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E-Government and Economic Growth in the European Union: With a Specific Focus on Slovakia

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Abstract:

The first objective of this paper is to map the evolution of the determinants of e-government (EGOV) in EU countries from 2012 to 2022 through descriptive statistics and cluster analysis, and to assess the impact of EGOV development on economic growth. The second objective is to explore the specific challenges of EGOV implementation in Slovakia through a questionnaire survey. Through cluster analysis, we identified the position of countries based on similarities in individual indicators and evaluated the development when comparing 2012 to 2022. In the regression model, the independent variables, Control of Corruption and Telecommunication Infrastructure Index, had the greatest impact on economic development. Regarding Slovakia, which did not experience a significant improvement in the individual variables over the chosen 10-year period, we identified technical problems as the core barrier to EGOV implementation.

Keywords:

digitalization, economic growth, e-government, gross domestic product, Slovakia as post-communist country

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1. Introduction

E-government (EGOV) represents one of the key dimensions of current public sector reforms in every country. The increasing use of EGOV is associated with expectations of higher levels of transparency, improved communication between public administration and citizens, and growing accountability of public administration to all societal actors. From the point of view of international organizations, the status of EGOV within the EU is mapped by the European Commission's studies "Digital Economy and Society Index" and "eGovernment Benchmark". Eurostat statistics and others also track several EGOV indicators. European countries, including Slovakia, invest considerable resources in developing "e-government," which should bring visible impacts. Considering the importance of EGOV today, the effectiveness of resources spent on EGOV development needs to be systematically addressed.

Previous research has shown a significant relationship between electronic government (EGOV) and economic growth. Majeed and Malik (2016) were the first to confirm that EGOV can stimulate economic growth empirically. This topic was later addressed by Castro and Lopes (2021), who found that EGOV contributes to a more efficient allocation of resources, thereby supporting long-term and sustainable growth. Other studies, such as those by Mohamed et al. (2023), recommend that governments invest in telecommunications infrastructure and human capital development to improve readiness for e-government implementation, thereby creating favorable conditions for supporting growth.

The first objective is to analyse the evolution of e-government determinants (EGOV) in EU countries between 2012 and 2022 using cluster analysis and to assess how EGOV development affects economic growth. The second objective is to explore the specific challenges of EGOV implementation in Slovakia through a survey that examines the use and effectiveness of EGOV services and provides insights for future improvements. The structure of the paper is standard. The introductory part characterizes the current state of knowledge, followed by the methodology and two parts of the analysis (EU and Slovak level analysis). The discussion compares our results with other studies, and the conclusion presents synthetic results.

2. Literature overview

Foreign studies have shown considerable theoretical interest in EGOV issues and policy mechanisms in countries actively influencing the implementation of electronification. EGOV is an inherent driver of countries' economic development in the contemporary world. Many authors from a variety of perspectives have addressed the importance and impact of its implementation. Castelnovo (2013) argues that policies for EGOV can be evaluated according to their ability to enhance the ability of public administrations to

create public value for citizens as users, customers, policymakers, and operators of public administrations.

There is now a body of research examining the shortcomings and evolution of EGOV, which confirms that there is considerable room for improvement in the piecemeal engagement of digital government from an international perspective. Hence, the results have revealed that countries are not synchronously implementing EGOV (Heeks, 2004).

The crisis related to the COVID-19 epidemic moved the issue of EGOV to an international level of concern that reflected the needs of all societies in developing solutions to the barriers to the functioning of individual societies that arose; states sought to implement means of functioning that reflected the needs of the population (Moser-Plautz, 2023). A study conducted in China pointed to the impact of policy on e-government performance through the mediating effect of resource allocation and the mitigating effect of public-private collaboration (Pan & Fan, 2023), in terms of public-private synergy, the study complemented the findings of Lopes and Farias (2020), who pointed to cross-sector collaboration as a positive strategy in implementing EGOV versus strategies that seek to compete. Nonetheless, there is a need to develop governance mechanisms that will contribute to stakeholder engagement and the achievement of intended outcomes for this strategy to be successful to avoid failure, such as in human resources, as low human resources and therefore unskilled people reduce the implementation of EGOV in countries (Pan & Fan, 2023). From a skilled workforce perspective, the technical side of public administrators comes into focus (Aftab & Myeong, 2022), which determines the relationship between digital government devices and perceived functional benefits, and therefore the ability for legislators to create responsive and fast service portal systems to fulfil citizens' preferences (Kyeong et al., 2022). Government funding for EGOV varies across countries, and it is worth noting that governments have shown selective responsiveness to citizens' preferences for e-government systems (Kyeong et al., 2022; Profiroiu et al., 2023). A recent trend in the field of EGOV is also the emergence of artificial intelligence, which opens a new direction of knowledge and research. The first findings point to the suitability of AI application in the optimization of administrative management, which is currently criticized as a barrier to the use of EGOV (Ruvalcaba-Gomez & Cifuentes-Faura, 2023).

Previous research has shown a link between EGOV and economic growth. Majeed and Malik (2016) conducted the first study to assess the relationship between economic growth and e-government empirically. They confirmed the hypotheses that EGOV is a stimulant of economic growth. Subsequently, authors such as Castro and Lopes (2021), following up on the studies, used the example of more than 100 countries, examined the link between EGOV and long-term and sustainable economic growth, and came to significant results that showed that resources are allocated more efficiently thanks to EGOV. In terms of variables such as: obtaining information, downloading official forms and submitting completed official forms online; and/or E-Government Index (EGDI), Online Service Index, (OSI), Telecommunication Infrastructure Index (TII) and

Human Capital Index (HCI), the author team Mohamed, et al. (2023) report the results of a study that recommends that governments invest in telecommunications infrastructure and human capital development to improve readiness for e-government implementation. By improving infrastructure and digital skills, countries can create favorable conditions for developing e-government and its impact on economic growth. Recent studies in this area have shown significant shortcomings, especially in monitoring e-government implementation and establishing ongoing evaluation and feedback mechanisms.

In the field of quantitative research on the significance of EGOV and its impact on economic growth, the most used methods of analysis have been correlation analysis and regression model (Abu-Shanab & Osmani, 2019; Androniceanu et al., 2020; Boyer-Wright & Kottemann, 2015; Goloshchapova et al., 2023; Park & Kim, 2019; Silal et al., 2023). Various research suggests that the e-government index can be a statistically significant independent variable in terms of a country's economic growth (Malik & Majeed, 2020) and corruption reduction (Aleksandrova, 2022; Lupu & Lazăr, 2015; Mammadli & Klivak, 2020; Tan et al., 2020; Zhang et al., 2022). Research also indicates that EGOV has a positive impact on transparency, participation, and communication, and influences personal control of government policies in the context of reducing corruption in a country (Andersen, 2009; Goloshchapova et al., 2023; Jaeger, 2005; Kardan & Sadeghiani, 2011; Kim, 2013; Mistry, 2012; Park & Kim, 2019; Twizeyimana & Andersson, 2019).

Allocation of resources to EGOV has a positive impact on the functioning of the country, such as reducing corruption in the country, increasing government efficiency, and economic growth in the country (Andersen, 2009; Kim, 2013; Krishnan et al., 2013; Mistry, 2012; Park & Kim, 2019). MacLean and Titah (2022) have pointed out that investments in EGOV can create public value directly for the clients of new systems and for two other stakeholder groups: taxpayers who are interested in the efficient use of government resources, and citizens who have a wider set of social goals including developing trust, communication, and cooperation with government. Investments in EGOV can develop organizational capacity within a public agency, which may transform the relationship between government and citizens in the future. E-government systems can improve the productivity of clients and governments. Clients also benefit from improved service quality and customer satisfaction.

The key barriers to the implementation of EGOV include three areas: environmental and social challenges, economic challenges, and technological challenges (Tiwari & Singh, 2023). The different areas divide the challenges into groups. The main environmental social barriers include language, digital literacy, and lack of experience, and economic barriers include limited financial resources and maintenance of electronic devices. In the last area, problems such as the misidentification of requirements, lack of infrastructure, privacy and security are found. Within the barriers related to the implementation of EGOV, Muradov (2022) complemented the individual barriers with the problems of low public awareness of EGOV services, confirmed the

low technological, socio-financial, and human resources related to e-government, and pointed out the low level of knowledge of citizens in the field of EGOV services, as well as the inability to use some services without visiting state institutions. Research also highlights the problem of the digital divide (Abu-Shanab & Osmani, 2019) and other problems that occur with the use of EGOV services, such as the quality of electronic information channels (Miłosz & Miłosz, 2013), language and authentication (Falch et al., 2018), and even low trust towards government authorities (Zahid & Din, 2019). Administrative complexity decreases the efficiency of EGOV and creates a negative burden for firms, as approached in an Italian study (Andreus et al., 2016). Specifically, without better integration between national and local legislation, firms will continue to face a higher administrative burden than firms based in the rest of Italy. Studies have also explored the legislative framework of EGOV (Andreus et al., 2016; Xin et al., 2022) and the need to establish a uniform legislative framework that is suitably applicable to EU member states (Bhatnagar & Singh, 2010). A well-designed and effective regulatory body focused on telecommunications and promoting competition in the telecommunications environment can positively influence the development of EGOV (Gulati & Yates, 2011).

From the literature review results, the authors confirmed positive impacts in the evaluation of the implementation of EGOV (reduction of corruption, increase in government efficiency, and the like). However, there are also shortcomings, such as barriers to using services (language, authentication, and the like). Also, much attention in implementing EGOV belongs to the political sphere. Political attention figures as one of the constantly emerging indicators of EGOV implementation from different perspectives: In enhancing EGOV performance (Pan & Fan, 2023), setting clear strategies and goals (Lopes & Farias, 2020), technical proficiency of officials (Aftab & Myeong, 2022), reflecting citizens' needs (Kyeong et al., 2022), and appropriate funding and responsiveness to citizens' preferences within the EGOV system (Kyeong et al., 2022; Profiroiu et al., 2023).

3. Methodology and data

Our paper has two main objectives. The first objective is to analyze the evolution of e-government determinants (EGOV) in EU countries in 2012 and 2022 using cluster analysis and to assess how EGOV development affects economic growth. The second objective is to explore the specific challenges of EGOV implementation in Slovakia through a survey that examines the use and effectiveness of EGOV services and provides insights for future improvements.

To address the first objective, we work with secondary, generally available data, which we present through tables and analyse using the cluster analysis method on a sample of all 27 EU Member States. In the cluster analysis, we compare clusters for 2012

and 2022 to document the evolution of the selected indicators in the EU Member States. We focus on the evolution of EGOV policies from the EU and national level, as well as the level of implementation in a specific country. We use a correlation analysis to identify and quantify the strength of relationships between variables. Subsequently, we use a Granger causality test to assess one variable’s predictive power over another, helping to establish a clearer causal link. Understanding correlations in policy-making and business contexts can guide decisions by illustrating which factors might influence outcomes, allowing for more effective strategies. Also, we use regression analysis to assess the impact of different areas of EGOV development. The results of the cluster analysis present countries with a similar structure of individual independent variables. Table 1 represents the variables used in cluster analyses and descriptive statistics that evaluate the current state of implementation of EGOV in EU countries.

Table 1:
Characteristics of variables based on the type of variable and unit of measure

Unit of measure	Indicator	Description	Source
Eur per capita	GDP	Gross domestic product	Eurostat
Score (%)	CC	Control of corruption	World Bank
Score (%)	GE	Government effectiveness	World Bank
Score (%)	OSI	Online service index	World Bank
Score (%)	HCI	Human capital index	World Bank
Score (%)	TII	Telecommunication infrastructure index	World Bank

Source: Authors’ own, 2025

The choice of variables is based on previous research practices, the results of which we intend to validate against our time series, but also to extend with a new dimension. The independent variables - TII, OSI and HCI are direct indicators of EGOV development as defined by the EGDI index (e-Government Development Index) (United Nations, 2023). The online services index reflects the accessibility and efficiency of government services, which can enhance transparency and reduce costs. The human capital index highlights the importance of education and health in driving productivity and innovation. The telecommunication infrastructure index indicates the quality of connectivity essential for modern economic activities. The other two independent variables, CC and GE, are control variables expressing two critical dimensions of government performance in the country. Control of corruption acts as a tautological variable that foreign studies have confirmed as both a cause and a consequence of the introduction of EGOV. From our point of view, we further worked with an expert sample to confirm or refute the claims in the conditions of Slovakia. In the sections on Slovakia, we also work with Eurostat indicators. Control of corruption is crucial as it

influences the efficient allocation of resources and public trust, while government effectiveness ensures the implementation of policies that foster stability and investment. The relationship between EGOV and economic growth is tested using a classical panel regression model, working with panel data from 2012 and 2022. These criteria provide a comprehensive view of the factors influencing economic growth.

The variables selected for our research replicate those of various authors, e.g., Mohamed et al. (2023) used the Online Service Index (OSI), Telecommunication Infrastructure Index (TII), and Human Capital Index (HCI) to confirm economic development. We enriched these variables with CC and GE, which have shown significant positions in assessing the EGOV nexus of CC and GE, e.g. Chen and Aklirikou (2019), whose results indicate a positive relationship between the development of e-government and the efficiency of public administration, as well as between the development of e-government and its control of corruption. By combining institutional, technological, and social factors, this model provides a broader framework for understanding the relationship between e-government and economic growth.

Based on the results of the p-values of the regression model coefficients, we assess the statistical significance of the model to reject the H_0 of model insignificance. To determine the amount of variability a given model indicates, we examine the adjusted coefficient of determination (Adjusted R-squared). To test the assumptions of the classical regression model, we verify the multicollinearity of the model and subsequently the normality of the residuals through the histogram and Q-Q plot. To verify the homogeneity of the data, we use the variance inflation factor (VIF) method, which we quantified based on the available secondary data.

For the cluster analysis, we used the R program, first we clustered the data, which we cleaned and then standardized the data, due to the use of the K-means algorithm, which based on the average distances.[1] Based on the elbow method and Silhouette score (0.85), we chose a model based on 4 clusters. Finally, we compared each year to assess trends. From the point of view of regression model building, we followed the same procedure as for cluster analysis (data collection, data cleaning) in the first steps. We chose a linear regression classical model. To assess the model's fit, we chose R-squared, which indicated the proportion of variance explained by the model. We tested the model for multicollinearity through VIF (average VIF of coefficients was 0.35) and normality of the residuals through visual methods (histogram and Q-Q plot) and descriptive statistics. We primarily used EViews and Excel to process the model. To complement future research, it would be appropriate to explore alternative approaches such as hierarchical clustering, which does not require a predefined number of clusters and allows for visualizing relationships between countries using a dendrogram. Although this method provides a deeper insight into the hierarchical structure of the data, it is computationally more demanding and less efficient for large datasets. Another perspective could be the use of density clustering (e.g., DBSCAN), which is less sensitive to outliers and does not require a spherical distribution of clusters, thus providing a different view of group patterns in the data. Future exploration of these alternative

methods could contribute to a deeper understanding of the relationships between the variables under investigation and increase the robustness of the obtained results.

To fulfil the second objective, we document the extent to which EGOV services are used in Slovakia and present the results of a survey that was distributed to firms in Slovakia between August 2024 and October 2024 via an anonymized questionnaire in which respondents could indicate a contact for the following completion of their answers. The sample is not fully representative, but sufficient to document the situation in Slovakia and to provide additional information that could be used in future periods of EGOV deployment. The questionnaire included multiple-choice and open-ended questions focusing on key topics related to EGOV. Participants were selected based on their use of EGOV services, resulting in 96 respondents, with relevant demographic information collected to contextualize the findings. The survey was conducted online and anonymized; however, the response rate was low, approximately 15%, limiting representativeness. However, the low number of respondents may affect the statistical validity of the data.

Nevertheless, the findings provide valuable information on the current use of EGOV services in Slovakia and suggest areas for future improvement. The survey was conducted between August 2024 and October 2024, and descriptive statistics and a comparative analysis of qualitative responses were used in the data analysis. The main limitations included time constraints and low response rates.

4. Evolution of EGOV determinants in EU countries

Table 2 presents the evolution of the determinants of EGOV in EU countries comparing 2012 and 2022 using the cluster analysis method.

Table 2:
Comparison of the results of the cluster analyses of 2012 and 2022

2012	n	CC	TII	HCI	GE	OSI
Cluster 1 (DK, FI, FR, DE, LU, NL, SE)	7	0.83	0.81	0.92	0.86	0.84
		0.06	0.05	0.04	0.11	0.08
Cluster 2 (BG, CR, CY, CZ, LV, MT, PL, RO, SK)	9	0.51	0.54	0.87	0.80	0.55
		0.33	0.28	0.05	0.13	0.29
Cluster 3 (GR, IE, IT, LT, PT, SI)	6	0.54	0.62	0.92	0.67	0.62
		0.12	0.04	0.02	0.09	0.06
Cluster 4 (AT, BE, EE, HU, ES)	5	0.66	0.66	0.92	0.91	0.73
		0.07	0.06	0.01	0.07	0.06

2022	n	CC	TII	HCI	GE	OSI
Cluster 1 (DK, EE, FI, NL, SE)	5	0.83	0.94	0.95	0.83	0.95
		0.06	0.03	0.02	0.15	0.04
Cluster 2 (BE, CZ, GR, IR, LT, PL, SI)	7	0.62	0.84	0.94	0.74	0.77
		0.09	0.01	0.02	0.08	0.07
Cluster 3 (BG, CR, HU, IT, PT, RO, SK)	7	0.50	0.80	0.84	0.70	0.76
		0.07	0.02	0.02	0.16	0.06
Cluster 4 (AT, CY, FR, DE, LV, LU, MT, ES)	8	0.65	0.90	0.89	0.89	0.84
		0.10	0.03	0.03	0.07	0.04

Source: Authors' own based on data from the World Bank, 2025

From a cluster analysis perspective, we compared trends over time to identify changes in the determinants of EGOV. These changes reflect shifts in policy and/or technologies in countries.

The cluster analysis indicates that the EU countries have improved their position. However, not significantly and not equally - the values are CC 0.64 (improvement of 0.02 points), GE 0.79 (deterioration of 0.02 points), OSI 0.82 (improvement of 0.15 points), TII 0.86 (improvement of 0.21 points), and HCI 0.90 (unchanged value of the index).

The Telecommunication Infrastructure Index has shown significant improvement in all clusters, fluctuating between 0.54 in 2012 and 0.81 in 2022, and improving to an average of 0.80 to 0.94.

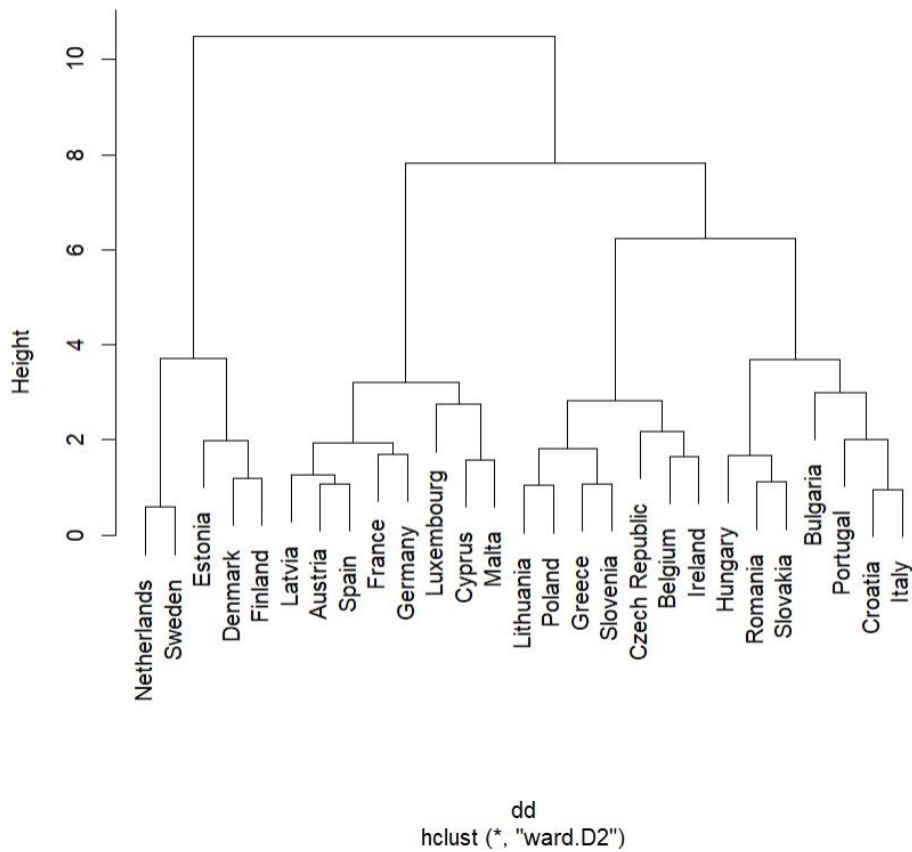
The most significant improvements were observed in Cyprus, Malta and Latvia; these countries improved their position by an average of 0.39 points. The Control of Corruption Index improved by 0.02 points. This index has decreased in Denmark, France, and Luxembourg, which had a higher CC value in 2012 than in 2022; on the other hand, improvement has been shown in several countries, although its average value was 0.63 in 2012 and only 0.64 in 2022. The Government Efficiency Index deteriorated, with Hungary experiencing a decline from 2012 to 2022 by an average of 0.21 points. We saw an average decline of 0.02 points in the overall change score.

The Human Capital Index remains unchanged between 2012 and 2022, averaging the same value at 0.9. On average, countries performed similarly in 2012. The most significant change is observed in Italy, which has the highest average HCI value in 2012 and the lowest in 2022 (2012 cluster 3, 2022 cluster 3). Hungary, Italy, and Portugal achieved the most significant negative change in that index at -0.08 points. The Online Services Index improved significantly, but three countries' values stagnated at 0.84 points and did not change (Denmark, France, Luxembourg). On the other hand, the

most positive changes were observed at 0.28 points in Malta, Latvia, and Cyprus.

Figure 1:
Dendrogram of European Union countries in 2022 based on variables

Cluster dendrogram



Source: Authors’ own based on data from the World Bank and Eurostat, 2025

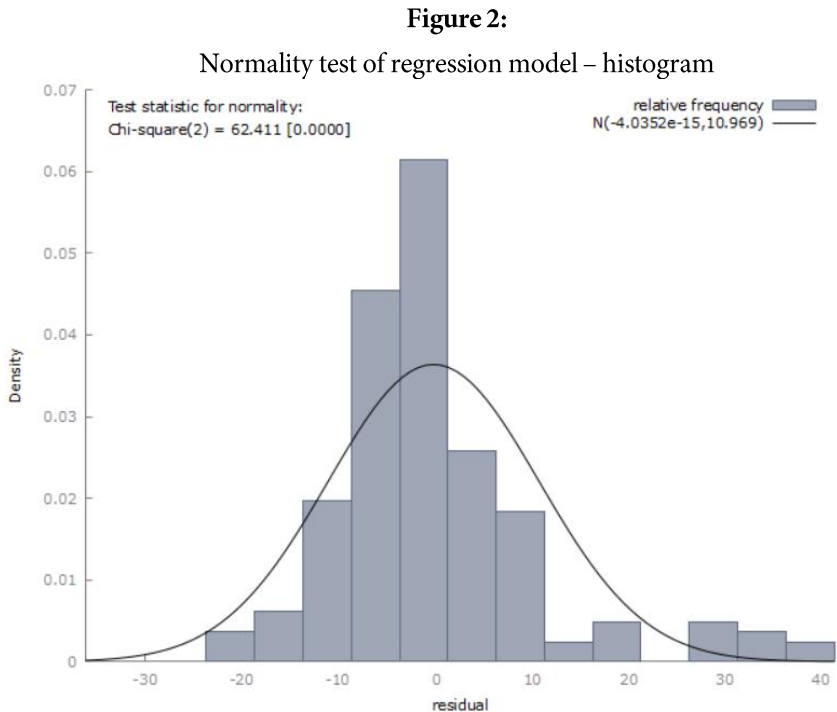
We used a combination of the Elbow method and the Silhouette score to determine the optimal number of clusters. The Elbow method analyzes the change in internal variability (inertia) with different numbers of clusters, with the “breakpoint” indicating the optimal number of four clusters for both analyzed years (2012 and 2022). We supported this result by calculating the Silhouette score, which reached a value of 0.85, indicating good separation and cohesion of the clusters. We used the k-means algorithm for the clustering itself, which was implemented in the R software.

K-means was chosen for its efficiency when working with large datasets and the interpretability of the results. Despite these advantages, we are also aware of the limitations of the method used—sensitivity to data scaling, the assumption of spherical clusters, and the potential variability of the results with different centroid initializations. To minimize these effects, the data were standardized, and the algorithm was run repeatedly to ensure the stability of the solution.

The selection of analyzed variables (GDP, Control of corruption, Government effectiveness, Online service index, Human capital index, Telecommunication infrastructure index) was motivated by their relevance to the socio-economic factors under study, while recognizing that including other indicators could affect the resulting segmentation.

4.1. The impact of EGOV on the economic growth of EU countries

Because the research question is solved through the regression model, it is necessary to verify the assumption of a linear regression model and the dependence of the individual variables. The model fit is verified through the graphical representation of the normality test and multicollinearity verification (Figure 2).



Source: Authors’ own based on data from the World Bank and Eurostat, 2025

Based on the Q-Q plot results and the normality test of residuals, we can evaluate that the model we constructed does not have a normal distribution. Still, rejecting H0 on the normality of residuals does not affect the following work with the model. Concerning the normality results, we note that the estimator is also not a maximum likelihood estimator. The given fact can also be explained by the fact that we are working with two years of data.

We evaluated the verification of multicollinearity in the model using the VIF method. Based on the results, we can conclude that there is no multicollinearity in the model because the VIF values for each variable reached a maximum value of 1.93 points (CC).

The correlation matrix (Table 3) confirmed a direct positive linear relationship between the variables from 2012 to 2022. We can assess the relationship between the variables based on the correlation results. However, we cannot determine the direction of the relationship; for this reason, we will further work with the Granger Causality Test.

Table 3:
Correlation matrix of GDP and independent variables between 2012-2022

	CC	TII	HCI	GE	OSI	GDP
CC	1	0.566	0.526	0.295	0.512	0.734
TII	0.566	1	0.377	0.159	0.614	0.540
HCI	0.526	0.377	1	0.133	0.368	0.257
GE	0.295	0.159	0.133	1	0.177	0.127
OSI	0.512	0.614	0.368	0.177	1	0.353
GDP	0.734	0.540	0.257	0.127	0.353	1

Source: Authors’ own based on data from the World Bank and Eurostat, 2025

The results of the Granger Causality Test yielded different conclusions about the correlation of each independent variable with the dependent variable (Table 4). Based on the p-value, we reject the hypotheses: GDP does not have an indirect cause with CC, GE does not have an indirect cause with GDP, GDP does not have an indirect cause with GE, GDP does not have an indirect cause with TII, GDP does not have an indirect cause with HCI, and OSI also does not have an indirect cause with GDP.

Table 4:

Results of the Granger Causality Test between the dependent variable and the independent variables according to the 5-time lags in the EU Member States between 2012 and 2022

Null Hypothesis:	Obs.	F-Statistic	Prob.
CC does not Granger Cause GDP	150	0.23	0.797
GDP does not Granger Cause CC		6.36	0.002
GE does not Granger Cause GDP	150	13.90	0.000
GDP does not Granger Cause GE		3.08	0.049
TII does not Granger Cause GDP	150	1.88	0.156
GDP does not Granger Cause TII		3.41	0.036
HCI does not Granger Cause GDP	150	0.18	0.838
GDP does not Granger Cause HCI		9.44	0.000
OSI does not Granger Cause GDP	150	4.56	0.012
GDP does not Granger Cause OSI		1.19	0.307

Source: Authors' own based on data from the World Bank and Eurostat, 2025

The universal regression line of the impact of the selected determinants on the economic development of the countries is as follows:

$$y(gdp) = a + b(cc) + c(ge) + d(osi) + d(hci) + e(tii) \quad (1)$$

where CC is the country's Corruption Control Index, GE is the Government Efficiency Index, TII is the Telecommunications Infrastructure Index, OSI is the Online Services Index, and HCI is the Human Capital Index.

Based on the regression model's results, which tell us the relationship of each variable to the percentage change in GDP, we can conclude that the determinants of EGOV development, the index of control of corruption and the index of government effectiveness, have a statistically significant impact on GDP, but the model explains almost 60% of the changes in GDP.

Table 5:

Results of a regression model examining the influence of indicators on the development of economic growth in EU member countries between 2012 and 2022

Variable	Coefficient	Std. Error	t-statistic	Prob.
C	16 591.08	15 562.17	1.0661	0.2880
CC	92 422.85	8 318.72	11.1102	0.0000
GE	-12 623.19	6 836.78	-1.0846	0.0667
TII	34 369.40	9 085.42	3.7829	0.0002
OSI	-13 021.98	7 443.57	-1.7494	0.0822
HCI	-61 705.15	19 056.62	-3.2380	0.0015
R-squared	0.60701	Mean dependent var	26 278.58	
Adjusted R-squared	0.59441	S.D. dependent var	17 223.03	
S.E. of regression	10 968.63	Akaike info criterion	21.47980	
Sum squared resid	0.00000	Schwarz criterion	21.59416	
Log likelihood	-1 733.86	Hannah-Quinn criterion	21.52623	
F-statistic	48.19083	Durbin-Watson stat	1.84904	
Prob(F-statistic)	0.00000			

Source: Authors’ own based on based on output of EViews, data from the World Bank and Eurostat, 2025

The regression model (Table 5) examines the dependence of the determinants of the development of e-government, government efficiency, and the corruption index on the economic growth of the EU member states, accounting for 59.44% of the changes in economic growth.

However, it is important to note that the p-value of the T-statistic of each variable is statistically significant. Therefore, we can evaluate and interpret the impact of each variable. If there is an increase of one unit in the CC index, GDP per capita will increase by 92,422.85. For the variable TII, if the index increases by one unit, GDP per capita will increase by 34,369.4. On the other hand, the other variables signaled a negative relationship, if the value of the index decreases by one unit for the variable GE, GDP will decrease by 12,623.19 per capita, a decrease of one unit for the variable axis is at the level of a decrease in GDP of 13,021.98 per capita and finally, the highest decrease in GDP is recorded when the human capital index decreases by one unit at 61,705.15 per capita. A one-unit increase in the corruption and telecommunications infrastructure indices positively impacts GDP growth. Conversely, the indices of government efficiency, online services and human capital reduce GDP growth. One reason that some variables reduce GDP may be that, in the short run, higher spending or reforms to improve government efficiency, develop online services, and invest in human capital

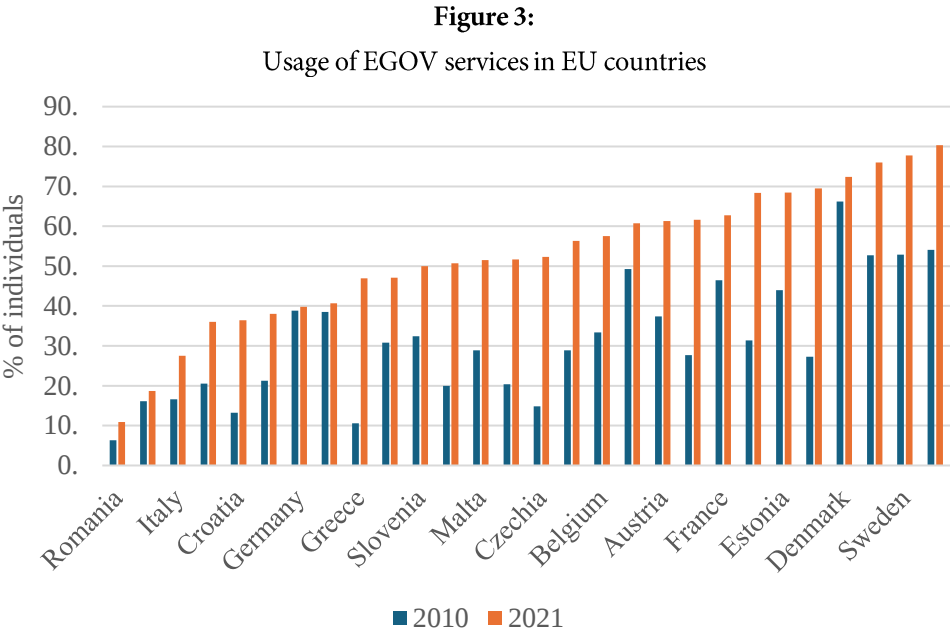
have costs that may temporarily reduce the GDP growth rate. For example, improving public institutions and education requires resources (time, money) that may not immediately translate into higher productivity and output. Moreover, in the case of more advanced economies (where these indices tend to be at higher levels), it is natural that growth rates slow down as they lack the ‘catch-up’ effect of less developed countries. Thus, a negative coefficient may reflect the direct costs of improving these indices and structural factors (e.g., a mature economy that no longer has the potential to grow as rapidly). Finally, there may also be a statistical implication - for example, a short time horizon over which the positive effect has not yet had time to manifest itself.

4.2. Development of EGOV in Slovakia

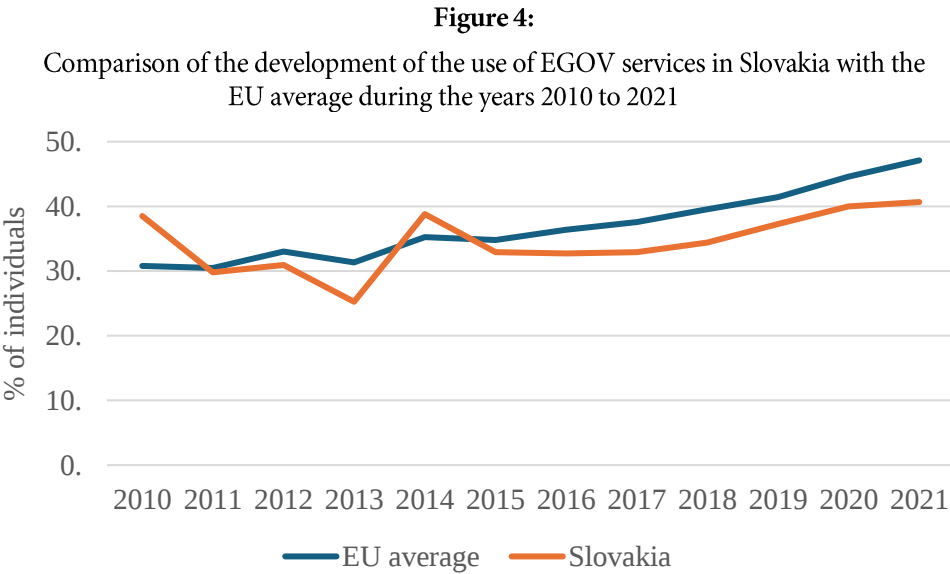
Assessment of Slovakia’s preparation and attitudes towards the DD objectives has shown positive results in actively improving the digital transformation landscape (European Commission, n.d.). Slovakia has developed targets and trajectory methodologies based on EU standards for all areas (basic digital skills, ICT professionals, connectivity, semiconductors, edge nodes, quantum computing, use of digital technologies, digital intensity baseline, innovative enterprises/expanding enterprises (unicorns), digitization of public services, e-health book, e-identification).

The aim of digitizing public services in Slovakia is that 100% of public services should be available online. This area is divided into two categories: businesses and citizens. By 2030, both areas should reach more than 90 points in the use of online services. The assumed EU baseline trajectory for 2030 is 94/100 for the citizen indicator and 97/100 for the business indicator.

In the post-2022 period, the digital transformation of the economy and society is one of the key areas of the “Recovery and Resilience Plan for Slovakia”. In the area of e-government, the main objective is to increase the number of users of the state’s digital services and user satisfaction with them. Processes will be optimized, and e-government solutions for priority life situations will be deployed. Improvements in e-government will be underpinned by connectivity reform to enable all citizens to access online tools and services. Slovakia plans to spend €1.33 billion on digital transformation, i.e., 21% of the total allocation for implementing the “Roadmap” (European Commission & Directorate-General for Communications Networks, Content and Technology, 2021). Despite the high attention and resources allocated, developing e-government in Slovakia lags behind other EU countries (Figures 3 and 4). The above is also confirmed by the cluster analysis of the EU situation, which shows that in terms of the TII and OSI indexes, Slovakia improved by more than 0.20 points, in terms of the GE and HCI indexes it was negative, the CC index remained relatively unchanged, in terms of clusters, in 2012 the country was represented in cluster 2, which had the lowest values of the four indexes (CC, TII, HCI, OSI), in 2022 the country was in cluster 3, which had the lowest values of all the indexes. We can say that the country’s position regarding government effectiveness, control of corruption, and human capital index has deteriorated.



Source: Authors’ own based on data from Eurostat, 2025

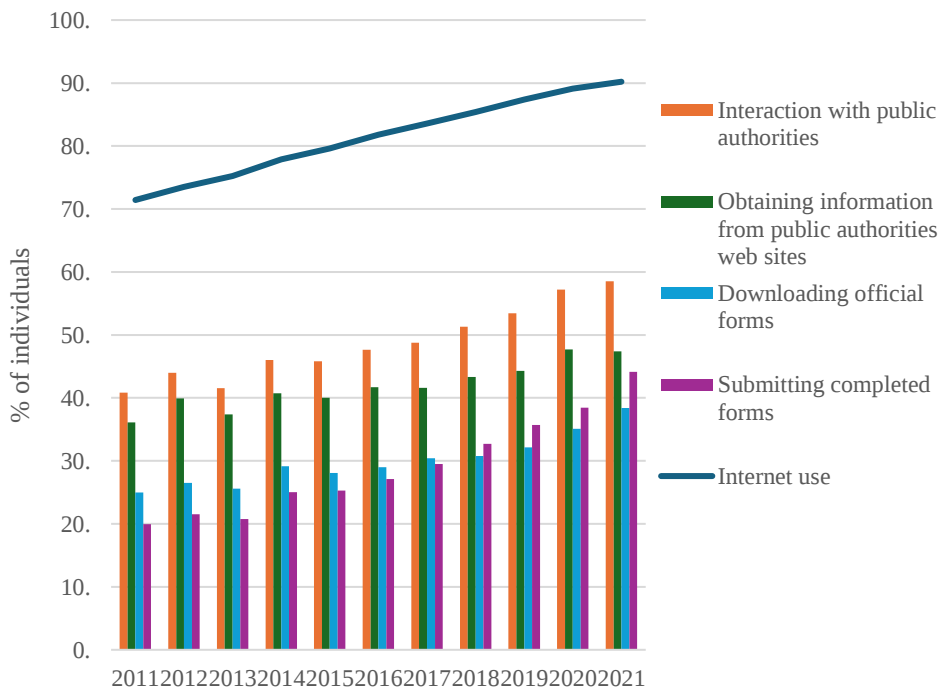


Source: Authors’ own based on data from Eurostat, 2025

The countries that have fallen below the EU level in 2021 compared to 2010 are Slovakia and Germany. As we can see in the trend graph in Figure 3, Slovakia’s value in terms of the use of EGOV services fluctuated between 2010 and 2015, during which time the country reached a level above the EU average in 2010 and 2014. Since 2015, the indicator’s value has followed the trend of the EU average and has been gradually increasing. It can be concluded that Slovakia started in a good position in terms of EGOV service usage indicators. However, with the continuous development of EGOV services, it could not maintain the speed of implementation, and the development gradually started to fall below the EU level. It can be argued that in 2012 and 2014, EU countries started to use EGOV services more significantly, so the EU average curve rose slightly. Slovakia could not maintain and implement the value at the rate of other EU countries. Figure 5 shows the evolution of the different indicators of EGOV usage in Slovakia for the period 2011 to 2021.

Figure 5:

Trends in Internet usage and Internet usage for EGOV services from 2011 to 2021 in Slovakia



Source: Authors’ own based on data from Eurostat, 2025

Trends over time confirm our assumptions based on data from 2011 to 2021. As

Internet use increases, Internet use for interacting with public services, downloading forms, uploading completed forms, and accessing information from public administration websites is also increasing on average. Interaction with public administrations via the Internet has long been the dominant mode of interaction (almost 60% in the last year under review), with an increase of 8 percentage points (pp) over the period under review, and uploading completed forms increased by more than 15 pp over the period under review.

4.3. Results of the questionnaire survey

63% of respondents in Slovakia use the Internet on average ten times a year; on the other hand, 8% try to avoid the online environment. Based on the results, we can say that the Internet does not represent a grave danger for potential users.

Table 6:
Answers to the question “How often do you use EGOV?”

How often you use EGOV	% of respondents	Abs.
Not interested	12%	10
Most often	49%	40
Usually use	17%	14
Always use	15%	12
Always try to avoid	7%	6

Source: Authors’ own based on data from questionnaire survey, 2025

There is a high awareness of EGOV services in Slovakia. Based on the respondents’ answers, we can assess that the representatives from individual regions are sufficiently informed about the online e-government services. However, there are three regions where more than 20% of respondents lack knowledge about EGOV. Despite the fact that user capacities exist, the use of EGOV is different between the sectors of the national economy (Table 7).

Table 7:

Number of EGOV services used by respondents based on SK NACE distribution

SK NACE/ EGOV services	Interaction with public authorities		Obtaining information from public authorities' websites		Downloading official forms		Submitting completed forms	
	Rel.	Abs.	Rel.	Abs.	Rel.	Abs.	Rel.	Abs.
Administrative and support services	100%	1	100%	1	100%	1	100%	1
Activities of extraterritorial organizations and associations	0%	0	0%	0	100%	1	0%	0
Water supply, sewage treatment and disposal, waste and waste removal services	100%	1	100%	1	100%	1	0%	0
Transport and storage	100%	1	0%	0	0%	0	100%	1
Information and communication	100%	1	0%	0	100%	1	100%	1
Other activities	80%	4	80%	4	80%	4	80%	4
Agriculture, forestry, fishing	82%	14	65%	11	71%	12	71%	12
Industrial production	80%	12	73%	11	80%	12	53%	8
Construction industry	77%	10	69%	9	62%	8	46%	6
Accommodation and catering services	33%	1	0%	0	67%	2	67%	2
Wholesale and retail trade, repair of motor vehicles and motorcycles	80%	4	60%	3	80%	4	80%	4
Public administration and defence, compulsory social security	20%	1	0%	0	0%	0	0%	0
Education	93%	13	36%	5	50%	7	29%	4
Healthcare and social assistance	0%	0	100%	1	100%	1	0%	0

Source: Authors' own based on data from questionnaire survey, 2025

Regarding the level of satisfaction, a high percentage of individuals (63%) rated that they were satisfied with the setup and use of EGOV services. On the other hand, dissatisfaction was recorded for one-quarter of the sample. We used a sample of 96 respondents who have been using EGOV.

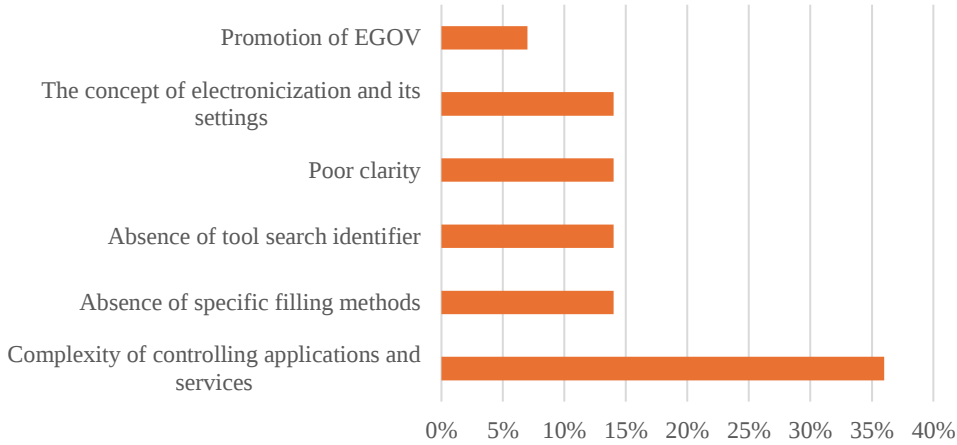
Table 8:
Answers to the question “What is your satisfaction level with using EGOV?”

Satisfaction level	% of respondents	Abs.
More dissatisfied	25.0%	24
Not interested	12.5%	12
More satisfied	60.42%	58
Completely satisfied	2.08%	2

Source: Authors’ own based on data from questionnaire survey, 2025

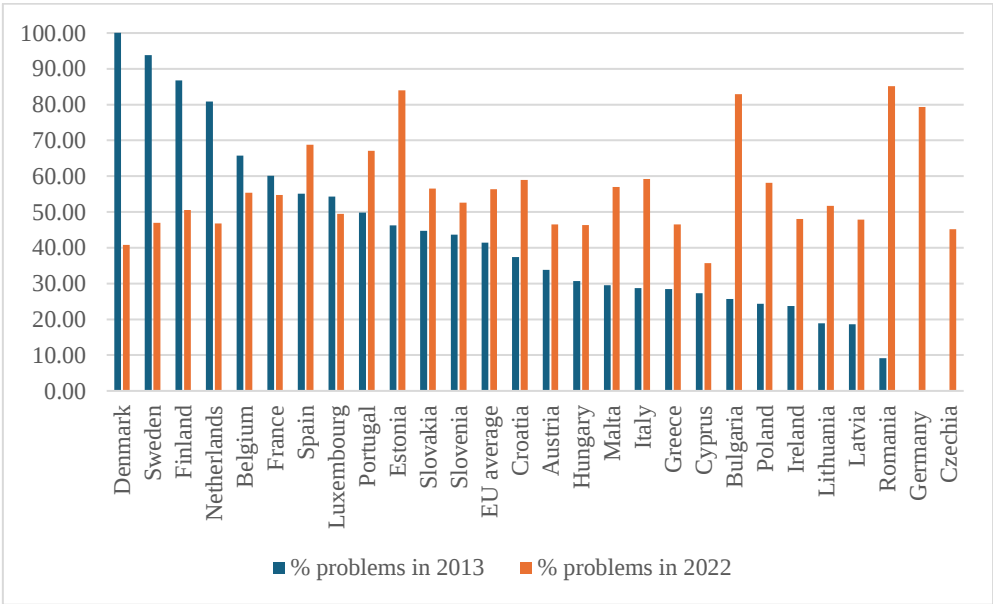
The results indicate that technical problems and the difficulty of using e-government websites are the most frequently encountered barriers to using EGOV services in Slovakia (Figure 6). The Slovak situation is similar to that of other EU Member States (Figure 7).

Figure 6:
Negative factors affecting the use of EGOV in Slovakia



Source: Authors’ own based on data from questionnaire survey, 2025

Figure 7:
Percentage incidence of problems in using EGOV



Source: Authors' own based on data from questionnaire survey, 2025

5. Discussion and conclusions

In terms of the evolution of the determinants of EGOV in the EU Member States, we document an annual increase, but this increase is very uneven. Many countries, including Slovakia, which is the focus of our paper, are lagging. The results of the regression model are consistent with the results of the models of foreign authors (Andersen, 2009; Kim, 2013; Krishnan et al., 2013; Malik & Majeed, 2020; Mistry, 2012; Park & Kim, 2019), who pointed out the statistical significance of the development of EGOV also concerning the economic growth. In this paper, we worked with variables affecting the implementation and development of EGOV because, based on foreign studies, the implementation of EGOV affects economic growth, and we verified which of the given components of EGOV affects economic growth to the greatest extent. We supplemented the given variables with CC and GE variables, which appear to be positively affected by the implementation of EGOV. Our results enrich the finding that among the components of EGOV adoption (OSI, HCI, TII) and the CC and GE variables, the CC variable and consequently the TII variable affect economic development to the greatest extent. In terms of negative values, the highest decline is

observed for the HCI variable. A suggestion for future research could be to use econometric models to assess the determinants over time through GMM methods, PSM, and the like. The task of future research is also to assess the policies for improving the status of countries and their approach to eliminating the problems occurring in implementing EGOV services.

The analysis takes a broader view of the factors that can influence countries' economic performance, especially in relation to the qualitative aspects of government management and the development of digital infrastructures. The variables we have chosen have proven significant because they affect the country's ability to implement policies, manage public finances efficiently, reduce administrative costs, and promote transparency and the investment environment.

These factors are becoming increasingly important in modern economies, where the quality of public services and infrastructure management play key roles in addition to traditional economic factors.

The development of e-government, which improves access to public services and transparency, can significantly support the business environment and thus economic growth. Similarly, reducing corruption and improving government efficiency lead to better use of public resources and increased investor confidence, which can positively impact economic growth.

From the perspective of studies that have addressed this area and used EGOV determinants to assess GDP growth, we can confirm that TII is the primary determinant of EGOV. By improving telecommunications infrastructure and investing in developing digital skills, countries can create a favorable environment for e-government initiatives and maximize their impact on economic growth (Mohamed et al., 2023). Another significant variable in our model was CC, which confirmed the ideas of theorists Castro and Lopes (2021), EGOV as a whole figure, a tool for reducing corruption, which will ultimately be reflected in economic growth. The remaining variables did not have positive values. Therefore, we can argue that the analysis suggests that in the period we examined, good governance, reducing corruption, and developing digital services may be key factors supporting GDP growth in some countries. These factors may be particularly important in countries undergoing a period of economic reform or modernization, where traditional factors such as consumption and investment may no longer be the only key drivers of growth. From the perspective of evaluating variables based on the enterprise, the HCI variable also figured as a negative variable, confirming the findings of Abu-Shanab and Osmani (2019), where again the TII and OSI variables came into focus.

In the example of Slovakia, we have documented through the cluster analysis and the descriptive statistics the stagnation, even decline, in the use of EGOV services within the public administration. The country has been below the EU level for a long time, since 2014 we have seen a decline, which reflects the slow state of use of these services in the country, we can assume failures on the part of the governing body/state, which

failed to reflect the implementation of digitalization of public administration compared to other EU countries. From the perspective of years, we can state that Slovakia started in a good position regarding indicators of the use of EGOV services. However, with the continuous development of EGOV services, it could not maintain the speed of implementation, and the development gradually began to fall below the EU level. It can be argued that in 2012 and 2014, EU countries started to use EGOV services more significantly. So, the EU average curve rose slightly, and Slovakia could not maintain the value and implementation at the rate of other EU countries. The cluster analysis evaluated the development and status of individual member countries in terms of selected independent indicators - CC, GE, OSI, HCI, and TII. At the same time, Slovakia reached the lowest values of the indices in both years and was placed in clusters with the countries that ranked last in using EGOV. Based on the results of the comparison of the development of the use of EGOV services in Slovakia with the EU average for the years 2010-2021, it can be argued that Slovakia has not been able to maintain the values and implement them at the same pace as other EU Member States.

Considering the situation in Slovakia, using our research, we document the problems that occur with the use of EGOV electronic services and the failures on the part of the state that can be eliminated, e.g., lack of information, and especially the technical problems associated with the use of EGOV sites. The questionnaire survey results showed that in Slovakia, e-government is actively used in all services and production enterprises. Out of 99 available respondents, 24% did not use e-government services, and the remaining respondents (75) used two to three EGOV services on average. A total of 206 responses were recorded regarding the use of services, the most frequent response being using EGOV for interaction with public administration authorities. Subsequently, we found an information asymmetry in the e-government of public administration, where respondents confirmed that they are not sufficiently informed about the use of available EGOV services. The most significant disadvantages of EGOV are the complexity of the processes, the lack of clarity of the website, and unclear search tools. The assessment of the position of Slovakia is relevant as an example of a post-communist country and its specific problems.

Based on this paper's findings, key areas of e-government in Slovakia could be improved. One of the main problems remains technical barriers that limit the effectiveness of digital public administration services. Improving digital infrastructure and greater information system interoperability could make administrative processes more efficient. For example, introducing a single electronic platform where citizens could handle all official matters without repeatedly entering data could significantly reduce the time needed for administrative tasks, as the Estonian digital government model successfully demonstrates.

In addition to technical aspects, improving the user's experience with e-services is also necessary. Implementing a single sign-on in all state systems, similar to Denmark, would allow citizens to access digital services more easily and securely. Another option would be to simplify administrative forms and automate data processing, which would

minimize frequent errors and speed up application processing.

At the same time, it is necessary to address the population's digital literacy level, which plays a key role in the effective use of e-government. Educational programs in Austria, which provide seniors with free training in using state digital services, thus reducing their digital exclusion, can be an inspiration. Similar initiatives could support the broader use of electronic services in Slovakia while reducing the burden on physical branches of authorities. Finally, improving the legislative framework could accelerate the digitalization of public services, especially in electronic identity and digital signatures. Fully digital ID cards, such as those already in operation in Estonia, would allow citizens to handle official matters online faster and more securely. These measures could significantly contribute to the development of e-government in Slovakia, increase its efficiency and transparency, and at the same time ensure a higher level of digital inclusion.

In terms of future development of EGOV implementation within Slovakia, based on our results, we recommend simplifying the existing system and streamlining the existing websites for user-friendly search. Further research could map and explain the main barriers to the development of EGOV in Slovakia.

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References

- Abu-Shanab, E. A., & Osmani, M. (2019). E-Government as a Tool for Improving Entrepreneurship. *International Journal of Electronic Government Research*, 15(1), 36–46. <https://doi.org/10.4018/ijegr.2019010103>
- Andreaus, M., De Poli, L., Dickson, M. M., & Espa, G. (2016). Administrative Burdens Evaluation: A Smart Perspective in the Province of Trento. *2022 IEEE International Smart Cities Conference (ISC2)*, 691, 1–4. <https://doi.org/10.1109/isc2.2016.7580742>
- Aftab, M., & Myeong, S. (2022). An Analysis of Foreign Residents' Perceptions and Behaviors Regarding Digital Government Portal Services in the Republic of South Korea. *International Review of Administrative Sciences*, 89(2), 536–554. <https://doi.org/10.1177/00208523221084498>

- Aleksandrova, A., Truntsevsky, Y., & Polutova, M. (2022). Digitalization and its Impact on Economic Growth. *Brazilian Journal of Political Economy*, 42(2), 424–441. <https://doi.org/10.1590/0101-31572022-3306>
- Andersen, T. B. (2009). E-Government as an Anti-Corruption Strategy. *Information Economics and Policy*, 21(3), 201–210. <https://doi.org/10.1016/j.infoecopol.2008.11.003>
- Androniceanu, A., Kinnunen, J., & Georgescu, I. (2020). E-Government Clusters in the EU Based on the Gaussian Mixture Models. *Administrație Și Management Public*, 1(35), 6–20. <https://doi.org/10.24818/amp/2020.35-01>
- Bhatnagar, S. C., & Singh, N. (2010). Assessing the Impact of E-government: A Study of Projects in India. *Information Technologies and International Development*, 6(2), 109–127. <http://workspace.unpan.org/sites/Internet/Documents/UNPAN95517.pdf>
- Boyer-Wright, K. M., & Kottemann, J. E. (2015). E-Government and Related Indices. *International Journal of Electronic Government Research*, 11(4), 24–37. <https://doi.org/10.4018/ijegr.2015100102>
- Castelnovo, W. (2013). A Stakeholder Based Approach to Public Value. In *Proceedings of 13th European Conference on Egovernment*. https://www.researchgate.net/profile/Walter-Castelnovo/publication/259962817_A_stakeholder_based_approach_to_Public_Value/links/0a85e52eb695dd47be000000/A-stakeholder-based-approach-to-Public-Value.pdf
- Castro, C., & Lopes, C. (2021). Digital Government and Sustainable Development. *Journal of the Knowledge Economy*, 13(2), 880–903. <https://doi.org/10.1007/s13132-021-00749-2>
- Chen, L., & Aklikokou, A. K. (2019). Relating E-government Development to Government Effectiveness and Control of Corruption: A Cluster Analysis. *Journal of Chinese Governance*, 6(1), 155–173. <https://doi.org/10.1080/23812346.2019.1698693>
- European Commission. (n.d.). *Europe's Digital Decade: Digital Targets for 2030*. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/europes-digital-decade-digital-targets-2030_en
- European Commission & Directorate-General for Communications Networks, Content and Technology. (2021). *The Strategic Use of Public Procurement for Innovation in the Digital Economy: Final report*. European Union. <https://data.europa.eu/>

- Falch, M., Williams, I., & Tadayoni, R. (2018). Cross-border E-Government Services in the Baltic Sea Region – Status and Barriers. *Nordic and Baltic Journal of Information and Communications Technologies*, 2018(1), 83–100. <https://doi.org/10.13052/nbjict1902-097x.2018.006>
- Goloshchapova, T., Yamashev, V., Skornichenko, N., & Strielkowski, W. (2023). E-Government as a Key to the Economic Prosperity and Sustainable Development in the Post-COVID era. *Economies*, 11(4), 112. <https://doi.org/10.3390/economies11040112>
- Gulati, G. J., & Yates, D. J. (2011). Strategy, Competition and Investment: Explaining the Global Divide in E-Government Implementation with Policy Variables. *Electronic Government an International Journal*, 8(2/3), 124. <https://doi.org/10.1504/eg.2011.039833>
- Heeks, R. (2004). *Causes of E-Government Success and Failure: Factor Model*. Institute for Development Policy and Management, University of Manchester, Manchester.
- Jaeger, P. T. (2005). Deliberative Democracy and the Conceptual Foundations of Electronic Government. *Government Information Quarterly*, 22(4), 702–719. <https://doi.org/10.1016/j.giq.2006.01.012>
- Kardan, A. A., & Sadeghiani, A. (2011). Is E-Government a Way to E-Democracy? *Government Information Quarterly*, 28(4), 466–473. <https://doi.org/10.1016/j.giq.2010.12.007>
- Kim, C. (2013). Anti-Corruption Initiatives and E-Government: A Cross-National Study. *Public Organization Review*, 14(3), 385–396. <https://doi.org/10.1007/s11115-013-0223-1>
- Krishnan, S., Teo, T. S., & Lim, V. K. (2013). Examining the Relationships Among E-Government Maturity, Corruption, Economic Prosperity and Environmental Degradation: A cross-Country Analysis. *Information & Management*, 50(8), 638–649. <https://doi.org/10.1016/j.im.2013.07.003>
- Kyeong, K., Ra, H., Park, J., & Im, T. (2022). How Does the Government Interact with Citizens within an Electronic Governance System? Selective Government Responsiveness. *International Review of Administrative Sciences*, 89(4), 1079–1096. <https://doi.org/10.1177/00208523221100109>
- Lopes, A. V., & Farias, J. S. (2020). How Can Governance Support Collaborative Innovation in the Public Sector? A Systematic Review of the Literature. *International Review of Administrative Sciences*, 88(1), 114–130. <https://doi.org/10.1177/0020852319893444>

- Lupu, D., & Lazăr, C. G. (2015). Influence of E-Government on the Level of Corruption in Some EU and Non-EU States. *Procedia Economics and Finance*, 20, 365–371. [https://doi.org/10.1016/s2212-5671\(15\)00085-4](https://doi.org/10.1016/s2212-5671(15)00085-4)
- MacLean, D., & Titah, R. (2022). A Systematic Literature Review of Empirical Research on the Impacts of E-Government: A Public Value Perspective. *Public Administration Review*, 82(1), 23–38. <https://doi.org/10.1111/puar.13413>
- Majeed, M. T., & Malik, A. (2016). E-government, Economic Growth and Trade: A Simultaneous Equation Approach. *The Pakistan Development Review*, 55(4), 499–519. <https://file.pide.org.pk/pdf/PDR/2016/Volume4/499-519.pdf>
- Malik, A., & Majeed, M. T. (2020). E-Government and Economic Growth: A Cross-country Analysis. *Journal of Economics and Management Sciences*, 1(1), 28–45. https://www.researchgate.net/publication/351992447_E-GOVERNMENT_AND_ECONOMIC_GROWTH_A_CROSS-COUNTRY_ANALYSIS
- Mammadli, E., & Klivak, V. (2020). Measuring the Effect of the Digitalization. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.3524823>
- Miłosz, M., & Miłosz, E. (2013). Efficiency Analysis of Electronic Channels Use to Communicate Between Enterprises and Administration. *Actual Problems of Economics*, 5(143), 409–415. https://www.researchgate.net/publication/236895110_Efficiency_analysis_of_the_electronic_channels_use_to_communicate_between_enterprises_and_the_administration
- Mistry, J. J. (2012). The role of eGovernance in mitigating corruption. *Accounting and the Public Interest*, 12(1), 137–159. <https://doi.org/10.2308/apin-10287>
- Mohamed, A., Sharobeem, F. Y., Abohussin, A. M., & Hussein, I. a. K. (2023). The Power of E-Government to Accelerate Economic growth: Panel data analysis on the role of E-Government in the European Union's Economic growth. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.4616566>
- Moser-Plautz, B. (2023). Barriers to digital government and the COVID-19 crisis – A comparative study of federal government entities in the United States and Austria. *International Review of Administrative Sciences*, 90(2), 402–418. <https://doi.org/10.1177/00208523231183566>
- Muradov, İ. (2022). Problems of E-Governance In Government Agencies and their Solutions. *SocioEconomic Challenges*, 6(1), 79–86. [https://doi.org/10.21272/sec.6\(1\).79-86.2022](https://doi.org/10.21272/sec.6(1).79-86.2022)
- Pan, T., & Fan, B. (2023). How Does Policy Attention Affect E-Government Performance? The Role of Resource Allocation and Public–Private Collaboration.

- International Review of Administrative Sciences*, 90(2), 369–384. <https://doi.org/10.1177/00208523231185531>
- Park, C. H., & Kim, K. (2019). E-government as an Anti-Corruption Tool: Panel Data Analysis Across Countries. *International Review of Administrative Sciences*, 86(4), 691–707. <https://doi.org/10.1177/0020852318822055>
- Profiroi, C. M., Negoită, C. I., & Costea, A. V. (2023). Digitalization of Public Administration in EU Member States in Times of Crisis: The Contributions of the National Recovery and Resilience Plans. *International Review of Administrative Sciences*, 90(2), 336–352. <https://doi.org/10.1177/00208523231177554>
- Ruvalcaba-Gomez, E. A., & Cifuentes-Faura, J. (2023). Analysis of the Perception of Digital Government and Artificial Intelligence in the Public Sector in Jalisco, Mexico. *International Review of Administrative Sciences*, 89(4), 1203–1222. <https://doi.org/10.1177/00208523231164587>
- Silal, P., Jha, A., & Saha, D. (2023). Examining the Role of E-Government in Controlling Corruption: A Longitudinal Study. *Information & Management*, 60(1), 103735. <https://doi.org/10.1016/j.im.2022.103735>
- Tan, H., Zhao, X., & Zhang, N. (2020). Technology Symbolization: Political Mechanism of Local E-Government Adoption and Implementation. *International Review of Administrative Sciences*, 88(2), 511–532. <https://doi.org/10.1177/0020852320915637>
- Tiwari, S. M., & Singh, D. S. (2023). Issues Related to E-Governance. *Research Spectra*, 4(1), 127–132. http://www.researchspectra.org.in/JournalPapers/V4_I1_P11.pdf
- Twizeyimana, J. D., & Andersson, A. (2019). The Public Value of E-Government – A literature review. *Government Information Quarterly*, 36(2), 167–178. <https://doi.org/10.1016/j.giq.2019.01.001>
- United Nations. (2023). *E-Government Development Index (EGDI)*. <https://publicadministration.un.org/egovkb/en-us/About/Overview/-E-Government-Development-Index>
- Xin, Y., Dilanchiev, A., Ali, M., Irfan, M., & Hong, Y. (2022). Assessing Citizens' Attitudes and Intentions to Adopt E-Government Services: A Roadmap toward Sustainable Development. *Sustainability*, 14(22), 15183. <https://doi.org/10.3390/su142215183>
- Zahid, H., & Din, B. H. (2019). Determinants of Intention to Adopt E-Government Services in Pakistan: An Imperative for Sustainable Development. *Resources*, 8(3), 128. <https://doi.org/10.3390/resources8030128>

Zhang, J., Zhao, W., Cheng, B., Li, A., Wang, Y., Yang, N., & Tian, Y. (2022). The Impact of Digital Economy on the Economic Growth and the Development Strategies in the post-COVID-19 era: Evidence from Countries along the “Belt and Road.” *Frontiers in Public Health*, 10. <https://doi.org/10.3389/fpubh.2022.856142>