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EVOLUTION OF THE ECONOMIC ACCOUNTS FOR AGRICULTURE

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Abstract

According to the data regarding the economic accounts for agriculture published on 16 November 2018 by Eurostat, (the Statistics Office of the European Union), the total agricultural production obtained in the European Union in 2017 was 6.2% higher than in 2016, amounting to 432.6 billion euro at basic prices.. In 2017, the equivalent of 56% of the value of the agricultural production generated was used for intermediary consumption, while the gross added value represented 44%. The present paper is looking at how a mathematical algorithm used to study the impact of the agricultural production on the GDP can represent a tool for analysing and assessing the evolution of the GDP..The conclusion of the article is that the current fluctuations of the agricultural production trigger variations of the GDP, which means that agriculture is maintaining its impact on the GDP.

Key words*:* *agricultural production, gross domestic product, national accounts, mean, dispersion, confidence intervals*

INTRODUCTION

The present article aims at analysing the economic accounts for agriculture starting from the data supplied by Eurostat for the countries which obtained the highest agricultural production in 2017, namely Germany, Italy, France, Spain, the Netherlands, UK, Romania and Poland.
It is worth mentioning that there is an interconnection among the four types of resources used in the agricultural processes, namely earth, technical equipment, labour and money. [6].
The economic development is measured using the GDP, an indicator which can also show how the countries in a certain region have evolved and what macro-economic activities they have performed, thus allowing for a comparison to be drawn among them.
The data published by Eurostat in November 2018, based on an analysis of the economic accounts for agriculture for the year 2017, show that the overall agricultural production of the European Union stood at 432.6 billion euro at basic prices, this representing an increase by 6.2% as compared to 2016. [5]
In 2017, the intermediate consumption accounted for the equivalent of 56% (or 244.1 billion euro) of the value of the agricultural production generated. The remaining 44% (or 188.5 billion euro) was represented by the GVA (gross added value), which is the difference between the value of the production and that of the intermediate consumption.
Lately, thanks to the development of knowledge, machinery and the chemical industry, agriculture has undergone notable changes. A comparison between the situation of the EU agricultural industry in two consecutive years (2016 and 2017) reveals a substantial growth of the value of the agricultural production. This, combined with a marginal rise of just 1.8% of the intermediate consumption, led to a significant increase of the GVA by 12.4% in 2017 as compared to 2016.

Of all the EU Member States, France ranked first in terms of agricultural production, with 72.6 billion euro in 2017, representing 17% of the total. The second place was occupied by Germany with 56.2% (or 13%), followed by Italy with 55.1 billion euro and Spain with 50.6 billion euro.

The agricultural production of the UK was almost 20 billion euro less than that of Spain, standing at 31.8 billion euro. Next came the Netherlands, which obtained a total agricultural production worth 28.9 billion euro. On the last two places in this top were Poland (24.9 billion euro) and Romania (17.5 billion euro). [7]

In a rapidly changing world, the EU wants to become a smart, sustainable and inclusive economy [8]. In almost all the EU Member States, the value of the agricultural production increased in 2017. The country which experienced the highest growth was Estonia (up by 18.2%), followed by Ireland with a 13.6% rise, Romania (+ 13.2%), UK (+ 12.6%) and Poland (+ 11.1%). On the other hand, there were also countries which saw a decline in the value of their agricultural production, such as Slovenia (-4.7%) and Malta (-3.1%), while the situation in Croatia and Slovakia remained unchanged.

As far as Romania is concerned, there were increases in all the sectors, especially in the vegetal one. The year 2017 brought a rise in the output of plant breeding farmers by 17.9% compared to 2016, while the zootechnical services went up by 5.1% and the production of zootechnical farms saw a rise of 8.8%. Nevertheless, the data published by Eurostat, indicate that there was a 7.2% decrease in secondary non-agricultural services (for example in agro-tourism). The first nine months of the year 2018 proved to be favourable for the Romanian agriculture, with excellent cereal crops.

MATERIALS AND METHODS

The proposed analysis will use the data published by Eurostat regarding the economic accounts for agriculture.

Table 1. Economic accounts for agriculture (ITM_NEWA - cereals including seeds, INDIC_AG - production value at basic price)- current values (Million Euro)

Country	2015	2016	2017
Germany	7,127.90	5,653.63	6.322.02
Spain	3,607.41	3,823.77	2,983.64
France	11,253.30	7,737.63	9,675.89
Italy	4,233.03	3,995.17	3,472.45
Netherlands	339.40	266.55	285.49
Poland	3,545.09	3,530.89	3,955.24
Romania	3,316.34	3,448.48	4,203.15
UK	4,092.24	2,941.78	3,676.76

Source: https://ec.europa.eu/eurostat/web/agriculture/data/database, [2]

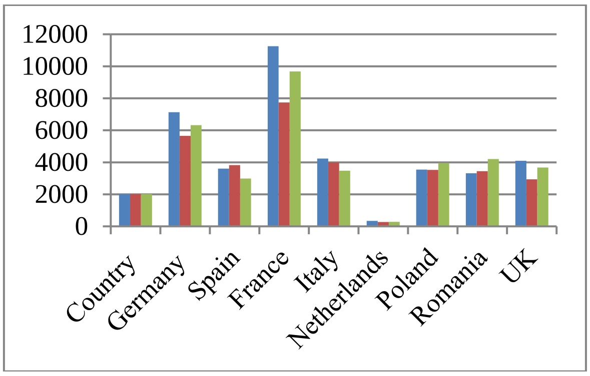

Fig. 1. Evolution of economic accounts for agriculture (ITM_NEWA - cereals including seeds, INDIC_AG - production value at basic price) , (Million Euro), Source: Eurostat, https://ec.europa.eu/eurostat/web/agriculture/data/database [2].

The mathematical algorithm used is structured as follows [3]:

In order to estimate dimensions we will be using confidence intervals. In most cases, an isolated (punctual) value can only be satisfactory if we refer to the variation domain and to the probability corresponding to it. Considering the fact that the sample estimators are random variables, one of the most important issues that arises consists in expressing the estimate accuracy or the estimate probability. However, the value of the P probability covers a certain interval (x_1, x_2) according to the relation:

$$P = Prob(x_1 < X < x_2) = \int_{x_1}^{x_2} f(x)dx \qquad (1)$$

to which the respective parameter belongs. In this way, a certain interval is established, called a confidence interval, has the property of containing the true value of the respective dimension with the P probability. Let a_0 be the true value of a characteristic for which a punctual estimate $\hat{a}$ is obtained through sampling experiments. We consider that the deviation $|\hat{a} - a_0|$ is lower than a ε value with a very high β probability (0.90, 0.95 or 0.99):

$$P(|\hat{a} - a_0| < \varepsilon) = \beta \qquad (2)$$

or

$$P(\hat{a} - \varepsilon < a_0 < \hat{a} - \varepsilon) = \beta = 1 - \alpha \qquad (3)$$

The punctual value $\hat{a}$ is calculated based on a sample and it defines the limits of the confidence interval: $a_1 = \hat{a} - \varepsilon$ and $a_2 = \hat{a} + \varepsilon$.

Considering the risks for the lower part α_i and the upper part α_s to be unequal, the interval limits are defined by the relations $P(a_0 > a_2) = \alpha_s$ and $P(a_0 > a_1) = \alpha_i$, with the significance level $\alpha = \alpha_i + \alpha_s$.

In order to analyse the confidence interval for the values presented above in Table 1, the confidence interval will be analysed for the theoretical mean μ of a characteristic with normal distribution, where the dispersion σ is known.

The necessary stages are the following:

(a)We take a population to be analysed with an X characteristic having a normal distribution $N(\mu, \sigma^2)$.

(b)A volume sample n is extracted from this population. Let us estimate the μ mean with a 95% confidence interval with symmetrical bilateral risk. The significance level is α=0.05.

(c)We know that the sample mean $\bar{x}$ has a normal distribution $N(\mu, \sigma^2/n)$.

(d)Since the μ parameter is unknown, a confidence interval will be built for this dimension, its (-z, z) limits being established with the help of the Laplace distribution.

We know that the random variable:

$$z = \frac{\mu - \bar{x}}{\sigma / \sqrt{n}} \qquad (4)$$

has a normal distribution N (0,1).

(e)According to the distribution table, the 95% probability is defined as the (1.96; +1.96) interval.

In this way we obtain the confidence interval with the P probability $P(-1.96 < z < 1.96) = 0.95$

Starting from this relation, we can write the double inequality:

$$-1.96 < \frac{\mu - \bar{x}}{\sigma / \sqrt{n}} < 1.96 \qquad (5)$$

which leads us to the interval limits:

$$\bar{x} - 1.96\frac{\sigma}{\sqrt{n}} < \mu < \bar{x} + 1.96\frac{\sigma}{\sqrt{n}} \qquad (6)$$

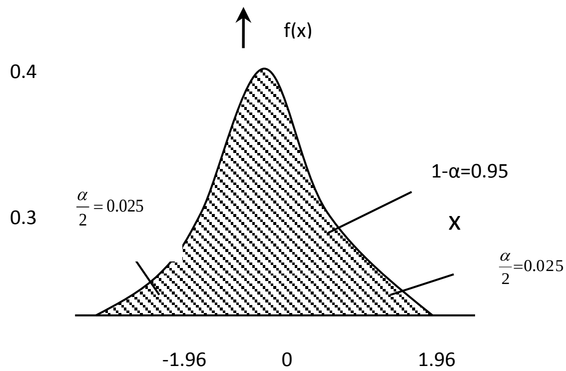

Fig. 1. Confidence interval with symmetrical bilateral risk interval having the significance level α=0.05.
Source: Ifrim, A. M., 2016, Mathematical tools in quality engineering – Application in project management, Lap Lambert Publishing, Saarbrücken, Germany.

(f) The 95% confidence interval has thus been built for μ. The result can also be expressed as:

$$\mu = \bar{x} \pm 1.96\frac{\sigma}{\sqrt{n}} \qquad (7)$$

the interval being symmetrical in relation to the $\bar{x}$ value.

RESULTS AND DISCUSSIONS

It is common knowledge that almost half of the land in the EU is used for agriculture. Consequently, agriculture is indeed very important for the environment. Throughout

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the centuries, it has contributed to the creation and preservation of a variety of valuable semi-natural habitats. Nowadays, they are shaping the diversity of the landscapes in the EU and are sheltering a rich and varied wild flora and fauna. [4]

An analysis of how the agricultural production evolved in the selected countries should take into account all the factors that can have an impact on the final results. [1].

The evolution of the agricultural production in the Member States in the past three years can provide the necessary data for estimating its evolution in the years to come.

In order to apply the previously described methodology, the main indicators must be calculated.

The next table presents the results of the mean and of the dispersion corresponding to the values of the agricultural production in the eight countries.

Table 2. Mean and dispersion values of agricultural production

Country	$\bar{x}$	σ
Germany	6,367.9	4,562.861
Spain	3,471.6	2,493.2535
France	9,555.6	6,982.5242
Italy	3,900.2	2,785.18
Netherlands	297.15	213.48714
Poland	3,677.1	2,611.229
Romania	3,656.0	2,629.0749
UK	3,570.3	2,590.9023

Source: Own determination.

One can observe that there has been a steady growth.

What we are trying to find out next are the intervals between which the respective countries should increase their agricultural production so that they maintain their growth and continue to exert the same influence on the economy as a whole.

Using the previously indicated values, we can calculate the 95% confidence interval for μ.

The result is presented in the following Table 3.

The analysis shows the confidence intervals for the evolution of agriculture in the presented countries, so that this evolution should continue to be positive and capable of influencing the GDP of the analysed countries.

Table 3. Confidence intervals

Country	$\bar{x} - 1{,}96\frac{\sigma}{\sqrt{n}} < \mu < \bar{x} + 1{,}96\frac{\sigma}{\sqrt{n}}$
Germany	2,716.80 $< \mu <$ 10,018.9
Spain	1,476.59$< \mu <$5,466.625
France	3,968.42$< \mu <$15,142.79
Italy	1,671.61$< \mu <$6,128.825
Netherlands	126.32$< \mu <$467.972
Poland	1,587.66$< \mu <$5,766.492
Romania	1,552.29$< \mu <$5,759.688
UK	1,497.11$< \mu <$5,643.414

Source: Own determination.

The evolution of the GDP should reflect the evolution of the value of the agricultural production. Thus, the GDP had the evolution as presented in Table 4.

Table 4. Evolution of GDP (Million Euro)

Country / Year	2015	2016	2017
Germany	2,745,337.0	2,847,740.0	2,954,696.0
Spain	980,992.0	1,014,839.0	1,057,467.0
France	1,967,466.0	1,991,276.0	2,042,082.0
Italy	1,485,251.4	1,517,530.6	1,546,693.5
Netherlands	620,835.0	634,824.0	660,393.0
Poland	381,730.8	376,783.3	410,255.8
Romania	140,928.1	152,853.4	169,732.4
United Kingdom	2,331,146.0	2,142,877.2	2,080,119.1

Source: Eurostat, https://ec.europa.eu/eurostat/web/agriculture/data/database, [2].

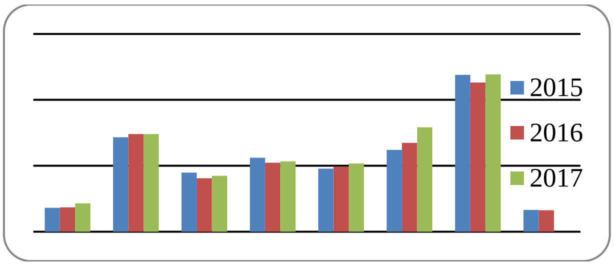

Fig.2.Evolution of GDP (Million Euro)
Source: https://ec.europa.eu/eurostat/web/agriculture/data/database, [2].

By applying the previously presented algorithm in order to establish the confidence intervals which correspond to the proportion of agriculture in the GDP, we have obtained the results showcased in Table 6.

Table 5. Percentage of agriculture in the GDP

Country / Year	2015	2016	2017
Germany	0.72	0.74	0.86
Spain	2.87	2.97	2.96
France	1.79	1.62	1.69
Italy	2.25	2.10	2.13
Netherlands	1.92	1.97	2.07
Poland	2.48	2.70	3.17
Romania	4.76	4.53	4.77
United Kingdom	0.66	0.65	0

Source: https://ec.europa.eu/eurostat/web/agriculture/data/database, [2].

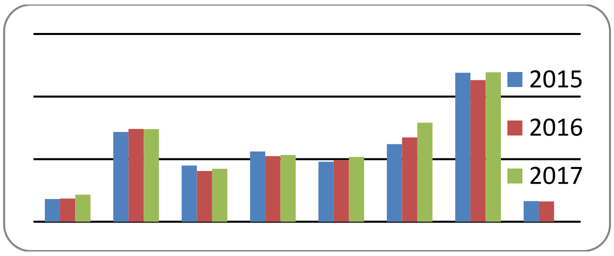

Fig.3. Evolution of the percentage of agriculture in the GDP
Source: https://ec.europa.eu/eurostat/web/agriculture/data/database, [2].

Table 6. Confidence intervals corresponding to the percentage of agriculture in the GDP

Country	$\bar{x}$	σ	$\bar{x}-1,96\frac{\sigma}{\sqrt{n}} < \mu < \bar{x}+1,96\frac{\sigma}{\sqrt{n}}$
Germany	0.77	0.45	0.33< μ <1.22
Spain	2.93	1.69	1.27< μ <4.59
France	1.70	0.98	0.74< μ <2.66
Italy	2.16	1.25	0.94< μ <3.38
Netherlands	1.99	1.15	0.86< μ <3.11
Poland	2.78	1.63	1.18< μ <4.38
Romania	4.69	2.71	2.03< μ <7.34
UK	0.44	0.40	0.05< μ <0.83

Source: Own determination.

Thus, one can notice the confidence intervals corresponding to the percentage of agriculture in the GDP so that agriculture should have the same impact on the GDP.
Agriculture and the food industry are essential elements of the current economy and society. In all the 28 Member States there are approximately 12 million agricultural workers, while another 4 million people are employed in the food sector. Together, the agricultural and food sectors make up 7% of the total work places and generate significant values in the GDP of the EU countries.

CONCLUSIONS

During the last decades there have been considerable changes in the EU agricultural policy meant to help the farmers cope with these challenges and react promptly to the changing attitudes and expectations of the population.
The EU institutions cooperate in order to guarantee optimal food and agricultural policies at all stages: planning, implementation, monitoring and evaluation. The national and local authorities introduce the legislation agreed upon at EU level. Through the EU budget, the funds are made available to the Member States in agreement with the norms established in the EU. Likewise, the EU monitors the way in which the legislation is enforced, as well as its effectiveness, while coordinating the amendments at the same time.
Within this context it is necessary to make a forecast of the evolution of the values of agricultural production because this implicitly allows one to analyse if the EU agricultural policy is correctly implemented.
This paper concludes that the fluctuations of the agricultural production are still triggering variations of the GDP, although the percentage of agriculture in the GDP is situated within the same range of values. This means that the agriculture is maintaining its impact on the GDP.

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