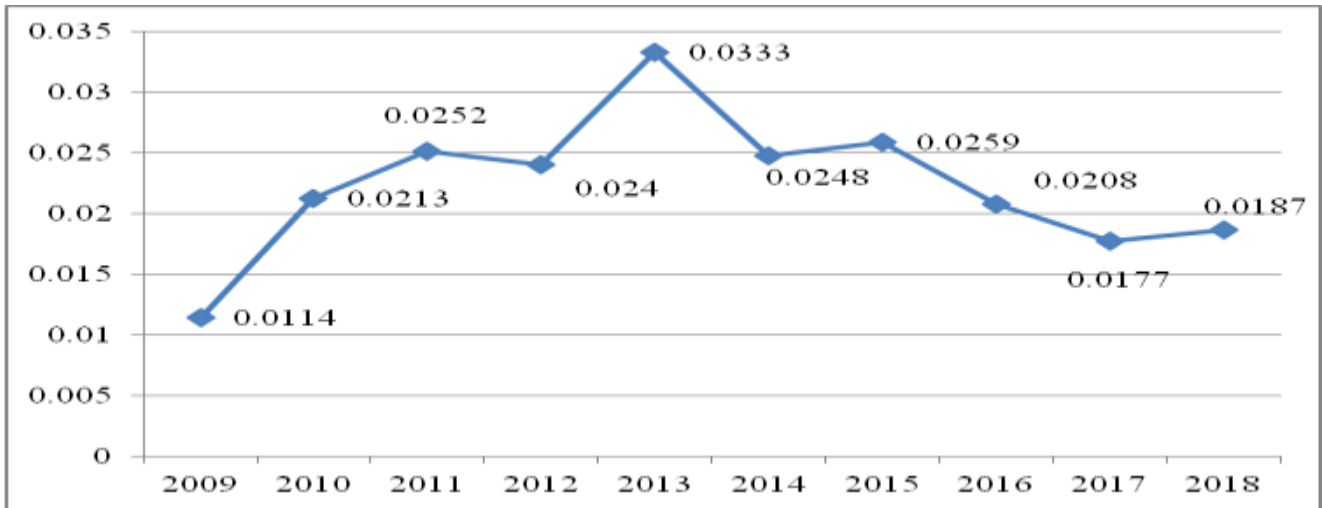


Fig. 5. Normalized Herfindahl-Hirschman Index for GDP in agriculture, Romania, 2009-2018

Source: Own design and calculation based on the data from National Institute of Statistics (2021).

(c) *Gini-Struck Index* ranged between GS = 0.1079 in 2009 and GS = 0.1369 in 2018 reflecting a relatively tendency of concentration by microregion. The peak of GS was registered in the year 2013, GS = 0.1826. Also, a slight trend of concentration was noticed in four microregions: South Muntenia, South East region, West region and South West Oltenia. A slight decline of GS was noticed in case of three microregions: North West, Center, and North East.

The values of Gini-Struck Index were smaller than 0.3 which reflects that there were no differences among microregions, therefore we may appreciate an uniformity in obtaining GDP from agricultural activities (Fig. 6).

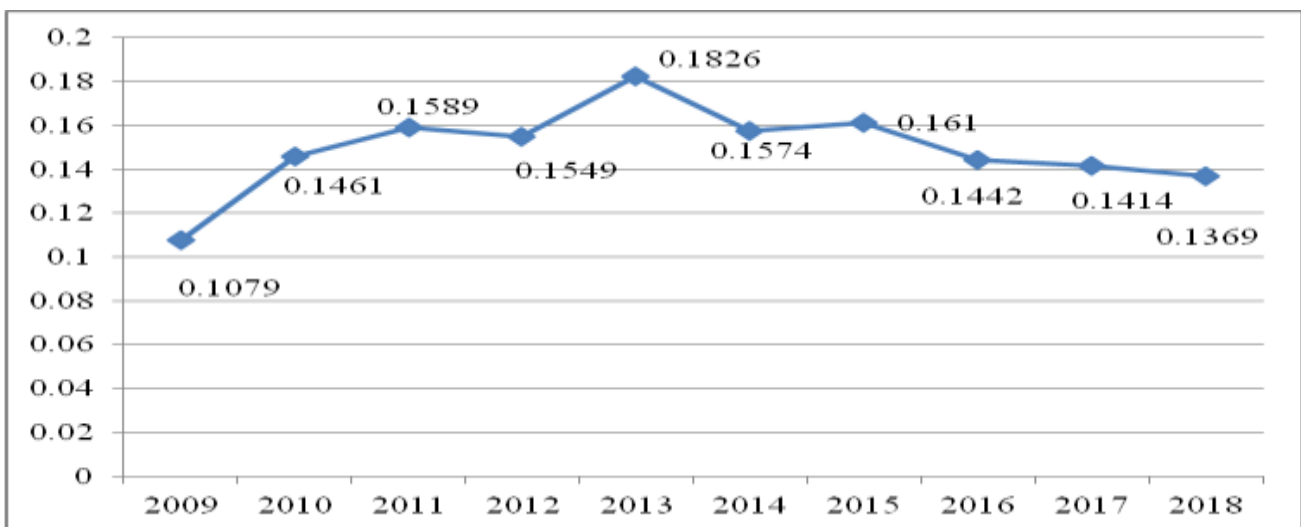


Fig. 6. Gini-Struck Index for GDP in agriculture, Romania, 2009-2018

Source: Own design and calculation based on the data from National Institute of Statistics (2021).

(d) *Concentration Coefficient, CC_j*, had a similar dynamics like the other previous indicators reflecting the concentration process of GDP and also a few disparities among two groups of microregions, but not essential.

At the national level, it registered values which ranges between $CC = 0.1233$ in 2009 and $CC = 0.1564$ in 2018 showing a slight increase. The peak of CC was 0.2086 registered in the year 2013.

The general increasing trend in CC was observed in South Muntenia, South East region, West region and South West Oltenia. But a slight decreasing tendency of CC was registered in North West, Center, and North East microregions (Fig. 7).

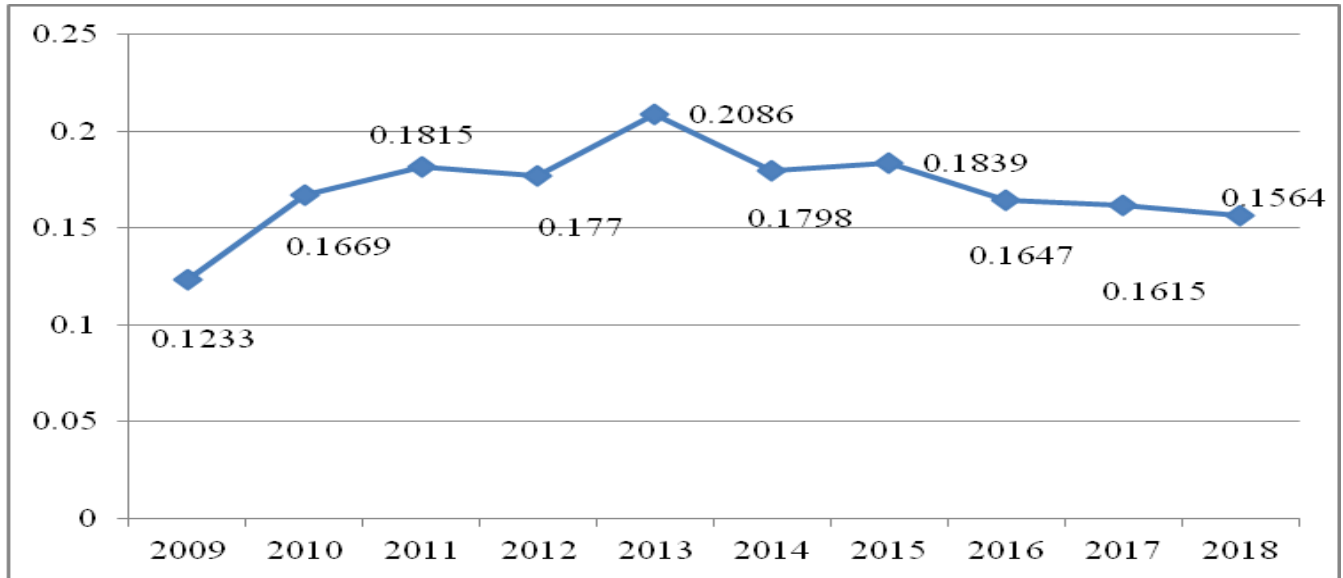


Fig. 7. Concentration Coefficient for GDP in agriculture, Romania

Source: Own design and calculation based on the data from National Institute of Statistics (2021).

Conclusions

The obtained results regarding the analysis of the degree of concentration in GDP realized in agriculture by means of the specific indices: Herfindahl-Hirschman Index, Normalized Herfindahl-Hirschman Index, Gini-Struck Index and Concentration Coefficient reflected an increasing trend from a year to another in the territory regarding GDP during the analyzed period. However, the low values of all the concentration indicators taken into consideration allowed to conclude that there is a relatively uniformity among microregions, despite a few deviations which appeared in a few years.

By microregion of development, we could also affirm that the microregions could be divided into two categories: one consisting of South Muntenia, South East region, West region and South West Oltenia microregions, where the concentration of GDP has a trend to grow, and another one including North West, Center, and North East microregions where GDP has a slight tendency to go down. But we can not discuss of a huge gap between these two groups, on the contrary its is about just a little difference, as long as the values of the concentration indices are small and reflect much more uniformity than disparities.

The study proved the importance of knowing the real situation in the territory, as long as the implementation of the Common Agricultural Policy has to sustain all the regions to benefit of the EU funds for increasing productivity, efficiency and competitiveness of this branch in the economy. The allocation of the funds should be based on the local needs.

The present analysis could be a starting point for ongoing the research for establishing various scenarios for the forecast of GDP which is going to be produced in the next years. More than this, for establishing the future strategy for a sustainable of agriculture in all the regions of Romania, the peculiarities of each region should be not denied, therefore the policy makers have to establish suitable economic mechanisms and policies adapted to the existing peculiarities.

References

- Andrei, J.V., and Popescu, G.H. (2014), 'Economy in Romania and the Need for Optimization of Agricultural Production Structures', Peter Lang Publisher.
- Antonescu, D. (2010), 'The Analysis of Regional Disparities in Romania with Gini-Struck Coefficients of

Concentration', *Economic Review*, No. 2. [Online] [Retrieved Oct. 10th, 2021], <http://www.revecon.ro/articles/2010-2/2010-2-8.pdf>

- Antonescu, D. (2020), 'Territorial inequalities and convergence – techniques and analysis methods', MPRA Paper No. 98505, [Online] [Retrieved Oct. 10th, 2021], https://mpra.ub.uni-muenchen.de/98505/1/MPRA_paper_98505.pdf
- Brown, A. (1994), 'Modelling turbulent sheared convection'. Ph.D. thesis, University of Surrey.
- Eurostat. (2021a), 'Output of agricultural industry-basic and producer prices', *Eurostat*. [Online] [Retrieved Oct. 10th, 2021], ec.europa.eu/eurostat/databrowser/view/tag00102/default/table/lang=en,
- Eurostat. (2021b), 'Agricultural labor input', *Eurostat*. [Online] [Retrieved Oct. 10th, 2021], appsso.eurostat.ec.europa.eu/nui/show.do?dataset=aact_ali01&lang=en
- Farris, F. A. (2010), 'The Gini Index and Measures of Inequality', *The American Mathematical Monthly*, 117(10), 851-864.
- Gastwirth, J.L. (1971), 'Notes and comments. A general definition of the Lorenz Curve', *Econometrica*, 39(6):1037-1039.
- Gini, C. and Ottaviani, G., (1955), 'Memorie di Metodologia Statistica', Universita di Roma. Pizetti, E., Salvemini, T., Eds. English Translation in Metron; Libreria Eredi Virgilio Veschi: Rome, Italy, 63, 33–38.
- Goschin, Z. (2015), 'Territorial Inequalities and Economic Growth in Romania. A Multi-factor Approach', *Procedia Economics and Finance*, 22, 690-698.
- Grigoras, M.A. (2016a), 'Trends in Romania's animal production', *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*, 16(4), 137-148.
- Grigoras, M.A. (2016b), 'Trends in Romania's agricultural production', *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*, 16(4), 183-191.
- Grigoras, M.A. (2017), 'Research on the trends in animal production in the last decade in Romania', *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*, 17(4), 131-142.
- Hayes, A., Rathburn, P., and Kindness, D. (2021), 'Herfindahl-Hirschman Index', *Investopedia*, [Online] [Retrieved Oct. 10th, 2021], <https://www.investopedia.com/terms/h/hhi.asp>
- Herfindahl, O.C. (1959), 'Copper Costs and Prices: 1870 – 1957'. The John Hopkins Press. Baltimore.
- Hirschman, A.O. (1964), 'The Paternity of an Index'. *American Economic Review* 54, 761-762.
- Ionescu, C.A., Paschia, L. and Coman, M.D. (2019), 'Romanian Agriculture and Sustainable Development', Proceedings of 11th LUMEN International Scientific Conference CATES, ISBN 978-1-910129-19-7, 23-24 November 2018, Targoviste, Romania, 7(1).
- Kjeldsen-Kragh, S. (2007), 'The Role of Agriculture in Economic Development'. Copenhagen Business School Press. Copenhagen. Denmark.
- Mackie, A. B. (1964), 'The Role of Agriculture in Economic Growth and Development', *Illinois Agricultural Economics*, 4(3), 1-10.
- Meijerink, G. and Roza, P. (2007), 'The role of agriculture in economic development', Wageningen University Press.
- National Institute of Statistics, 2021, 'Tempo online data base'. *National Institute of Statistics*. [Online] [Retrieved Oct. 10th, 2021], www.insse.ro

- Nica, E., Sima, V., Gheorghe, I., Drugau-Constantin, A. and Mirica (Dumitrescu), C.A. (2018), ' Analysis of Regional Disparities in Romania from an Entrepreneurial Perspective', *Sustainability*, 10, 3450. [Online] [Retrieved Oct. 10th, 2021], doi:10.3390/su10103450
- Nitescu, A., and Dobre-Baron, O. (2018), 'Peculiarities of the Romanian agricultural sector in the current period', *Annals of the University of Petroșani, Economics*, 18(1), 133-142.
- Popescu, A. (2015a), 'Research on the distribution and concentration of the farms cultivating maize for grains in Romania using the Gini Coefficient'. *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*, 15(3), 261-264.
- Popescu, A. (2015b), 'Analysis of the dynamics of Gross Domestic Product and of its main factors of influence in Romania's agriculture'. Proceedings of 25th International Business Information Management Association (IBIMA), ISBN: 978-0-9860419-4-5, 7-8 May, 2015, Amsterdam, The Netherlands, 1379-1393.
- Popescu, A. and David, L. (2015), 'The use of the Cobb-Douglas production function to analyze the relationship between GDP, Fixed assets and Employment in Romania's Agriculture', Proceedings of 25th International Business Information Management Association (IBIMA), ISBN: 978-0-9860419-4-5, 7-8 May, 2015, Amsterdam, The Netherlands, 1366-1378.
- Popescu, A., (2016a), 'Research on concentration of pork production in Romania', *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*, 16(1), 405-410.
- Popescu, A. (2016b), 'Research on the concentration of tourist arrivals in Romania', *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*, 16(1), 425-430.
- Popescu, A. (2017a), 'Convergence of Regional Development in Romania in Terms of Gross Domestic Product', Proceedings of 29th International Business Information Management Association (IBIMA), ISBN: 978-0-9860419-7-6, 3-4 May 2017, Vienna, Austria, 1279-1293.
- Popescu, A., (2017b), 'Concentration of apple production in Romania in the period 2007-2016', *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*, 17(3), 323-331.
- Popescu, A., (2018), 'Analysis of Agro-tourism Concentration in Romania', Proceedings of 32nd International Business Information Management Association (IBIMA), ISBN: 978-0-9998551-1-9, 15-16 November 2018, Sevilla, Spain, 4315-4329.
- Popescu, A. (2019), 'Trends in Labour Productivity in Romania's Agriculture', Proceedings of 34th International Business Information Management Association (IBIMA), ISBN: 978-0-9998551-3-3, 13-14 November 2019, Madrid, Spain, 9999-10016.
- Popescu, A. (2020), 'Contribution of Agriculture to Romania's Gross Domestic Product', Proceedings of 36th International Business Information Management Association (IBIMA), ISBN: 978-0-9998551-5-7, 4 -5 November, 2020, Granada, Spain, 2207-2220.
- Postoiu, C., and Busega, I. (2015), 'Romania's agriculture and its role in the convergence process', *Global Economic Observer*, 3(1), 33-43.
- Săvoiu, G., Crăciuneanu, V., and Țaicu, M. (2010), 'A new method for concentration analysis and market diversification', *Romanian Statistic Review*, 2., 21-27.
- Van Egeraat, C., Edgar Morgenroth, E., Kroes, R., Curran, D. and Gleeson, J. (2015), 'A Measure for identifying substantial geographic Concentrations', *MPRA Paper No. 65954*, [Online] [Retrieved Oct. 10th, 2021], <https://mpra.ub.uni-muenchen.de/65954/>