

Vine growing and production in global context

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Abstract.

Research background: The global agri-food complex changed in last years. From global scale point of view agri-food complex must face new challenges in the field of changes of natural conditions and in the field of social and trade relations. Vine growing is due to the specific demands on its production is a suitable representative of these global changes.

Purpose of the article: The aim of this paper is to investigate relationship between area of vineyards and its production in context of globalization.

Methods: Secondary data were obtained from official information sources. From the point of view of the methodological apparatus, the analysis of time series were used. Based on the selection of a suitable trend function were forecasted following two period. Furthermore, modifications to the data matrix were made. For individual variables, which were compared using appropriate statistical methods. The growth coefficient was determined. The relationship between the variables was investigated.

Findings & Value added: Based on the data, there is an obvious degressive trend in vineyards, which could be caused by the European Union standard for maximum planting up to 2 % per year. Wine production fluctuates significantly during monitoring and it is very difficult to determine its trend. In the last decade, there is possible to see an increasing of wine consumption. In future research, the relationship between consumption and production, or the production and overall performance of agriculture as a sector, may be examined.

Keywords: *globalization; vine; vineyards; vine growing; vine production*

JEL Classification: *F18; L66; Q13*

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1 Introduction

Vine growing and wine production and consumption have a long tradition in human history. Grapevines require specific climatic conditions for their successful growth and can be grown only in some areas [1]. Modern wine industry in the international context is global in nature and its state is characterized by growing complexity [2, 3]. The long-term effects of climate change, the evolving market and regulatory and trade measures increase risks and create new challenges for the wine sector in a globalized economy [3, 4].

Globally, area of vineyards decreased in period 2000-2010, this was mainly due to reduction of vineyards areas in European Union, which took place due to restrictions by European Union grubbing up programme (up till the 2010/2011 harvest). In the last decade, it is possible to observe fluctuations in world area of vineyards [5]. Despite the ongoing restrictions set by the EU, it was possible to monitor the overall growth of vineyard areas in 2013. This was mainly due to an increase in areas in some new wine regions (China, South America). Since 2016, the area of vineyards appears to have stabilized and has stabilized at approximately 7.4 million hectares. However, this fact conceals a very heterogeneous development in individual regions of the world. In 2018, 51% of the vineyard area was concentrated in five countries, namely Spain (13%), China (12%), France (11%), Italy (9%) and Turkey (6%). Since 2015, the area of vineyards in the EU has stabilized at 3.2 million hectares, which is due to undergoing and global balance between grubbing up and new planting since 2015 [5, 6].

The EU has long been involved in viticulture and winery under the Common Agriculture Policy. A reform came into force in 2008, driven by the EU's efforts to re-establish the reputation of wine from traditional wine-growing region to improve competitiveness and simplify market management rules. Subsequently, in 2013, further reform measures were taken to harmonize, simplify and make more effective the provisions of the CAP, which were adopted in previous reforms. Between 2014 and 2018, the EU represented approximately 45% of the world's wine regions [7]. In June 2018, a proposal for a new CAP reform for the period after 2020 was officially presented. The wine sector is still important segment of agriculture in EU [8].

Total world production of grapes in 2018 reached 77.8 million tons Total world production of juices and musts excluded in 2019 is estimated at 260 million hl, which means a significant decrease (11.5%) compared to 2018. However, it should be noted that in 2018, wine production compared to with previous years of exceptionally high value, mainly due to the exceptionally prosperous weather in a given year [5-7].

Globally, wine consumption is characterized by a fluctuating trend. Until the turn of the century, wine consumption declined for a long time. The period 2000-2007 can be characterized as growing and in the following period we can see a further decline in wine consumption, which was due to the global economic crisis in 2008. The last decade is characterized by slight fluctuations, when in 2018 wine consumption amounted to 244 million hl and the same value was also estimated for the following year [5]. In 2019, the EU accounted for approximately 53% of global wine consumption. However, it must be taken into account that there have been changes in EU consumption within individual Member States. In terms of trends in wine demand as is in increasing of public interest in the social and environmental aspects of consumption [9]. Wine consumers increasingly associate quality of wine with its geographical origin and sustainability of production, which includes agronomic and ecological conditions and reduction of environmental impacts [10].

The aim of this paper is to investigate relationship between area of vineyards and its production in context of globalization. The article consists of individual chapters, which logically follow each other. The Introduction defines theoretical framework of the problem. In the chapter Materials and Methods, attention is focused on the actual methodological

procedure of article processing. In the chapter Results and Discussion, the obtained results are presented and a subsequent discussion is performed. The most important findings are summarized in the Conclusion chapter.

2 Material and Methods

According to the recommendations of Hendl and Remr (2017) [11], three areas were taken into account in the elaboration of the theoretical basis, namely theories on the given topic, similar empirical studies on the given topic and methodological literature. Scientific articles, professional books and current statistical data from official sources were used to determine a suitable theoretical framework. The analysis was based on a comparison of secondary data and documents, taking into account their identification price according to the criteria according to Hendl (2009) [12].

These were mainly official reports of the International Organization of Vine and Wine [5] and Eurostat [6]. The obtained values and information were analysed and processed in order to create a suitable basis for subsequent interpretation and evaluation.

Hendl (2009) [12] defines regression analysis as the relationship between the dependent variable y -regressor and the independent variable x -regresand. The analysis is used to express the degree of dependence and allows to predict the estimate for the future. As Meloun and Militký (2013) [13] further develops, the least squares method is used to estimate the parameters of the regression model. To verify the suitability of the model, according to Fan and Huang (2001) [14] is possible to use F-test, which will evaluate quality of model. If the p value is lower than the determined significance α , we find the model as a statistically significant.

After calculating the coefficient of determination R^2 (square of the correlation coefficient), it is possible to estimate the future values of different prices using point and interval prediction. With a predetermined degree of probability, the interval in which the predicted value will be found can be determined [15]. Considered models where R^2 will be calculated are linear, logarithmic, inverse, quadratic and Compound. In case that R^2 determination would be low, growth factor and average growth factor will be used.

The following abbreviations are used in this paper: $df1$ = the numerator degrees of freedom, $df2$ = the denominator degrees of freedom, EU = European Union, OIV = International Organisation of Vine and Wine, Sig. = Significance level.

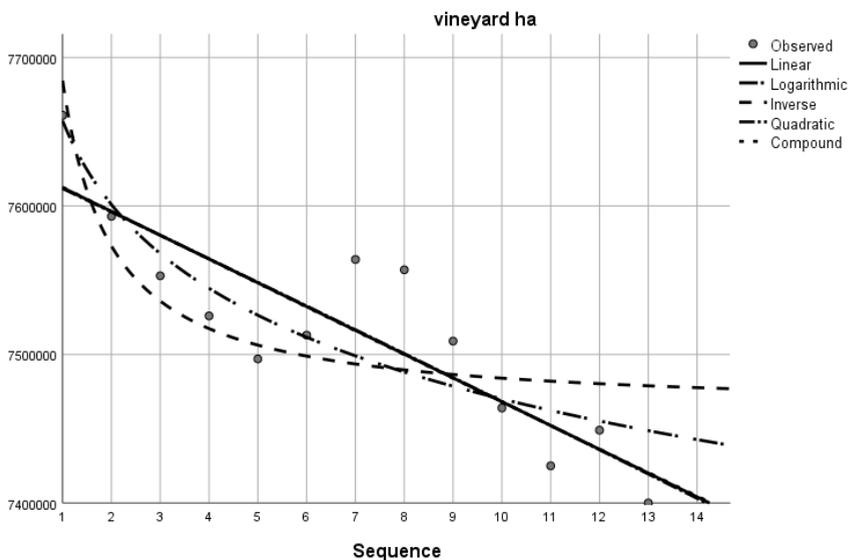
3 Results and Discussions

In the results chapter, model trends and estimates for future will be calculated. The trend for vineyards in world was estimated using multiple regressions. Data were represented by compound model in the form $y' = 7628874,883 * 0.998t$ where $t = 1,2,\dots,n$. The calculated model reflects from 75.8% the development of vineyards during the observed period (Table 1.). The model is statistically significant at the 5% significance level. After creating a computational relationship between the development of vineyard areas and the time factor, predictions were made for 2020 and 2021. The year 2019 was used for the calculations, where a preliminary estimate is made. For 2020, the point estimate is equal to 7404627 hectares, the interval estimate is from 7312466 hectares to 7497951 hectares. For the year 2021, the point estimate is 7388864 hectares, and the interval estimate is from 7294143 hectares to 7484816 hectares.

Table 1. Results of regression for world vineyards

Equation	Linear	Logarithmic	Inverse	Quadratic	Compound
R Square	0.757	0.753	0.636	0.757	0.758
F value	34.179	33.613	19.247	15.538	34.362
df1	1	1	1	2	1
df2	11	11	11	10	11
Significance level	0.000	0.000	0.001	0.001	0.000
Constant.	7628384.615	7657356.749	7461772.870	7627405.594	7628874.594
b1	-16021.978	-81350.852	222617.270	-15630.370	0.998
b2				-27.972	

In the world vineyards areas is possible to see degressive. The trend and suitability of the model is possible to see in following graph (Fig. 1).

**Fig. 1.** Graph of development of vineyards in world

As other important for global wine market were investigated consumption of wine in the world. Quadratic model was chosen for reflecting world wine consumption in the form $y' = 251,084 - 2,445t + 0,163t^2$ where $t = 1, 2, \dots, n$. The calculated model reflects development of wine consumption from 51,7 % during the observed period. The model is statistically significant at the 5% significance level. Predictions were made for years 2020 and 2021. The point estimate for 2020 is equal to 248.78 million hectolitres. The interval estimate is with a

95% probability between the values of 241.51 million hectolitres up to 256.04 million hectolitres. For the year 2021, the point interval is equal to 251.05 million hl. The interval estimate is between 242.56 million hectolitres and 259.55 million hectolitres.

Table 2. Results of regression for world consumption

Equation	Linear	Logarithmic	Inverse	Quadratic	Compound
R Square	0.044	0.208	0.398	0.517	0.042
F	0.507	2.883	7.268	5.346	0.483
df1	1	1	1	2	1
df2	11	11	11	10	11
Sig.	0.491	0.118	0.021	0.026	0.501
Constant.	245.385	247.390	242.394	251.084	245.338
b1	-0.165	-1.821	7.507	-2.445	0.999
b2				0.163	

From Fig. 2 is possible to see that model is not corresponding with given data.

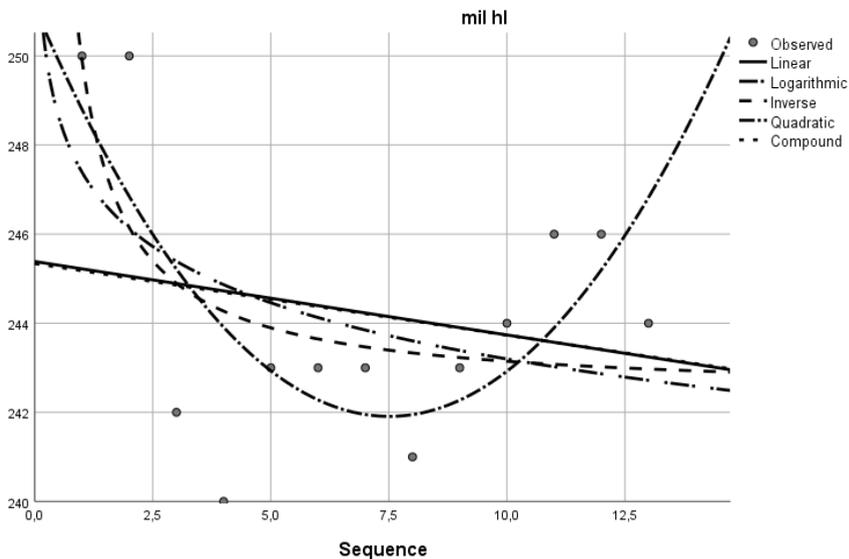


Fig. 2. Graph of development of world consumption

For world wine production, it was not possible to estimate any trend with regard to very low R^2 values. Average growth factor was counted on 99,74%. Relationship between world consumption and delayed variable vineyards areas was examined. Similar situation occurs

here and with regard to the insignificance of the model and the low coefficient R², it can be argued that global wine consumption does not fundamentally affect the sown areas of vineyards. This fact is mainly due to the fact that the vineyard is not an annual crop that is harvested. Also relationship between area of vineyards and its production in context of globalization was not proven, R² value was very low. Production was not dependent on vineyards areas.

The trend for wine areas in the EU was estimated by using regressions. The model is in the form $y' = 3758687,705 - 124208,572t + 6706,365t^2$ where $t = 1.2 \dots n$. The calculated model reflects the development of wine areas during the observed period from 98.5%. The model is statistically significant at the 5% significance level. After creating a computational relationship between the development of vineyard areas in EU and the time factor, predictions were made for 2019, 2020 and 2021. For 2019, the point estimate is equal to 3277351 hectares, the interval estimate is equal to values from 3209882 hectares to 3344822 hectares. For 2020 there is a point estimate, the predicted value is 3334215 hectares and the interval value is from 3253644 hectares to 3414786 hectares. For the year 2021 the point estimate is 3404491 hectares. The interval value is from 3307025 hectares to 3501957 hectares.

Table 3. Results of regression for vineyards in EU

Equation	Linear	Logarithmic	Inverse	Quadratic	Compound
R Square	0.754	0.940	0.872	0.985	0.762
F	30.680	157.277	68.347	297.673	31.941
df1	1	1	1	2	1
df2	10	10	10	9	10
Sig.	0.000	0.000	0.000	0.000	0.000
Constant.	3555261.303	3643064.079	3173567.587	3758687.705	3555960.769
b1	-37025.829	-197208.468	545341,624	-124208,572	0.989
b2				0.989	

In Fig. 3 is possible to see good reflection of quadratic model on vineyards in EU. Trend is degressive it could be caused by the European Union standard for maximum planting up to 2 % per year [8].

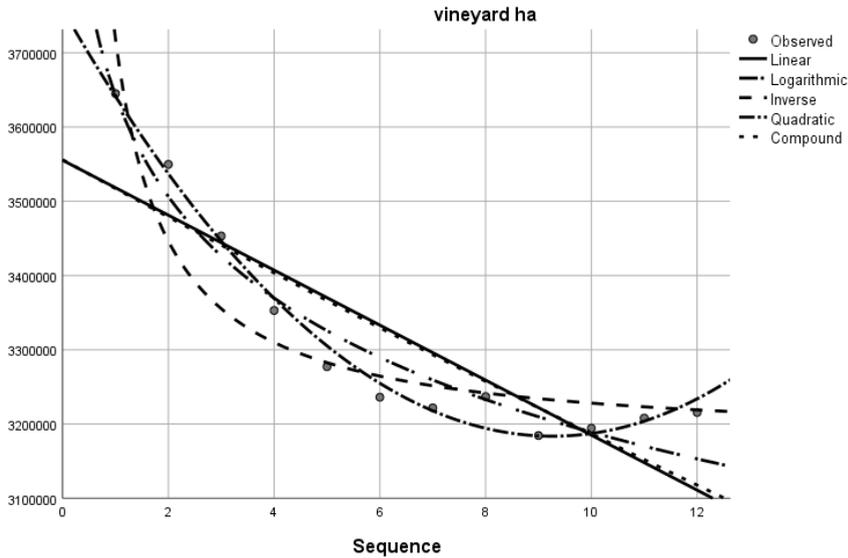


Fig. 3. Graph of development of vineyards in EU

The research shows a declining trend in terms of vineyard areas, both globally and within the European Union. This idea is confirmed by Ferrer Lorenzo, Maza Rubio and Abella Garcés (2018) [16], who state that despite the reduction of cultivation areas, production is maintained through restructuring and the application of progressive harvesting techniques. Hannah et al. (2013) and Neethling et al. (2017) [17, 18] draw attention to the importance of climate change in relation to vine growing. Wolkovich et al. (2018) [19] emphasize the need to diversify the cultivated vine varieties in order to preserve the traditional wine-growing regions and their historical, cultural and economic importance. When establishing vineyards in new localities in connection with climate change, it is also necessary to take into account potential risks such as negative interventions in ecosystems or loss of biodiversity in a given locality. Increased water use in irrigating and cooling grapes due to warming can be potentially problematic for the conservation of freshwater resources. New practices can then cause conflicts in land protection and use [17].

From the point of view of wine production, it was not possible to trace a trend that would clearly declare production over time. Production of wine is impacted by frost, hail, floods, drought etc. The fluctuating trend in global wine consumption can also be seen.

The decision to buy wine as a specific product is influenced by a number of factors that affect the customer. Wine consumption is also associated with a certain social status in some countries [20]. Consumer preferences can be linked to cultural traditions and current fashion trends. An important role in the purchase of wine is played by its sensory properties, but also the way of presentation and marketing tools applied in its sale [21, 22]. As a result of declining wine consumption, competition has intensified significantly, placing particular demands on stakeholders [16]. Carroquino, Garcia-Casarejos and Gargallo (2020) [23] emphasize the importance of adaptation and mitigation measures for viticulture and winemaking and consider the ability to reflect the current situation to be the most important task within these sectors [18].

4 Conclusion

The article deals with globalization in the wine industry. Specifically, the areas of vineyards, their production and consumption. The research found that the area of vineyards is declining

worldwide. This trend can also be seen in the European Union, which is the largest wine producer in the world (45%). In case of the EU, this is due to fact that a number of vineyards have been capped. For global wine production, it was not possible to choose most suitable model for development of world production. This is mainly due to fact that coefficient of determination was very low. Therefore, average growth factor was calculated, which can at least approximately determine further development of production. Wine production is very volatile due to external influences such as drought, floods, hail and frost, which affect consumption in individual regions. Wine consumption was best described by a quadratic function. The article also calculated point and interval estimates and predicted values of the development of global production and vineyards areas of the EU and the world in 2020 and 2021. The limits of the research are mainly in the possible incompleteness of data caused by data collection from around the world. The reasoning for variables is very difficult due to the nature of data. Other directions of research will be on production in the European Union, where data are published by Eurostat and better interpretable to author's team. This research is the first analysis for further research in the field of wine.

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