

## THE ECONOMY OF EU MEMBER COUNTRIES IN 2020 FROM PERSPECTIVE OF MAGIC SQUARE<sup>3</sup>

*The aim of our article is to quantify the impacts of COVID-19 disease on four basic aggregate economic indicators, which are set in Kaldor's magic square in EU member countries in the year 2020, as well as to identify changes in the area of the square compared to the five-year average. The result of our article is the finding that, compared to the five-year average, the area of the magic square decreased by more than 15% in 2020 from the point of view of the entire EU. The drop in real GDP in 2020 is particularly significant. There is a general economic decline and economic recession in the EU, with significant disparities between individual countries. However, there is also one member country, Lithuania, which managed to increase the area of the magic square in 2020 compared to its five-year average.*

*Keywords: EU; COVID-19; magic square; GDP; balance of payments; HICP; unemployment*

*JEL: E66; F63; O11; O52*

### 1. Introduction

The COVID-19 disease has exposed the weak points of the globalized world, affecting all sectors of the economy, and all of the countries, and we can see its effects in the political, security, social, environmental and societal levels. All EU member countries also had to face the negative impact of the crisis caused by the COVID-19 disease. From our point of view, we consider identifying the effects of the pandemic primarily important – especially within the economic indicators of the EU countries, because they strongly determine other, even non-economic parameters.

The primary area of our research is to quantify the impacts of the COVID-19 disease into four economic indicators and the area of the magic square in the EU countries in the year

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2020. From a number of potential research methods, we decided to monitor the basic macroeconomic indicators of the economy, which are set in the magic square. The reason for this is their establishment as one of the basic and most frequent economic indicators, which can be used to demonstrate the effects of the COVID-19 disease on the economies of EU countries. At the same time, these four macroeconomic indicators represent a standard platform used by many international organizations for comparing countries (EU, OECD, IMF, WB).

The magic square represents a generalized relationship between four macroeconomic parameters, which basically demonstrate the economic well-being of the state and the level of its economy. We consider N. Kaldor to be the author of this approach with his work from 1971, describing the achieving of selected macroeconomic goals and the role of the state in achieving them, based upon empirical research (Kaldor, 1971). The concept of the magic square was subsequently established very quickly to compare the performance or well-being and economy of individual countries. Since the 70s of the 20th century, economists and international organizations (e.g. OECD) have started using the magic square model to monitor the level of performance of countries and their four basic macroeconomic parameters determining economic growth.

Compared to the originally determined macroeconomic aggregates, our article is based on their modified version, where the original peak GDP growth was modified into the year-on-year change in real GDP growth, the peak trade balance was changed to the balance of the current account within the balance of payments, the peak inflation was replaced by the harmonized index of consumer prices (hereinafter HICP) and the peak unemployment rate remained in its original form. Our approach is therefore based on more specific indicators, tailored for EU countries.

Thanks to this approach, we will certainly be able to quantify the effects of the COVID-19 disease on macroeconomic aggregates, the economy and the total area of the magic square in all EU countries. Our research is also based on the comparison of development trends since 2015 and the comparison with the situation in 2020. This approach brings several positives, such as abstracting from one-year economic fluctuations since 2015, creating a multi-year multi-element base, as well as applying an important theoretical concept to the current situation and its modification to match the specific EU conditions.

In the discussion, we briefly deal with selected factors which, according to the authors, had a dominant influence on the disproportionate economic development in the EU member countries during the pandemic year 2020. We see a lot of room for future research, in the form of identifying the most significant determinants which influenced the development of the four macroeconomic variables in the EU member countries.

## **2. Literature Review**

The impacts of the COVID-19 disease have been elaborated quite widely. Among other things, the analyses, evaluations and predictions were also related to the economic and commercial consequences of the COVID-19 disease. Our contribution focuses on a specific

economic area, due to the atomization of researches mapping certain economic consequences of the COVID-19 disease in EU countries. Most of the current literature and scientific works are focused more on the global situation of the EU in 2020. Several authors dealt with selected macroeconomic aggregate values in 2020, which they compared with the global economic downturn, or with economic leaders such as the USA or China. We can mention, for example, the publication *Economic Policy and the Covid-19 Crisis* (Andreosso-O'callaghan et al., 2021) with the aim of mapping the economic impact of the COVID-19 disease on the EU and selected EU member countries and comparing them with the results from Asian countries and the USA. Baldwin and Di Mauro (2020) examine the globalization of the COVID-19 pandemic and its economic impacts in the EU and Eurozone, France, Germany and Italy. In contrast, Barua (2020) compares the economic impacts of the pandemic in 2020 in the EU, China and the USA. The publication is based on research on the likely macroeconomic shocks of the pandemic, which include economic activities and areas including demand, supply, supply chain, trade, investment, price level, exchange rates and financial stability and risk, economic growth and international cooperation. A global analysis of the pandemic in 2020 and its impact on the economies of the most important economic centres (USA, Japan, China, Russia and the EU) can also be found in other publications (Hošoff et al., 2021).

Welfens (2020) observes macroeconomic impacts and health care in his publication. Again, it is a global analysis of economic shocks in the USA, EU, UK and selected Asian countries, but this time in connection with the role of the health sector. Bretschger et al. (2020) also work with a similar, but expanded, view, which observes the regression between selected economies of OECD countries. Their research includes economic, political, medical and environmental variables.

The dominant direction in the development of scientific research with the aim of mapping the economic impacts of the pandemic in 2020 was to abstract from the position of the EU as part of the global system, thus monitoring selected economic indicators and economic variables from the point of view of the EU's unified economy. The work of De Vet et al. (2021) entitled *Impacts of the COVID-19 pandemic on EU industries* is significant in this regard, as it describes the impact of COVID-19 on the economy of the EU as a whole. Another broadening of the horizon within the analysis of the European semester with an emphasis on the coordination of macroeconomic policies and the solution of future challenges can be found in the publication from D'erman and Verdun (2020).

The historic decline of macroeconomic aggregates in 2020 was initially accompanied by the complete closure of the borders of the entire EU, which significantly affected the economies of the member countries. The EU experienced a decline in real and nominal GDP, falling incomes, a decline in employment and an increase in unemployment (Đukić et al., 2021).

An analysis of the economic consequences of the pandemic in 2020 is followed by Ehnts and Paetz (2021). It turns out that in the Eurozone, the economic crisis has revealed significant shortcomings, and it is recommended that national governments use their regained sovereignty to find a way out of economic recession.

The COVID-19 pandemic has paralyzed the EU economy. Based on the analysis of models of other macroeconomic and market impacts, Marino and Pariso (2021) put previous

macroeconomic concepts into a new context. The scenarios elaborated by SPSS 26.0, highlight that even a contained outbreak could significantly affect the European economy in the middle rung in terms of public social values and these weaknesses could undermine the objectives of building a united Europe in addressing the crisis created by COVID-19.

Zamfir and Iordache (2022) synthesized the results of their research in which they examined macroeconomic indexes for European countries. The main results show that, comparing European countries' economic situation in 2020 with the previous 2 years and considering variables that show the adopted closure measures, the Covid-19 pandemic has influenced the GDP of European countries.

The economic consequences of the COVID-19 pandemic on European economies and the subsequent response of economic policies in the first half of 2020 are described in the study *The COVID19-Pandemic in the EU: Macroeconomic Transmission and Economic Policy Response* (Pfeiffer and Roeger, 2020). The focus of their study is the research of stabilization measures and economic policy responses to economic problems caused by the COVID-19 pandemic.

We can consider the significant macroeconomic impacts of the pandemic in 2020 as a trigger of growing support for a more protective government. Economic supports aimed at solving economic and social problems can lead to the restoration of relations between the state and the market (Bergsen, 2020).

Sapir (2020) investigated the economic reasons for the different impacts of the COVID-19 pandemic on selected economic units (EU member countries). The main indicator was the change in GDP in connection with the severity of blocking measures, the structure of national economies, the fiscal capacity of governments and the quality of governance in all EU countries.

The atomization of research on the COVID-19 effects on European economies is underlined by several studies of individual countries, regions or other territorial administrative units. As an example, there is monitoring of the impacts of COVID-19 pandemic in 2020 within selected economic indicators in Romania (Albu et al., 2020), Visegrad group (Masarova et al., 2022), Visegrad group and Austria (Astrov and Holzner, 2021) Spain (Pedauga et al., 2022), Croatia (Čavrak, 2021), Croatia and Slovenia (Gricar et al., 2022) France, Germany, Spain, Italy and the United Kingdom (Su et al., 2022), Greece (Hazakis, 2021), Belgium, Italy, Spain and the United Kingdom (Cantó et al., 2022), the Czech Republic (Fialová et al., 2021) Slovakia (Frank et al. 2021; Mura et al., 2022), Estonia (Radula, 2021), Lithuania (Černikovaitė and Karazijienė, 2021; Petrylė, 2022), Latvia (Karnite, 2021; Lagzdina 2020) Romania and Bulgaria (Christova-Balkanska, 2021), Cyprus, France, Spain, Greece, Italy, Malta, Croatia and Portugal (Kapitsin and Sykas 2021) or in selected countries of Central and South-Eastern Europe (Avrămescu, 2020).

Economic impact research involving European regions, NUTS 3 or municipalities does, for example, appear within the work of Brada, Gajewski and Kutun, (2021) and Fernández-Villaverde and Jones, (2020).

The literature research indicates a relatively good coverage of the researched issue, but none of the available studies quantify the four basic macroeconomic indicators together, nor does

any focus on tracking the area of the magic squares of all 27 EU countries in 2020, or their five-year average area. From our point of view, the available sources contain atomized research areas, partial results, time series too short, or the study of the problem only from the point of view of a single EU member country, or just a given group of EU countries. There is also an opposite extreme case when the researchers analyse the effects of the COVID-19 disease on the entire EU and monitor aggregate data for the entire EU. Therefore, we see a great opportunity to cover this blank space with our research.

### **3. Methodology and Data**

The aim of our paper is to quantify the impacts of the COVID-19 disease into four basic aggregate economic indicators, which are set in Kaldor's magic square, within EU member countries in 2020 and to identify changes in the area of the square compared to the five-year average.

The object of our research are all EU member countries as of December 31, 2020. During this period, the EU consists of a total of 27 European countries: Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Greece, the Netherlands, Ireland, Lithuania, Latvia, Luxembourg, Malta, Hungary, Germany, Poland, Portugal, Austria, Romania, Slovakia, Slovenia, Spain, Sweden and Italy.

The first monitored macroeconomic economic indicator is the real rate of GDP growth. It expresses the year-on-year percentage change (increase/decrease) of the country's GDP. Our analysis operates with the rate of real GDP growth compared to the previous calendar year and captures the change in GDP in market prices. Of the three possible approaches to defining GDP (production, expenditure, pension), our work is based on the production approach to determining GDP.

The unemployment rate represents the second monitored indicator of the economy, which is based on the magic square model. All persons aged 15 to 74 who were not employed during the reference time frame, were actively looking for work and were ready to start work immediately or within two weeks are considered unemployed in the EU. In our case, the unemployment rate is expressed in percent of the ratio of unemployed persons to the total labour force in percentages.

The third peak of the magic square is inflation. The EU and Eurostat use the HICP to express the rate of inflation and the stability of the price level. This indicator of the net change in the prices of goods and services is calculated as a "Laspeyres-type price index" based on the prices of services available for purchase in the territory of each EU member state for the direct satisfaction of consumer needs (final consumption).

The last monitored macroeconomic indicator, which we use to map the effects of the COVID-19 disease on the economy in EU countries, is the balance of payments. The current account represents the most important and dominant component of the balance of payments. This was the reason for choosing the balance of the current account within the balance of payments as a component that maps the foreign trade position of the member country while summarizing

the export and import balance of the economy. We express the current account balance within the balance of payments as a share of GDP.

The time series begins with the base year 2015. We calculated the five-year average as the arithmetic average of the examined macroeconomic aggregates over a period of five years (2015-2019), and used it for comparison with the year 2020, which we equated with the year when the economic effects of the COVID-19 disease on the economies of EU member countries fully manifested for the first time. We consider the five-year average to be optimal because it exceeds the period of the classic political cycle (4 years) and minimizes short-term disparities.

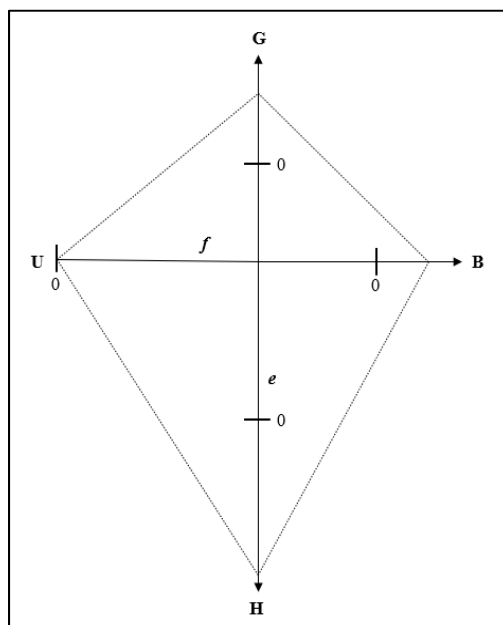
Determining the level of the five-year average of four macroeconomic aggregates (peaks) and their values in 2020 was the first task. Subsequently, our attention was focused on the calculation of the area of the imaginary magic square, while we graphically captured its five-year area as well as the situation in 2020. To calculate the magic square, we used a standard formula (Saavedra-Rivano, Teixeira, 2017) to calculate its area. This is a formula for calculating the area of a convex quadrangle (geometric figure - deltoid) with perpendicular internal diagonals:

$$S = \frac{ef}{2} \tag{1}$$

In the original, as well as our modified magic square, the length of the diagonals (e, f) will be bounded by two points. For the vertical diagonal e, these points will represent the vertices with the values of the real GDP growth rate and the HICP level. The horizontal diagonal f will be bounded by vertices representing the unemployment rate and the current account balance within the balance of payments. The sum of the values of the units on the vertical axis subsequently represents the length of the vertical diagonal of the deltoid, and the sum of the values of the units on the horizontal axis subsequently represents the length of the horizontal diagonal of the deltoid. After substituting this data into the surface/area calculation equation, we get the final data for the area of the magic square in a five-year average in 2020 as well. Depiction of the modified magic square is captured in Figure 1.

During the processing of the documents and the primary analysis of the data, we encountered a complication, which is not reflected in the original magic square. The partial data and the diagonal lengths calculated from them reached differentially negative values as well, which cannot be easily captured graphically. It also brought a problem with the final determination of the area of the magic square, which could not be a negative value. Therefore, with regard to the maximum limit values, we decided to set the intersection of the diagonals and our base point to the numerical constant of 22. The result of our preliminary research was that the constant must have a value higher than the highest partial value of all four variables of the monitored set of countries. A reliable procedure is to set a constant higher than the highest value of the year-on-year change, which is higher by 1 than the highest partial data rounded to the nearest larger whole number. In our case, the highest partial value of the variable is at the level of 20.5 (average unemployment in Greece), which reaches the value of 21 after rounding to the first whole number. Subsequently, the constant represents a value higher by one whole number (22).

**Figure 1. Modified magic square**



Where: **G** - real growth rate GDP; **B** –current account balance within the balance of payments; **H** – HICP;  
**U** – unemployment rate; **e, f** - diagonals  
Source: Own processing

The role of the constant does not end only with the graphical capturing of magic squares. When inserting the data into the formula to calculate the area of the magic square, we must take the constant (intersection of the axes) into account. Without this procedure, it would not be possible to calculate the positive values and graphically capture the results. In order to maintain the basic rules and logical conclusions about the increase and decrease of the area of the square, we need to modify the primary data of the real GDP growth rate, the unemployment rate, the HICP and the balance of the current account within the balance of payments. In the case of two macroeconomic indicators (real GDP growth rate, current account balance within the balance of payments), the constant of 22 was added. In the case of the unemployment rate and the HICP, their five-year average value and the value from 2020 were subtracted from the constant. With this procedure, we stick to the basic premise, according to which a positive economic situation (GDP growth, unemployment reduction, slightly positive trade balance and low inflation rate) increases the area of the magic square. In case of negative economic development (decline in GDP, increase in unemployment and inflation) the area of the magic square reduces.

The research sample (all EU member countries) predicts, that the main source of data for the initial analysis will be the EU Statistical Office (Eurostat). In our research, we focused on a set of data included in the Economy and Finance and Labour Market statistics. The first indicator was the real GDP growth rate. We identified the data on the development of this

indicator in the Eurostat database with the online code TEC00115, and the reference data were labelled (nama10) according to the system of national accounts. The percentage rate of unemployment was the second monitored macroeconomic indicator. The necessary data can be found in Eurostat statistics in the labour market section. According to the main indicators of the LFS, data on the annual unemployment rate fall under the code label (une\_rt\_a) or (lfsa\_urgaed). HICP data were located in the Eurostat folder named Harmonized Index of Consumer Prices and the specific data had the code (prc\_hicp\_manr). We drew primary data for the last analysed macroeconomic indicator (current balance of payments) from the World Bank Databank. The required data was located in the database of world development indicators in the Economy & growth section (under the code BN.CAB.XOKA.GD.ZS) and after adjustment, it captured the development of the current balance of payments of all EU countries since 2015 as a percentage of GDP. The primary data set for our analysis represented a total of 648 data entries (27 member countries x 6 years x 4 macroeconomic variables). Through secondary calculations, we found out the length of the diagonals of the squares, put them into the formula for calculating the area and obtained data on 27 average areas and 27 areas in 2020.

At the end of our paper, we present a comparison of partial data on economic aggregates and a comparison of the areas of the magic squares of specific countries. Each of the 27 EU countries will have a quantified area of magic squares (average and in 2020) in areal units. We will indicate the resulting area in abstract units *u*. The larger the area of the magic square (the greater the number of *u* units), the higher the prosperity of a specific economy of a member country. A lower number of *u* units, thus also the lower area of the magic square de facto, will indicate to us a worse economic situation of a specific EU member state.

#### **4. Results**

We monitored the values of real GDP growth, the current account balance within the balance of payments, the HICP and the unemployment rate from 2015 to 2019 and calculated their arithmetic average. We analysed four macroeconomic aggregates in 2020 and compared them to their long-term average.

Between the years 2015 and 2019, the average rate of real GDP growth across the EU reached 2.2%. Each of the member states also showed a positive average increase during this period, with Ireland (10.0%) and Malta (7.24%) achieving the highest. The lowest average increase in the growth rate of real GDP was recorded in Greece (0.78%) and Italy (1.02%).

The pandemic year 2020 reversed this trend of positive development in all EU countries (except Ireland), which registered a year-on-year decrease in real GDP. The most significant year-on-year decline in 2020 was in Spain, Greece and Italy. The only exception across the EU is Ireland, which also achieved a positive increase in the real GDP growth rate in 2020. In general, the year 2020 represented a significant year-on-year drop in real GDP from the point of view of the entire EU, which reached almost 6%.



**Table 1. Macroeconomic aggregates in EU member states (2015-2020)**

	REAL GROWTH RATE GDP			CURRENT ACCOUNT BALANCE WITHIN THE BALANCE OF PAYMENTS		
	Average	2020	Difference	Average	2020	Difference
EU (27)	2,20	-5,9	-8,10			
Belgium	1,76	-5,7	-7,46	1,68	1,20	-0,48
Bulgaria	3,18	-4,4	-7,58	0,41	0,83	0,42
Czechia	3,86	-5,8	-9,66	1,75	-0,38	-2,13
Denmark	2,48	-2,1	-4,58	0,89	3,61	2,72
Germany	1,72	-4,6	-6,32	7,96	8,13	0,17
Estonia	3,82	-3,0	-6,82	8,05	7,00	-1,05
Ireland	10,0	5,9	-4,10	1,74	-0,46	-2,20
Greece	0,78	-9,0	-9,78	-0,75	-2,09	-1,34
Spain	2,84	-10,8	-13,64	-1,74	-6,57	-4,83
France	1,64	-7,9	-9,54	2,40	0,84	-1,56
Croatia	3,16	-8,1	-11,26	-0,50	-1,87	-1,37
Italy	1,02	-8,9	-9,92	2,76	0,09	-2,67
Cyprus	5,36	-5,2	-10,56	2,46	3,81	1,35
Latvia	3,22	-3,6	-6,82	-3,84	-10,19	-6,35
Lithuania	3,48	-0,1	-3,58	0,27	2,91	2,64
Luxembourg	2,78	-1,8	-4,58	0,15	7,36	7,21
Hungary	4,04	-4,7	-8,74	4,92	4,02	-0,90
Malta	7,24	-8,3	-15,54	1,71	-1,48	-3,19
Netherlands	2,30	-3,8	-6,10	3,75	-3,07	-6,82
Austria	1,86	-6,7	-8,56	9,05	6,97	-2,08
Poland	4,44	-2,5	-6,94	1,84	1,88	0,04
Portugal	2,56	-8,4	-10,96	-0,59	2,90	3,49
Romania	4,74	-3,9	-8,64	0,74	-1,06	-1,80
Slovenia	3,58	-4,2	-7,78	-3,00	-5,08	-2,08
Slovakia	3,30	-4,4	-7,70	5,36	7,38	2,02
Finland	1,78	-2,9	-4,68	-2,45	0,19	2,64
Sweden	2,64	-2,8	-5,44	-1,15	0,95	2,10
				3,35	5,71	2,36
	HICP			UNEMPLOYMENT RATE		
EU (27)	1,02	0,7	-0,32	8,28	7,1	-1,18
Belgium	1,62	0,4	-1,22	6,96	5,6	-1,36
Bulgaria	0,78	1,2	0,42	6,48	5,1	-1,38
Czechia	1,58	3,3	1,72	3,24	2,6	-0,64
Denmark	0,54	0,3	-0,24	5,64	5,6	-0,04
Germany	1,22	0,4	-0,82	3,80	3,8	0,00
Estonia	2,06	-0,6	-2,66	5,72	6,8	1,08
Ireland	0,34	-0,5	-0,84	7,18	5,7	-1,48
Greece	0,26	-1,3	-1,56	21,32	16,3	-5,02
Spain	0,72	-0,3	-1,02	17,66	15,5	-2,16
France	1,00	0,5	-0,50	9,46	8,0	-1,46
Croatia	0,56	0,1	-0,46	11,12	7,5	-3,62
Italy	0,62	-0,1	-0,72	11,08	9,2	-1,88
Cyprus	-0,14	-1,1	-0,96	10,92	7,6	-3,32
Latvia	1,70	0,1	-1,60	8,38	8,1	-0,28
Lithuania	1,68	1,1	-0,58	7,32	8,5	1,18
Luxembourg	1,16	0,1	-1,06	5,94	6,8	0,86
Hungary	1,84	3,4	1,56	4,64	4,3	-0,34
Malta	1,32	0,8	-0,52	4,28	4,4	0,12
Netherlands	1,18	1,1	-0,08	5,00	3,8	-1,20
Austria	1,52	1,4	-0,12	5,32	5,4	0,08
Poland	0,80	3,7	2,90	5,16	3,2	-1,96
Portugal	0,84	-0,1	-0,94	9,28	6,9	-2,38
Romania	1,52	2,3	0,78	5,14	5,0	-0,14
Slovenia	0,84	-0,3	-1,14	6,64	5,0	-1,64
Slovakia	1,18	2,0	0,82	8,32	6,7	-1,62
Finland	0,66	0,4	-0,26	8,18	7,8	-0,38
Sweden	1,48	0,7	-0,78	6,86	8,3	1,44

Source: Own calculations based on Eurostat (2021).

The average balance of the current account within the balance of payments of the entire EU reached a positive value of 1.68% of GDP between 2015 and 2019. The Netherlands (9.05% of GDP), Germany (8.05% of GDP) and Denmark (7.96% of GDP) reported the highest average value of the current balance within the balance of payments. On the other hand, we identified a total of eight EU member countries whose five-year average was negative. We identified the most significant deficit of the average current account balance within the balance of payments in the case of Cyprus, Romania and Slovakia. In these countries, the average balance of the current account within the balance of payments ranged in the interval of  $<-3.84\%$  of GDP;  $2.45\%$  of GDP  $>$ .

During 2020, the value of the current account balance within the balance of payments decreased from the point of view of the entire EU and reached 1.2% of GDP. A total of 17 countries achieved a positive current account balance within the balance of payments. Denmark (8.13% of GDP), followed by Slovenia (7.38% of GDP) and Lithuania (7.36% of GDP) achieved the highest value of the current account balance within the balance of payments in the given year. Of the ten EU member states, Cyprus (-10.19% of GDP), Greece (-6.57% of GDP) and Romania (-5.08% of GDP) registered the most significant current account deficit in 2020.

The pan-European HICP average was just above one percent in the period of years 2015-2019. Over five years, the HICP average was the highest in Estonia, where it barely exceeded the 2% mark, followed by Hungary and Lithuania. The lowest HICP was registered in Cyprus, where the five-year average reached a negative value (-0.14%) and this development came close to deflation.

The 2020 HICP level in the member countries was differentiated. Most (19) countries reported a positive HICP value ranging from 3.7% (Poland) to 0.1% (Luxembourg, Lithuania). Other countries reported a decrease in HICP in the range of  $<-1.3\%$  in 2020;  $-0.1\%$   $>$ . We found the lowest values in 2020 in Greece and Cyprus. For the entire EU, the HICP reached the level of 0.7% in 2020.

The unemployment rate represents the last monitored macroeconomic aggregate. In the period of years 2015-2019, the average unemployment rate in the EU was 8.28%. The highest average unemployment rate was found in southern EU countries, i.e., in Greece (21.32%) and Spain (17.66%). In the same period, the Czech Republic and Germany achieved an average unemployment rate of under 4%, which was the lowest among all EU member countries.

From the point of view of the unemployment rate, it is typical for the year 2020 that the EU-wide average just exceeded the 7% mark. The two southern EU members Greece (16.3%) and Spain (15.5%) reported the highest unemployment rate again. The unemployment rate in 2020 was below four percent in the Czech Republic, Germany and Poland. In the Czech Republic, the level of unemployment rate was at the level of 2.6%, and this value created the lowest achieved level of unemployment across all EU countries in 2020.

From 2015 to 2019, the average area of the magic square across the EU was 844.91 u. Malta, the Netherlands, Germany and Denmark achieved highly above-average areas of the magic square, exceeding 1000 u. In opposition to them, there are average values of the area of the

magic square in the southern EU countries. We identified the lowest average values in Greece (466.04 u), Spain (662.74 u), Cyprus (723.74 u) and France (759.77 u).

The pandemic year 2020 affected the four monitored macroeconomic aggregates in a significantly different way, hence affecting the areas of the magic squares in the EU countries as well. In general, with one exception, we can observe a decrease in the area of magic squares in all EU countries. The year 2020 is characterized by a decrease in the area of the magic square in 26 EU countries - except Lithuania. These results were also reflected in the average area of the magic square for the entire EU in 2020, which was 712.47 u. The highest area of the magic square within the interval <967.82 u; 912.49 u> was calculated in Denmark, Slovenia, the Netherlands, Germany, Lithuania and Ireland. Greece (383.51 u), followed by Spain (491.44 u) and Cyprus (522.89 u) reported the smallest area of the magic square in the year 2020.

**Table 2. Area of the magic square (u) in EU member states (2015-2020)**

	Area of the magic square			
	Average 2015 - 2019	2020	Difference	Change %
EU (27)	844,91	712,47	-132,44	-15,68
Belgium	826,57	743,41	-83,16	-10,06
Bulgaria	910,97	739,58	-171,39	-18,81
Czechia	963,83	785,42	-178,40	-18,51
Denmark	1063,92	967,82	-96,10	-9,03
Germany	1073,56	920,40	-153,16	-14,27
Estonia	915,75	764,19	-151,56	-16,55
Ireland	967,70	912,49	-55,21	-5,71
Greece	466,04	383,51	-82,53	-17,71
Spain	662,74	491,45	-171,30	-25,85
France	759,77	607,51	-152,26	-20,04
Croatia	830,51	654,96	-175,54	-21,14
Italy	785,48	679,54	-105,94	-13,49
Cyprus	723,74	522,89	-200,85	-27,75
Latvia	816,77	782,02	-34,74	-4,25
Lithuania	843,45	917,20	73,75	8,74
Luxembourg	980,42	869,74	-110,68	-11,29
Hungary	948,62	686,05	-262,58	-27,68
Malta	1084,96	637,45	-447,51	-41,25
Netherlands	1084,10	922,17	-161,92	-14,94
Austria	898,33	726,62	-171,71	-19,11
Poland	911,21	825,93	-85,28	-9,36
Portugal	810,71	643,31	-167,39	-20,65
Romania	846,75	641,09	-205,66	-24,29
Slovenia	998,32	929,92	-68,40	-6,85
Slovakia	766,28	704,81	-61,47	-8,02
Finland	782,25	756,00	-26,24	-3,35
Sweden	914,31	838,55	-75,76	-8,29

Source: Own calculations.

## **5. Discussion**

What was the development of the four basic macroeconomic aggregates and the area of the magic square in EU member countries in 2020 compared to the five-year average? In principle, we found a very significant drop in real GDP growth in the case of all EU member countries in 2020, compared to the five-year average. The decrease in the real growth rate was quite striking, and in the case of five countries (Malta, Spain, Croatia, Portugal and Cyprus) it was a double-digit decrease. The trend of negative development of individual member countries was also reflected in the value of the drop of the real GDP growth rate in 2020, compared to the five-year average of the entire EU, reaching a value of -8.1%.

The overall negative trend in the development of real GDP was subsequently also reflected in the balance of the current account within the balance of payments. The reason is the methodical adjustment and determination of the balance rate expressed as a percentage of GDP. From this point of view, even if the balance of the current account within the balance of payments decreased in real terms, the macroeconomic indicator was not able to capture this decrease, because it is linked to the development of GDP - which could have decreased more significantly. Therefore, if we want to have a more realistic reflection of the balance of the current account within the balance of payments, we should add its values to the values capturing the real rate of GDP growth. If we proceed from the basic framework, which is established in the magic square, we will find out that more than half (16) of the member countries reached negative values of the balance of the current account within the balance of payments in 2020 compared to the five-year average. We identified significantly the highest negative difference in the current account balance in Malta (-6.82% of GDP), Cyprus (-6.35% of GDP) and Greece (-4.83% of GDP). At this point, it is necessary to note that the negative difference in the current account balance within the balance of payments does not apply to all EU countries when comparing the five-year average with the year 2020. A total of eleven countries managed to increase their current account balance during 2020 compared to the five-year average. In this respect Lithuania is leading, as the current account balance within the balance of payments in 2020 showed an increase of 7.21% of GDP when compared to the five-year average.

The average HICP value during the years 2015-2019 in EU countries does not show significant deviations when compared to 2020. It has a relatively stable development without significant disparities. By comparison, we found a positive development trend (decline in HICP) in 2020 compared to the five-year average in almost  $\frac{3}{4}$  of the EU countries. Only for the group of six former post-socialist countries, the year 2020 brought a slight increase in the HICP compared to the five-year average.

We found similar results when analysing and comparing the unemployment rate in 2020 against the five-year average. In the vast majority of EU countries (20), the unemployment rate decreased during 2020 compared to the 2015-2019 average. This is also evidenced by the data from the entire EU, where the unemployment rate decreased in 2020 compared to the five-year average by more than 1.1%. The maximum positive difference was registered in Greece, where the unemployment rate fell by more than 5%. On the other hand, there is a group of six EU member states where the unemployment rate increased in 2020 compared to the five-year average. However, this is not a significant increase, because compared to the

five-year average, the unemployment rate in 2020 increased only slightly (by a maximum of 1.44%).

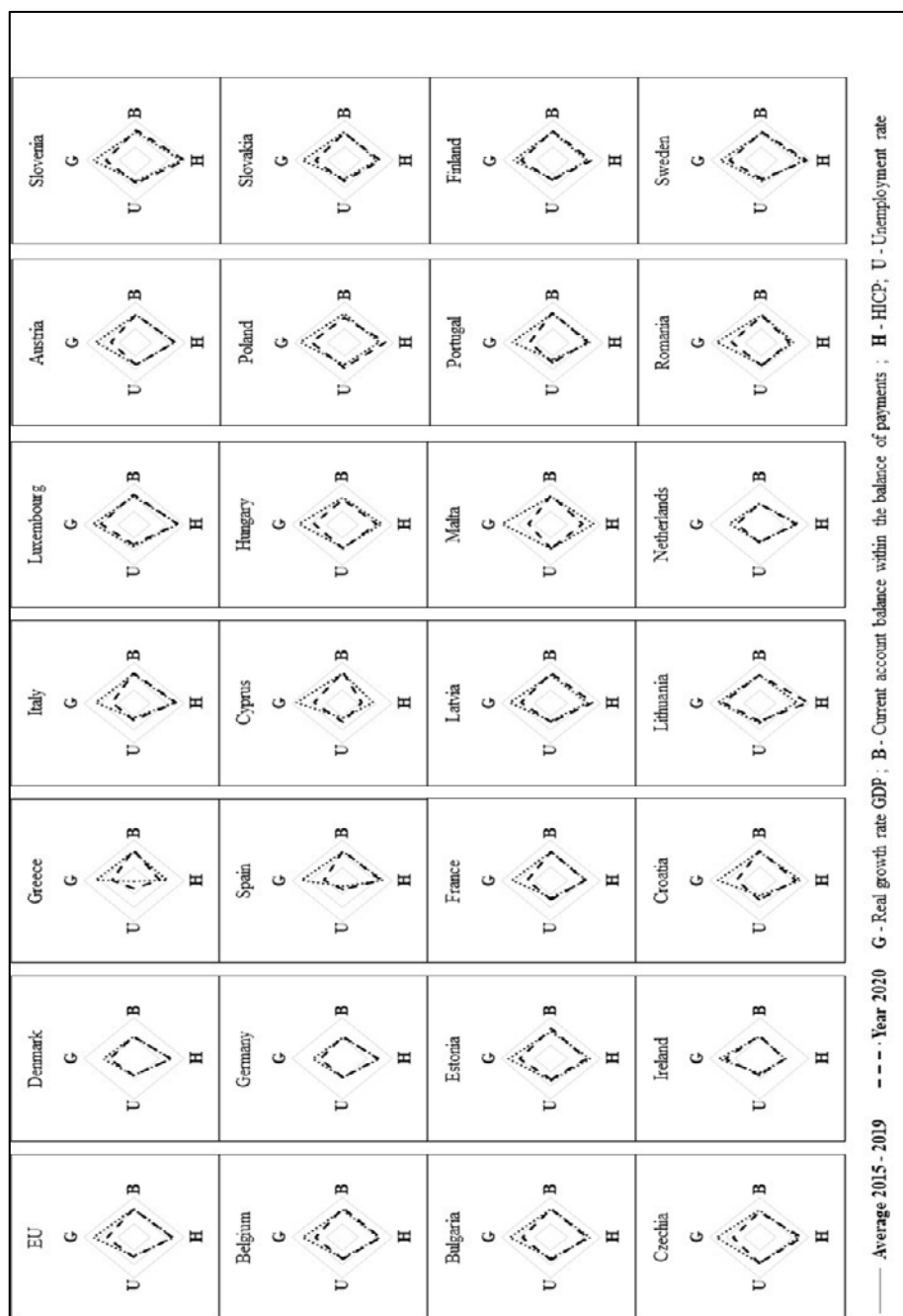
How our partial findings are reflected in the areas of the magic squares is graphically captured in the following image. It contains 28 magic squares - the entire EU and 27 member states, delimiting the five-year average area and the area in 2020.

The 2020 results indicate a slight to significant decrease in the area of the magic square in all EU member states, with one exception, compared to the five-year average. We found the most significant reduction in area in the case of Malta. Compared to the five-year average, the area of Malta's magic square shrank by more than 447 u in 2020, representing an area loss of over 40%. The results from Cyprus, Hungary, Spain, Romania, Croatia, Portugal and France also revealed a significant decrease in the average area of the magic square compared to 2020. In all mentioned countries, the area of the magic square decreased from -20.04% to -27.75%. On average the area of the magic square in the EU decreased by 132.44 u in 2020, which represents a reduction in area by approximately 15.68%. The given data indicate a general decline in the economies of 26 EU countries and foreshadow major challenges for national economies.

The only exception from the EU countries, where the area of the magic square did not decrease in 2020 compared to the five-year average, was Lithuania. This Baltic country achieved positive growth and an increase in the area of the magic square in 2020, contrary to the general EU-wide trend. From the point of view of absolute data, the area of the magic square increased by 73.75 u in Lithuania in 2020, which represents the expansion of the area of the magic square by 8.74% against the five-year average.

If we resorted to the generalization of our results, we could conclude that the year 2020 marked by the COVID-19 pandemic had a relatively negative impact on the economies of all EU member countries. In particular, a clear trend was the drop in the real GDP growth rate compared to the five-year average, which was not avoided by any EU country. Figure 1 also confirms this visually - it is clear that peak A (real GDP growth rate) always moved towards the intersection of the diagonals in 2020. The deficit balance of the current account within the balance of payments in 2020 also contributed to the reduction of the areas of the magic squares in the 15 member countries. The other two monitored economic indicators (HICP, unemployment rate) had the opposite impact on the area of the magic squares compared to the five-year average and 2020. Both the HICP and the unemployment rate, with minor exceptions, were lower in 2020 which automatically increased the areas of the magic squares of the EU countries. This (to a large extent) inertial effect from the passing progressive economic period could not balance the steep drop in real GDP. Thus, in 2020, the areas of the magic squares of countries across the entire EU are generally declining.

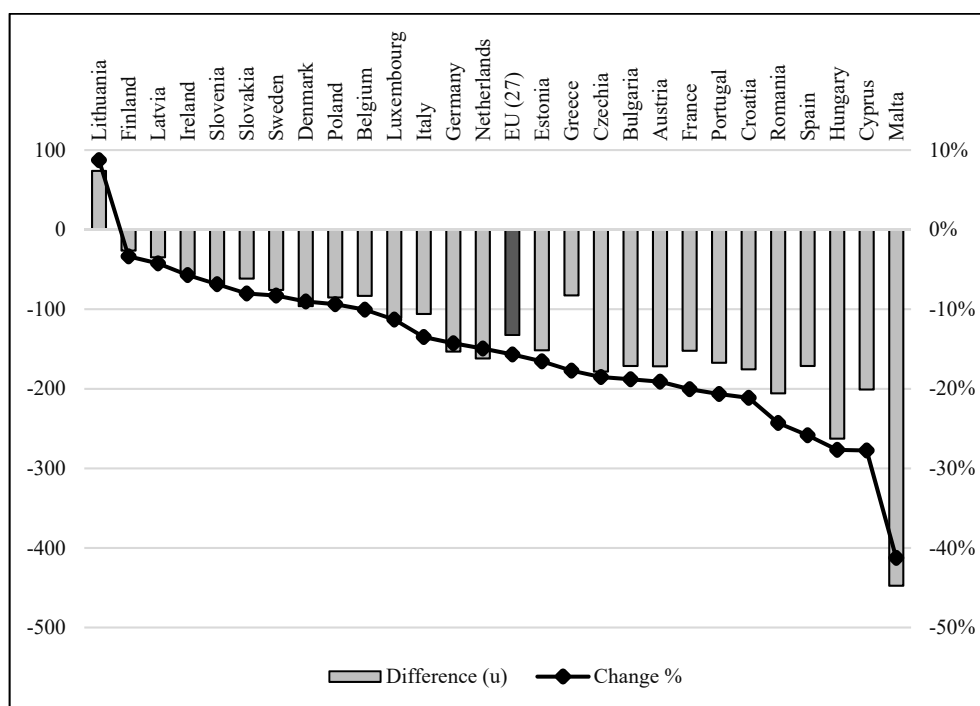
Figure 2. Magic squares in EU countries 2015-2020



Source: Own calculation

The only exception is Lithuania, which was the only country in the EU which increased the area of its magic square compared to the five-year average during the first year of the COVID-19 pandemic. The reason is the lowest drop in the real GDP growth rate in 2020 among all other EU member countries. In addition, the results in two other economic indicators (a positive balance of the current account within the balance of payments and a decline in the HICP) in 2020 made the area of Lithuania's magic square widen. The relatively lowest drop in real GDP, a highly positive current account balance within the balance of payments, a reduction in the HICP and only a minimal increase in the unemployment rate are a combination creating a unique situation of an increase in the area of the magic square in Lithuania. This is largely due to the inertia of development, especially the HICP, the unemployment rate, as well as the internal structure of the economy.

**Figure 3. Change in the area of the magic square in EU countries in 2020 compared to the five-year average**



Source: Own calculation.

In general, we could state that the most significant reduction in the areas of magic squares in EU countries during 2020 was found in the case of countries where tourism contributes significantly to the total GDP. This industry was hit very hard by the measures to mitigate the spread of the COVID-19 disease, and the tourist-attractive EU countries (Malta, Cyprus, Spain, Croatia, France or even Portugal) reported a significant drop in the real GDP growth rate in 2020 (Statista, 2022), which was automatically reflected in a significant reduction in

the areas of their magic squares. This factor is also underlined by the fact that EU countries with a lower share of tourism in their GDP (Lithuania, Finland, Latvia, Ireland, Slovakia) reported smaller changes in the area of their magic square.

Similarly, the very structure of the economies of the EU member countries had a significant impact on the slowdown of economic growth and the decrease in the areas of magic squares. It meant an increased risk of stagnation and recession in 2020 for the open and globalized economies of EU countries, as long as they were focused on the production of goods from oil, cars, equipment for mining and transport, or for the production of aircrafts and aircraft parts (OECD 2021).

In addition, many other determinants come into play as well, impacting one or more vertices of the magic square, thus increasing or decreasing its area in the case of all EU countries. For example, other factors include the quality of management and the quality of public government processes (WGI), the strictness of the anti-pandemic measures adopted (Sapir, 2020) and the role of the member states and the EU itself in dealing with the economic impacts of the COVID-19 disease through the public finance system.

Considering further economic development in the EU, it is very likely that the areas of the magic squares will continue to decrease. We observe economic recession and economic stagnation as the reasons (caused by two years of the COVID-19 pandemic and the war in Ukraine), while the positive short-term inertial effects of HICP stability from previous years will be minimized. These effects will affect the labour market as well, where the unemployment rate will increase. The negative economic outlook and shrinking area of the magic square will put public governments under severe pressure and will mean huge, possibly structural challenges for public finance systems.

## **6. Conclusions**

The aim of our paper was to quantify the impacts of COVID-19 disease within the EU member countries in 2020 according to four basic aggregate economic indicators, which are set in Kaldor's magic square, and to identify changes in the area of the magic square compared to the five-year average. The drop in real GDP in 2020 which occurred across all EU countries compared to their five-year average is particularly significant, representing the most important negative factor in the decrease of the areas of magic squares in all EU countries. The deficit balance of the current account within the balance of payments had also contributed to the reduction of the areas of the magic squares in the 15 member countries in 2020. The other two monitored economic indicators (HICP and unemployment rate) mostly had the opposite impact on the areas of the magic squares when compared to their five-year averages.

The result of our paper is the finding that the area of the magic square has significantly decreased from the point of view of the entire EU in 2020 when compared to the five-year average. Hence, the area of the magic square for the entire EU has decreased by more than 15% in 2020. A total of 26 EU countries experienced a decrease in the area of the magic square ranging from -3.35% to -41.25%.



However, there is also one member country which was able to increase the area of the magic square even in 2020. This only exception is Lithuania, which is the single country in the EU increasing the area of its magic square by 8.74% during the first year of the COVID-19 pandemic, compared to the five-year average. The relatively lowest drop in real GDP, the highly positive balance of the current account within the balance of payments, the reduction in the HICP and only a minimal increase in unemployment were combined and together created a unique situation, where the area of the magic square increased. This is largely due to the inertia of development - especially the HICP, the unemployment rate, as well as the internal structure of the domestic economy.

The authors are aware that the secondary analysis of macroeconomic aggregate indicators presented in this text is limited by the utilized comparative procedures and the extent of this paper. At the same time, authors are aware of the limited selection of research methods. The performed analysis represents a generalized result, which is the result of the influence of multiple factors and variables, as well as specific conditions of the analysed countries.

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