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CATEGORISATION OF EU COUNTRIES IN TERMS OF THE IMPACT OF CRISIS PERIODS ON VALUE-ADDED TAX*

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Abstract. The categorisation of EU countries based on their reactions and approach to value-added tax (VAT) during crisis periods can be divided into several groups according to how countries responded to crises such as economic recessions or the COVID-19 pandemic. The responses of individual countries included adjustments to VAT rates, the introduction of tax incentives, payment deferrals and other measures to mitigate the impact of the crisis on the economy. The present research focuses on identifying, analysing and evaluating the impact of crises on VAT. Its main objective is to develop an economically meaningful categorisation of EU countries based on the level of the basic VAT rate and macroeconomic and institutional indicators. We included gross domestic product, population, unemployment, inflation and international trade among the macroeconomic indicators. Further, the paper uses institutional indicators of government effectiveness and more narrowly focused indices such as control of corruption and legislation. The classification of countries is divided into three periods 2004, 2008 and 2020. The crisis periods 2008 (global financial crisis) and 2020 (pandemic crisis) are compared with the base period 2004 in the research. The analysis is complemented by the evolution of rates and the incidence of applied measures in the European Union countries under study. The categorisation of countries was carried out on the 28 member countries, considering the actuality of membership in the year under review. To categorise groups of countries within the European Union, we used four analysis methods: rate change analysis, principal component analysis, correlation analysis and cluster analysis of hierarchical type (Ward method). The research results show a significant impact of crisis periods on the categorisation of countries. Despite the crisis periods, the most developed EU economies have maintained their economic growth in contrast to other countries. This is evidenced by the fact that the cluster analysis method separated them into a distinct cluster in each period under study. The research further showed that EU Member States applied changes to their tax rates on goods and services mainly after the global financial crisis. During the pandemic crisis, it became apparent that measures other than a change in the basic tax rate were applied. These measures are mainly adjustments to reduced tax rates, financial incentives, employer support, etc. In particular, the use of reduced tax rate adjustments and support to employers through wage cost recovery has proven to be an effective way of increasing tax revenue and a form of assistance.

Keywords: value-added tax; standard tax rates; cluster analysis; correlation; Ward's method

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1. Introduction

Value-added tax is one of the most important sources of tax revenue for most EU governments. It is part of any taxation policy and significantly influences consumer and government behaviour. Value-added tax changes are perceived as harmful as they directly affect household budgets. Significant adverse impacts include global

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crises, which have recently increased in frequency. Periods of economic and pandemic crises have had a significant effect on the functioning of European economies and their macroeconomic development in recent years. In such crises, it is up to the countries to react correctly. However, the experience of crises suggests that it is precisely the increase in the tax burden on consumers that is taking place to a greater extent. The negative effects on consumers may, in turn, impact society and its perception of the state. The monitoring of institutional indicators and macroeconomic indicators can demonstrate the fact that indirect taxation is very important. From a macroeconomic perspective, VAT broadly impacts a country's economy. It is a crucial source of government revenue but also affects consumption, inflation, unemployment, economic growth and competitiveness. Getting the tax burden right can help governments address macroeconomic challenges and ensure long-term economic prosperity.

On the other hand, institutional indicators of VAT assess the efficiency, transparency, and fairness of the administration and collection of this tax. VAT is an important source of revenue for countries, and its proper functioning depends on the quality of the institutions that administer it. These indicators look at how well the state manages the VAT system, reduces tax evasion and ensures a fair burden on taxpayers. Our research was targeted to reveal the impact of crisis periods on VAT rates and their impact on the categorisation of EU countries.

2. Theoretical background

The determinants of the value-added tax are mainly national macroeconomic development indicators and, to a lesser extent, indicators used from the perspective of institutional development. From a macroeconomic perspective, a study by Castro and Camarillo (2014) confirms that if a country has a higher gross domestic product, lower foreign direct investment and a more widespread level of industry, the economy can achieve higher tax revenues to the country. In the context of the standard of living in countries, many are concerned about its direct impact when introducing a value-added tax. According to Alavoutunka, Happen and Pirttlä (2019), the introduction of this type of tax has not significantly impacted the change in the population's standard of living. Concerns related to an increase in inequality in the country have not been demonstrated, and therefore, the impact of VAT on living standards is insignificant.

A study by Acosta-Ormaechea and Morozumi (2021) focusing on the economic growth of OECD countries traced that an increase in VAT results in an increase in economic growth only under the condition of an increase in the efficiency of tax collection, the so-called C - efficiency. The authors also pointed out that a reduction in the applied basic tax rate can offset an increase in the efficiency of tax collection. This compensation would increase the population's purchasing power, supporting increased economic growth to a greater extent through increased tax revenues. On the other hand, VAT would also positively impact economic growth theoretically if the efficiency of tax collection and collection were increased. According to another study by Andrejovská and Helcmanovská (2021), a change in the basic rate results in a negative impact on the economic development of a country in the short run. It mainly points to a slowdown in economic growth.

In the long run, the impact of a change in the basic tax rate is perceived more positively. The accumulation of tax revenues in the national budget of economies will help to build up reserves in the event of a crisis. Household consumption is often associated with VAT. A study by Alm and El-Ganainy (2013) highlighted VAT's effectiveness. The results confirmed that the use of VAT in a country's tax system results in a reduction in household consumption. Another indicator from the group of macroeconomic indicators is the determinant of unemployment. Unemployment was not confirmed to impact VAT use efficiency significantly in the study.

A negative result in the context of the impact of unemployment growth on economic growth through VAT was obtained in a scientific study by Acosta-Ormaechea and Morozumi (2021), Urbancová and Hudáková (2015). Increasing levels of unemployment result in a reduction in tax revenues from goods and services, which, in turn, negatively affects the economic growth of countries. Another important indicator is inflation. According to Alm and El-Ganainy (2013), inflation has a positive relationship with VAT. The positive relationship was equally confirmed in a study by Limberg (2022) focusing on fiscal pressure. In the long run, rising inflation impacts the

fraudulent behaviour of the population. Another important determinant of value-added tax is international trade. This determinant in relation to VAT was pointed out in a study by Johnson and Noguera (2012). According to its authors, the inadequacy and inaccurate reporting of mainly imported services between countries was confirmed. This confirmed the negative influence between international trade and VAT. From a macroeconomic perspective, Limberg (2022) points out the importance of this indicator. He argues that countries with democratic political regimes use VAT as a tool to increase the efficiency of taxation in times of crisis. The most common way is to broaden the base of the basic tax rate, which affects the country's largest group of goods and services. At the same time, the author comments on corruption in public administration and confirms the general statement about the negative impact of corruption on the efficiency of VAT.

3. Research objective and methodology

The paper aims to assess the impact of the crises on the change in the distribution of the surveyed countries in the context of value-added tax. This impact on macroeconomic and institutional development indicators has been examined. The paper aimed to answer the research question: "Did the crisis period in the economy have an impact on the change of the value-added tax rate?" The research included rate change analysis, correlation analysis, principal component analysis, and cluster analysis. The correlation analysis consisted of testing the analysed data to ensure its independence. Using principal component analysis, we adjusted the selected data into two groups of components. The theoretical basis of PCA analysis comes from Abdi and Williams (2010). The next part of the research consists of applying cluster analysis using the hierarchical method, while we used the most used Ward's method. The theoretical base comes from Král' and et. Al (2009) and Labudová (2021). Cluster analysis was performed for each observation period separately. The results of the cluster analysis were then compared.

For the analysis, annual data of the European Union countries for the period 2000-2021 are used. Data were drawn from the European Commission, the World Bank, the OECD and DataFinder databases. From the selected period, the analyses mainly focus on the crisis periods of 2008 (global financial crisis) and 2020 (pandemic crisis). The results of the crisis periods were then compared with 2004. The countries analysed are the Member States of the European Union. Specifically: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Sweden and the United Kingdom. In each of the years under review, emphasis was placed on the validity of membership in the year under review.

The choice of determinants (Table 1) was heavily influenced by Castro and Camarillo (2014), Acosta-Ormaechea and Morozumi (2021), Andrejovská, Helcmanovská (2021), Alm and El-Ganainy (2013), Morrow, Smart and Swistak (2022), Johnson and Noguera (2012), and Limberg (2022). With the rule, the authors have focused on examining value-added taxes from the perspective of various macroeconomic indicators. Limberg (2022) was the only one of these authors who analysed the topic of value-added tax from the perspective of selected indices.

Table 1. Overview and Description of Variables

Variable	Unit	Label	Source	Description
Standard rates	%	STR	European Commission	Tax is applied to the value-added of goods and services sold within the territory of a country.
Macroeconomics Variables				
Gross domestic product per capita	\$	GDPpc	World Bank	Gross domestic product based on purchasing power parity per capita.
Population	Total number	POP	World Bank	Total population with nationality of the country.
Unemployment	%	UNE	World Bank	Proportion of the labour force that is unemployed and looking for work.
Inflation	%	INF	World Bank	The annual percentage change in the consumer's cost of acquiring goods and services.

International trade	Billions of dollars	TOGC	OECD	Net trade in goods and services representing transactions between residents and non-residents.
Institutional Variables				
Index of globalisation	<0-100>	KOF	DataFinder	Government's ability to effectively formulate and implement sound economics.
Government Effectiveness	<-2,5 – 2,5>	GE	World Bank	Degree of independence from political pressures and the clauses of policy formulation. The quality of public government services.
Regulatory Quality	<-2,5 – 2,5>	RQ	World Bank	The ability of the government to formulate and implement regulations that promote development in the economy.
Rule of law	<-2,5 – 2,5>	ROL	World Bank	Level of private sector trust in compliance with social rules.
Control of Corruption	<-2,5 – 2,5>	COC	World Bank	Perceptions of the extent to which public power is used to benefit private interests.

Source: Own processing

We tested the expected relationships between the selected determinants of Table 2 with the results of empirical studies.

Table 2. Expected Impact of Selected Variables on Value-Added Tax

Author, Year	Variable	Relationship between Dependent and Independent Variables	Expected Relationship
Castra, Camarillo (2014)	GDPpc	positive	+
Acosta-Ormaechea & Morozumi (2021)		positive	
Limberg (2022)	POP	positive/negative	+
Alm & El-Ganainy (2013)	UNE	positive	-
Acosta-Ormaechea & Morozumi (2021)		negative	
Alm & El-Ganainy (2013)	INF	positive	+
Limberg (2022)		positive	
Morrow, Smart & Swistak (2022)	TOGC	positive	+
Johnson & Noguera (2012)		negative	
Morrow, Smart & Swistak (2022)	TOGC	positive	+
Limberg (2022)		KOF, GE, RQ, ROL, COC	

Source: Own processing

The analysis was based on the following hypotheses:

- Developed countries of the European Union will be more likely to implement temporary reductions in the standard VAT rate during the global financial crisis and the pandemic crisis to support economic growth.
- Less developed EU countries resorted to increasing the standard VAT rate to compensate for losses in international trade and maintain the stability of their state budgets due to the global financial crisis and the pandemic.

4. Results and discussion

4.1 Analysis of rate change

The basic rate of value-added tax has been analysed from two perspectives. Changes in the basic tax rate are examined in the paper using an extended time frame. The reason is that this allows a better understanding of trends and changes in the periods before and after and increases the accuracy of the analysis. Table 3 shows the countries where the basic tax rate has changed. For the other countries studied, there were no changes in base

rates. There were only exceptional changes in the base rate in the 2004 reference period, while the rate remained unchanged in the other 20 countries. The most frequent change was a decrease in the base rate with the application of the new rates from 1 January 2004. The highest increase was recorded in Malta, where there was a 3% increase in the basic tax rate. The increase in VAT in Malta was reflected in a decrease in institutional indicators as the country's consumer goods and services prices increased. Conversely, in Slovakia and the Czech Republic, where there was a reduction in the basic tax rate, this may have had a positive impact on the observed quality determinants. In the context of 2004, the analysis also focused on the post-period in which there were two increases in the basic tax rate, namely, in Greece and Portugal.

Table 3. Evolution of standard tax rate

Countries	2004			2008			2020		
	2003	2004	2005	2007	2008	2009	2019	2020	2021
Czech Republic	22	19 (-3)	19	19	19	19	21	21	21
Estonia	18	18	18	18	18	20 (+2)	20	20	20
Great Britain	17,5	17,5	17,5	17,5	17,5	15 (-2,5)	20	20	NA
Greece	18	18	19 (+1)	19	19	19	24	24	24
Hungary	25	25	25	20	20	25 (+5)	27	27	27
Latvia	18	18	18	18	18	21 (+3)	21	21	21
Lithuania	18	18	18	18	18	19 (+1)	21	21	21
Malta	15	18 (+3)	18	18	18	18	18	18	18
Portugal	19	19	21 (+2)	21	20 (-1)	20	23	23	23
Slovak Republic	20	19 (-1)	19	19	19	19	20	20	20

Source: Own processing

The evolution of the standard VAT rate in crisis periods shows differences. In the 2008 period, changes in the applied standard rate were made due to the negative effects of the global financial crisis. This was particularly evident after 2008 when the basic tax rate increased. These are the countries of Hungary, Lithuania and Latvia. This decision may have had the effect of lowering the institutional indicators of the respective economies. The analysis shows that Portugal has changed its tax policy more often than other EU countries in the light of their economic development. The reduction in the applied VAT rate occurred during the global financial crisis when the UK reduced its standard VAT rate to the lowest recommended level. This was a demonstration of strong fiscal stability on the part of the UK and an attempt to mitigate the impact of the crisis. In contrast, a consistent fiscal policy was pursued during the pandemic crisis. The economies did not apply any changes to the standard VAT rate.

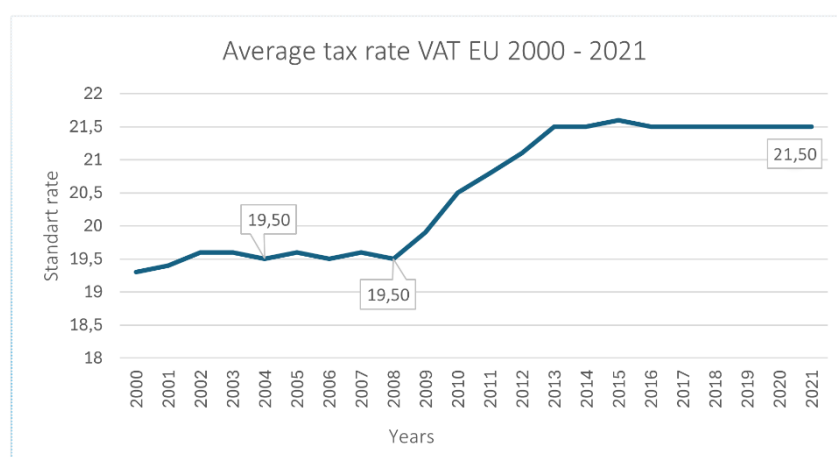


Figure 1. Evolution of the average standard rate

Source: Own processing

From the results of the rate changes in the years under review, it can be assumed that there were no significant changes. Analysing the average basic tax rate for all countries of the European Union showed the opposite.

According to the analysis, the crisis periods of 2004, 2008, and 2020 are relatively stable in this respect (Fig. 1). However, the most significant increase in the average basic tax rate occurred only after the economic crisis of 2008-2009. According to the results, economies changed their tax policies after this economic crisis due to possible bankruptcy and its consequences. Most economies changed the value-added tax by increasing the applied tax rates. The overall average in the European Union has increased from 19.50% to 21.50%.

4.2 Correlation analysis

The results of the correlation analysis in the crisis periods of 2008 (global financial crisis) and 2020 (pandemic crisis) showed a strong positive effect among the determinants of institutional development (Fig. 2).

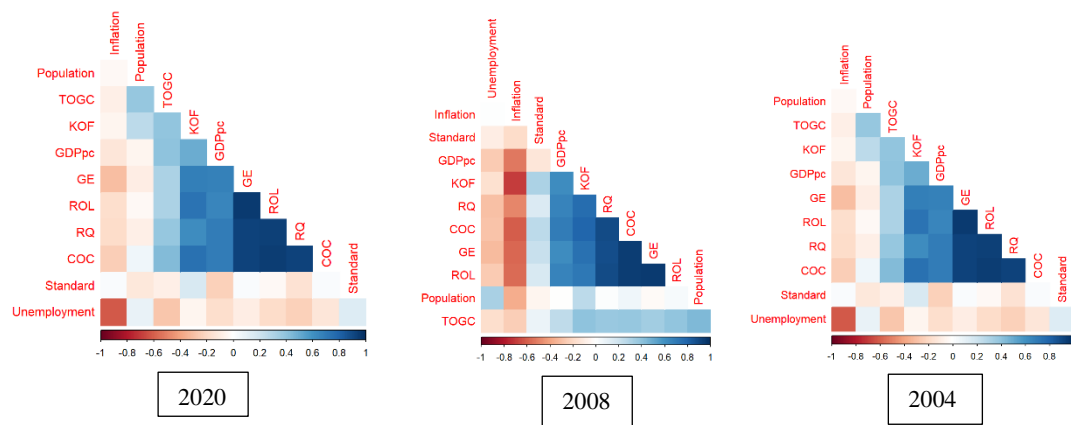


Figure 2. Correlation matrix

Source: Own processing based on results in Rstudio

Evidence of correlation between the population standard of living indicator and the globalisation index (KOF), government effectiveness (GE), legislation (ROL), and regulatory quality (RQ). A strong positive effect between institutional indicators and international trade is also confirmed in both years under study. This suggests that increasing quality and satisfaction in a state is related to increased international trade. In the crisis year 2020, there is a negative relationship between inflation (INF) and unemployment (UNE). In the next crisis year, 2008, the negative relationship between inflation and the observed institutional indicators and standard of living is negatively manifested. The zero relationship was confirmed in the crisis years mainly in relation to population, unemployment and inflation. This relationship is mainly demonstrated by the population and indicators of legislation and control of corruption. Crisis years showed comparable results to the baseline year. The predicted strong positive relationship between institutional development indicators and the standard of living (GDPpc) of the countries was observed in all the years under study. The standard tax rate did not significantly impact the other indicators observed.

4.3 Cluster analysis results

4.3.1 Global financial crisis

The first crisis period addressed in the article is the global financial crisis. The data are taken from Tab. 5. The cluster analysis results between 2004 and 2008 showed minor differences in the categorisation of European Union countries. The results are shown graphically in Fig. 3.

The categorisation of countries between 2004 and 2008 was divided into three clusters. The clusters are analysed according to size, from the smallest to the largest. The first cluster in the base period contains Germany, France, Italy and Poland. In 2008, the first cluster included Germany, Italy, Spain, France, and the UK.

The main characteristics of the clusters are shown in Table 4. A more detailed focus is on the baseline characteristics during the global financial crisis. Generally, it is a cluster of countries whose value-added tax rate did not reach a higher level than 22% in the years under review. In this cluster, we register a higher average unemployment rate of up to 7.63%; the standard of living is at \$35,685.2 per person. Compared to the countries in the second cluster, this is a decrease of only \$12,349.7.

The level of inflation is the lowest of all the clusters studied. It is 4.07%. In terms of institutional development, the results show a very good condition of the government despite the global financial crisis. The globalisation indicator scores only 2.44 points lower than the most advanced economies. The impact of the crisis on these countries has been minimal. Although the lowest value of the decline in international trade reached as low as -63,391.16 their average value was estimated at \$38,836.61 million.

The proof of this is that in the merged countries, according to the above statistics, there was no significant decline in international trade due to its impact. We identify a difference in the positioning of the countries of Great Britain, Spain and Poland. In the case of Poland, from a macroeconomic point of view, there has been a very significant fall in international trade of up to 11 823.83 million \$. Spain, during the period of the global financial crisis, suffered a substantial decline in international trade, and the fact is that it achieved the largest decline for all EU countries at -69 391.2 million dollars. In the area of social policy, Spain had the highest unemployment rate of any country at 11.25%.

The results of the institutional indicators showed that society is satisfied with the government and its provisions despite the deteriorating economic situation in the country. The high values in the quality indicators monitored evidence this. This shows that from an economic point of view, Spain has been significantly affected by the global financial crisis. Another country that has been categorised differently is the UK. The country shows a stable economic situation with respect to institutional indicators. This is also evident in the case of international trade, which has improved significantly over the period under review from a decline in 2004 of USD 6 962 million to an increase of USD 34 702 million.

The second cluster in the base period comprises the countries of the Netherlands, the UK, Belgium, Austria, Ireland, Luxembourg, Denmark, Finland and Sweden. The countries are clustered identically in 2008 except for the UK. The analysis showed that the countries in this cluster did not change their standard VAT rates. Countries in the years studied had high living standards, which in 2008 were a maximum of \$90,970.72 per person. The results also show that these countries achieve an average standard of living of \$48,034.90 per person.

During the global financial crisis, the countries reached unemployment levels of up to a maximum of 7%. This demonstrates a good economic situation and the countries' efforts to maintain jobs. Regarding international trade, the global financial crisis did not significantly affect trade relations with foreign countries. This is evidenced by the fact that its level has not fallen below USD 7,368.05 million.

Similarly, in terms of the country's institutional development, the indicators do not indicate a significant deterioration compared to the previous period. In the case of the indices monitored, they reach high values above 1.5 points. This shows that the countries in this stable grouping are achieving economic growth despite the global financial crisis (Table 4).

Table 4. Characteristics of Variables in Clusters 2008

		STR	GDPpc	POP	UNE	INF	TOGC	KOF	GE	RO	ROL	COC	
2004	1. cluster (9)	MIN	15	31201.93	458095	4.49	0.19	-6962	81.29	1.52	1.34	1.31	1.27
		MAX	25	64692.94	59987905	10.36	2.23	47571.61	87.42	2.28	1.78	2.41	2.41
		MEAN	20.6	37236.46	13224152	6.03	1.44	17347.52	80.54	1.95	1.65	1.73	1.92
	2. cluster (15)	MIN	15	8990.40	401268	4.33	1.16	-47237.51	67.07	-0.17	0.18	-0.18	-0.32
		MAX	25	26143.77	42921895	18.60	11.87	487.97	81.37	1.33	1.31	1.33	1.34
		MEAN	18.9	17903.93	8928690	9.61	4.30	-6502.83	74.36	0.73	0.95	1.02	0.56
	3. cluster (4)	MIN	16	13353.76	28182222	7.87	1.66	-2934.87	75.21	0.43	0.75	0.41	0.11
		MAX	22	31334.02	82516260	19.70	3.38	136147.38	84.84	1.75	1.47	1.84	1.84
		MEAN	19.4	25824.50	60275029	11.65	2.35	40287.74	80.54	1.07	1.13	1.01	0.94
2008	1. cluster (8)	MIN	15	37883.3	48865	3.65	2.48	7368.05	82.82	1.38	1.40	1.33	1.36
		MAX	25	90970.72	16445593	6.98	4.48	57150.46	89.37	2.24	1.91	1.95	2.37
		MEAN	21	48034.9	756023	5.36	3.57	20454.59	87.42	1.77	1.68	1.78	1.98
	2. cluster (14)	MIN	15	14346.9	40937	3.65	2.58	-26882.58	71.64	-0.35	0.59	-0.12	-0.27
		MAX	22	34830.27	38125759	9.51	15.40	4689.34	84.49	1.52	1.38	1.61	1.19
		MEAN	18.93	23816.4	884499	6.33	7.09	-6472.92	78.59	0.73	1.03	0.79	0.47
	3. cluster (5)	MIN	16	33263.2	4595410	5.62	2.62	-69391.16	81.11	0.27	0.97	0.44	0.26
		MAX	20	37802.39	82110097	11.25	4.07	222825.08	88.10	1.63	1.78	1.73	1.74
		MEAN	18.42	35685.2	6261552	7.634	3.28	38836.61	84.98	1.18	1.36	1.31	1.25

Source: Own processing

The last cluster is made up of countries mainly from smaller economies. In 2004, these countries were Romania, Luxembourg, Slovakia, Belgium, Croatia, Portugal, Cyprus, Malta, Slovenia, Estonia, Lithuania, Spain, Hungary and Greece. In 2008, on the other hand, the cluster was made up of Cyprus, Czech Republic, Malta, Estonia, Slovenia, Poland, Portugal, Slovakia, Greece, Hungary, Lithuania, Latvia, Belgium and Romania. The grouping of countries has not changed significantly over the years. Over the years, there have been changes in the taxation policy applied to goods and services. As in previous cases, a more detailed analysis focuses on the impact of the global financial crisis on the determinants under consideration. The average applied rate has remained at 19 %. The maximum value of the standard tax rate is reduced by 3% to 22%. For this grouping, the distribution according to the economic performance of the countries was confirmed. Over the years under review, countries have experienced increased living standards despite the pressure caused by the global financial crisis. Newly integrated economies reduced unemployment levels over the period under review. However, the economic situation in 2008 caused the most significant decline in international trade among the other clusters. Evidence of the significant decline in international trade is the average value - \$6,472.92 million. Institutional indicators also point to the impact of the crisis on countries.

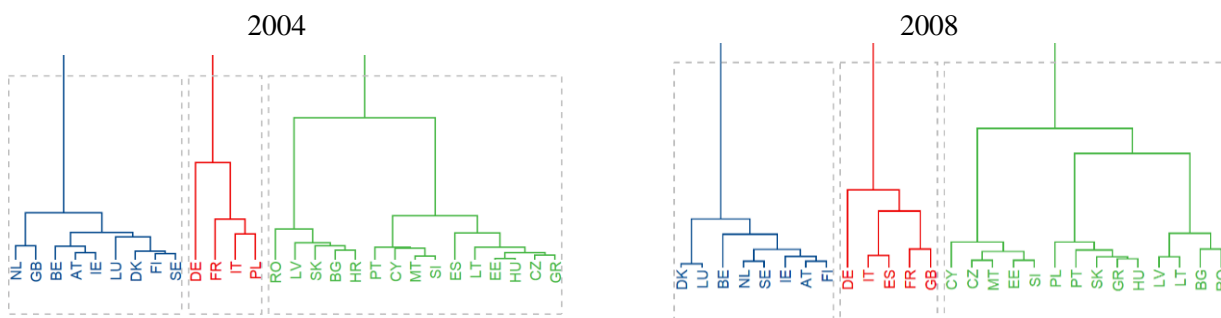


Figure 3. Cluster's dendrogram in economic crisis
 Source: Own processing based on results in Rstudio

The quality of government policies and public confidence is significantly lower than other clusters in 2008. This is evidenced by the index's average level reaching a maximum of 1.03 points. This demonstrates the lower population satisfaction with government decisions. This issue may also be related to the negative perception of changes related to the value-added tax. In view of this, most countries have been undergoing tax reforms.

4.3.2 Pandemic crisis

Another crisis period that the article focuses on is the pandemic crisis. The following findings were identified based on the results of comparing clusters using cluster analysis. All the data presented in the article come from Table 6. In the case of the pandemic period, clusters are analysed based on the similarity of groupings. The analysis of the pandemic crisis period, comparing 2004 with 2020, showed different results in classifying outcomes compared to the previous period under observation. In the case of the pandemic crisis, the classification of countries is divided into three optimal clusters. The graphical representation of the clusters is provided in Figure 4. The first cluster, in the baseline period, includes the countries of the Netherlands, Finland, Sweden, Luxembourg, Denmark, Ireland, Austria, Belgium, and the United Kingdom. In the pandemic crisis period, the countries in this cluster are the Netherlands, Finland, Sweden, Luxembourg, Denmark, Ireland, Austria, Belgium, and Germany.

The research results indicate the following findings: Between 2004 and 2020, during this period, the basic VAT rate increased from a minimum of 15% to 17%. On average, the basic VAT rate rose to approximately 22%. This increase in the basic VAT rate could have been caused by the slowdown of economies following previous crises and their efforts to support economic growth. The first cluster in 2020 generally consists of economies with higher living standards compared to other economies. For example, the average living standard in this cluster is around \$67,929.4 per person, with the highest value during the entire period reaching \$120,010.12 per person. Despite the outbreak of the pandemic and the implementation of measures, the countries achieved very positive results in the monitored indicators. During the pandemic, there were no significant fluctuations in international trade, and the unemployment rate decreased on average to 5.85%. From the perspective of institutional indicators, countries achieved high levels of indices. For example, this is evidenced by reaching up to 90 points in the globalisation index and a corruption control determinant score of 2.23 points. This shows that countries are implementing effective anti-corruption measures, supporting the fight against corruption in public administration, and the state has a high level of public trust. There were differences in the classification of the United Kingdom. The UK achieved high economic growth and relatively high government quality in the baseline period. Due to its exit from the EU in 2020, it is impossible to compare its position during the pandemic. Another country whose classification was different was Germany. Over the years, Germany's basic VAT rate rose to 19%, the standard of living increased to \$56,482 per person, and the level of international trade reached

\$175,429.60 million. Compared to the development of other countries, Germany's economy achieved the highest values and demonstrated significant economic growth despite the pandemic.

Table 6. Characteristics of Variables in Clusters 2020

			STR	GDPpc	POP	UNE	INF	TOGC	KOF	GE	RQ	ROL	COC
2004	1. cluster (9)	MIN	15	31201.93	458095	4.49	0.19	-6962	81.29	1.52	1.34	1.31	1.27
		MAX	25	64692.94	59987905	10.36	2.23	47571.61	87.42	2.28	1.78	2.41	2.41
		MEAN	20.6	37236.46	13224152	6.03	1.44	17347.52	80.54	1.95	1.65	1.73	1.92
	2. cluster (15)	MIN	15	8990.40	401268	4.33	1.16	-47237.51	67.07	-0.17	0.18	-0.18	-0.32
		MAX	25	26143.77	42921895	18.60	11.87	487.97	81.37	1.33	1.31	1.33	1.34
		MEAN	18.9	17903.93	8928690	9.61	4.30	-6502.83	74.36	0.73	0.95	1.02	0.56
	3. cluster (4)	MIN	16	13353.76	28182222	7.87	1.66	-2934.87	75.21	0.43	0.75	0.41	0.11
		MAX	22	31334.02	82516260	19.70	3.38	136147.38	84.84	1.75	1.47	1.84	1.84
		MEAN	19.4	25824.50	60275029	11.65	2.35	40287.74	80.54	1.07	1.13	1.01	0.94
2020	1. cluster (9)	MIN	17	52305.2	63041	3.82	-0.33	7368.05	85.37	1.08	1.34	1.33	1.45
		MAX	25	120010.21	83160871	8.29	1.38	175429.64	90.48	1.90	1.85	2.02	2.23
		MEAN	21.66	67929.4	1648755	5.85	0.58	48193.13	88.09	1.60	1.63	1.68	1.87
	2. cluster (5)	MIN	19	25296	693401	2.55	1.67	-26882.58	79.04	-0.29	0.34	-0.12	-0.32
		MAX	27	42827.06	37899070	5.12	3.37	21929.17	84.85	0.91	1.23	1.02	0.61
		MEAN	22	34188.9	1690926	4.02	2.83	3277.55	81.59	0.25	0.67	0.45	0.16
	3. cluster (13)	MIN	18	28416.5	51533	4.35	-1.25	-69391.16	76.79	0.36	0.36	0.21	0.03
		MAX	25	48134.96	67571107	16.31	1.93	37965.42	86.94	1.29	1.53	1.33	1.58
		MEAN	21.23	38085.5	1651984	8.49	0.13	-1346.06	82.09	0.83	0.91	0.79	0.63

Source: Own processing

EU countries are divided differently in the other two clusters. The first group is characterised by the smallest number of merged countries. In 2004, the most developed economies of the European Union were grouped in the smallest cluster. These countries are Germany, France, Italy, and Poland. On the other hand, in 2020, the economies with a lower standard of living were grouped. These countries include Bulgaria, Romania, the Czech Republic, Hungary, and Poland. The only exception in this case is Poland, which remained in the smaller group of countries. Poland distinguished itself from the smaller EU economies through its economic stability, particularly by showing an increase in international trade at a time when the international trade of less developed EU economies was declining. The largest cluster in the baseline period was composed of Romania, Luxembourg, Slovakia, Belgium, Croatia, Portugal, Cyprus, Malta, Slovenia, Latvia, Estonia, Hungary, Czech Republic, and Greece. In 2020, the largest cluster was composed of Greece, Spain, Croatia, Lithuania, Latvia, Cyprus, Estonia, Portugal, Slovenia, Malta, Slovakia, Italy, and France. Compared to the baseline period, differences were identified in the positions of Romania, Bulgaria, Hungary, and the Czech Republic. In general, the countries in 2020 were significantly impacted by the crisis, mainly through a decline in international trade, reaching as low as -\$69,391.16 million. Another assumption is that the standard of living in these observed clusters reaches only one-third of the standard of living of the countries in the first cluster in 2020.

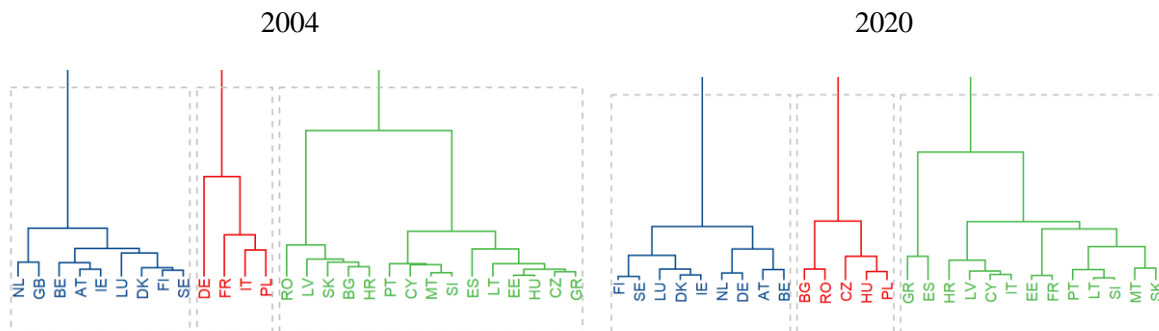


Figure 4. Cluster's dendrogram in pandemic crisis
Source: Own processing based on results in Rstudio

Institutional development indicators also confirm their influence on the division of countries. The lowest satisfaction is demonstrated by indicators of corruption control and government effectiveness, with an average score below 1 point. Based on this, we can assume that the public perceived the guidance used during the spreading pandemic very negatively, and trust in the state decreased.

4.4 Analysis results and discussion

The analysis of the results of correlation analysis, combined with the results of cluster analysis, answers the research question: "Did the economic and pandemic crises affect the change in the value-added tax rate?" The results of the analyses pointed to the significant impacts of crisis periods on the economic situation in the observed economies. The pandemic and global financial crises have significantly influenced countries' economic outcomes. Changes occurred mainly in indicators such as living standards, unemployment, and international trade. Economies more affected by the economic crisis showed significantly higher levels of unemployment than others. At the same time, these countries experienced a decline in living standards, which affected the population's purchasing power. The crises also manifested in institutional development indicators. During the observed periods, there were declines in qualitative indicators. The analysis of results also revealed a relationship between changes in the basic VAT rate and the development of institutional indicators. With the increased applied tax rate, institutional indicators responded by decreasing, confirming negative perceptions from society. The research results confirmed a positive relationship between the standard VAT rate and international trade. Another positive relationship exists between the standard VAT rate and institutional indicators. These findings confirm that increased international trade and quality improvement positively affect VAT's development. Unemployment demonstrated a negative impact in relation to the standard VAT rate. During this period, the influence of other determinants was not confirmed. The research found different results in the next period of the pandemic crisis. The only variable that partially confirmed its influence on the basic VAT rate was the globalisation index indicator. As globalisation increased between countries, the standard VAT rate was positively affected, for example, by its rise. According to the results, other determinants during the pandemic crisis did not significantly affect the development of the basic VAT rate.

Due to the differences in tax policy implementation, many countries did not significantly change the tax rates applied during the observed years. The most developed countries in the European Union were less prone to changes or only temporarily reduced VAT rates. Among the countries that aimed to stimulate the economy during the global financial crisis were the United Kingdom and Portugal. The United Kingdom sought to stimulate the economy, so in 2008, it temporarily reduced the standard VAT rate from 17.5% to 15% for 13 months. This step was part of a broader government stimulus package to support consumer demand and stabilise the economy during the financial crisis. Portugal implemented several VAT reductions for specific sectors to ensure the population's basic needs, with cuts primarily concerning food and certain services.

In contrast, Spain did not implement a blanket VAT reduction. Still, it adopted several measures to reduce taxes for small and medium-sized enterprises and certain consumer goods to stimulate demand and support small businesses. More significant changes occurred in smaller European economies, aiming to increase their tax revenues to mitigate negative impacts. It was confirmed that these countries have lower economic stability and weaker fiscal capacity. Another group comprises countries with the lowest fiscal capacity, with more extensive reductions impossible. During the global financial crisis, these countries utilised other fiscal measures. For example, Romania provided tax relief to small businesses and reduced VAT rates for the most vulnerable population; however, in response to economic pressures, it even increased VAT to stabilise public finances. Greece similarly faced a deep debt crisis during the financial crisis, and reducing VAT was not a sustainable solution; thus, under pressure from international creditors, it decided to increase VAT to reduce its budget deficit. France responded to the global financial crisis and its pressures by implementing fiscal stimuli and job support programs.

Conversely, Italy supported businesses through tax relief and subsidies for small enterprises. Some EU countries adopted more progressive measures in response to the global financial crisis. For example, Hungary increased its standard tax rate to 25%. Despite the increased VAT, Hungary simultaneously implemented an 18% tax rate on essential consumer products, bakery items, and central heating for the most vulnerable population. These measures aimed to cover the budget shortfall in the economies (European Commission 2009, 2021). Keen and Lockwood (2010), Clossen (2019), Bird and Gendron (2007) state regarding Hungary that during the global financial crisis, Hungary was in recession, and the increase in the standard tax rate artificially boosted demand for products (OECD 2010), (IMF 2020). Hungary's institutional indicators confirmed claims about the negative perception of changes in basic rates (Andrejovská & Helcmanovská, 2021). However, the impact of the pandemic crisis is also evident. The pandemic crisis influenced changes primarily in implementing fiscal stimuli and changes related to the reduced tax rate. For example, Spain focused on supporting tourism and hospitality. In Greece, the VAT rate was reduced for services related to transportation and dining. Portugal, Romania, and Bulgaria governments also focused on reducing VAT in the food service sector. The research did not address the nature of the fiscal stimuli provided and the reduced tax rates in other contexts. Slovakia and the Czech Republic decided not to reduce VAT rates but instead introduced the option of deferring VAT payments for companies facing significant financial difficulties. At the same time, processes for deducting VAT for businesses were simplified. Poland focused on improving the efficiency of VAT collection and strengthening tax controls while offering more flexible payment options for businesses. The analysis also indicates that the most significant changes occurred mainly after the global financial crisis from 2010 onward. Changes in this area can also be identified regarding the impacts of the pandemic crisis, but only in the post-COVID period. This fact confirms the claim that the VAT rate is influenced by the economic crisis within and outside the country. Evidence of this is that the average applied tax rate increased by 3% overall.

The impact of the global financial and pandemic crises led to the segregation and clustering of countries with similar economic situations. The results in all observed years confirmed the separation of countries with the best economic performance and sufficiently strong fiscal capacity. For this reason, these countries maintained their economic stability, and the fluctuations caused by the crises did not significantly affect them. In other clusters, some countries were more significantly impacted by economic recessions. From a research perspective, international trade was confirmed as a determinant of crises. The recorded decline and increase significantly influenced the arrangement of countries, especially during the observed crisis years. The most significant changes occurred mainly during the pandemic crisis when countries resorted primarily to closing their economies for the safety of their citizens. These measures significantly affected the demand side. Due to globalisation, there were declines in unproductive sectors, underutilisation of capacities, and supply disruptions. According to the International Monetary Fund, the crisis mainly affected cities and urban areas that generated most of the economic growth in the countries. De La Feria (2015), Hudakova et al. (2016), Seely (2013), Tait (1988), Poniatowski et al. (2020), Vígiová et al. (2023) also criticise the use of uniform procedures known as "best practices," which were transferred from more developed countries to less developed ones. Critics justify this by stating that less developed economies must consider the consequences, such as increasing public debt compared to fiscally more advanced economies.

We verified the established hypotheses' validity by analysing the research question and conducting a correlation analysis. The first hypothesis: "Developed countries of the European Union will be more likely to implement temporary reductions in the standard VAT rate during the global financial crisis and the pandemic crisis to support economic growth," has not been confirmed. According to the results, developed EU economies showed that reducing the standard VAT rate was not applied during the crisis. The research revealed that developed countries primarily relied on financial stimuli to maintain economic growth, such as benefits, support programs for employment retention, tax deferrals for businesses, and temporary reductions in tax rates for the tourism and restaurant sectors.

The second hypothesis: "Less developed EU countries resorted to increasing the standard VAT rate as a means to compensate for losses in international trade and to maintain the stability of their state budgets due to the global financial crisis and the pandemic crisis", was confirmed. The increase in standard VAT rates was primarily implemented by countries that joined the European Union in 2004. The goal of these countries was to compensate for the loss of state revenues, especially during the global financial crisis and a few years after it, up to 2010. The significant decline experienced in less developed economies resulted in substantial fiscal shortfalls during the years of the global financial crisis. Despite their fiscal declines, other less developed economies in the European Union implemented different forms of support for their economic growth. Following the examples of "western" countries, they primarily utilised tax deferrals, financial incentives for entrepreneurs, and similar measures. However, the actions of less developed countries in the European Union during the pandemic crisis did not confirm the hypothesis regarding increasing standard rates. These countries significantly adjusted their policies regarding reducing specific tax rates, tax relief, and financial incentives for the population. In the case of lowering specific rates, these were only temporary solutions that resulted in short-term improvements in the economic situation.

Conclusions

The crisis periods of the past two decades have confirmed that the nature of crises in European Union countries was different. While the global financial crisis primarily affected social policy through rising unemployment, the pandemic impacted international trade by implementing so-called "closed economies" during lockdowns, resulting in the most significant decline in international trade during the observed period. Using unconventional indicators of institutional development confirmed that countries with better economic situations received better ratings according to quality indices. According to this measure, the more effectively an economy tries to address a crisis situation with an impact on its population, the higher the quality of society. Changes in the standard VAT rate were confirmed only exceptionally. EU economies primarily utilised changes in specific rates, tax relief, and other financial stimuli to mitigate the impacts. In terms of legislative changes to the standard VAT rate, adjustments mainly occurred after the global financial crisis between 2008 and 2009, when many EU countries revised their fiscal policies, often raising VAT rates as part of fiscal consolidation. Our research indicated that the nature of changes in the standard VAT rate was only temporary. This was particularly evident during the pandemic crisis. However, we cannot unequivocally state that the COVID-19 pandemic brought significant economic shocks that necessitated stricter tax measures and support for affected sectors. EU countries differed in their response strategies, with some opting for temporary reductions in VAT rates to support consumption while others kept their rates unchanged. In the future, it would be interesting to expand the research to include additional determinants, both macroeconomic and focusing on the effectiveness of government measures. From the perspective of the countries analysed, based on the research results, it would be appropriate to focus on countries with the most significant changes in VAT issues during crisis years. Additionally, a more suitable focus on the years following the crisis would help capture results in the post-crisis period for a better evaluation of outcomes.

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