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E-GOVERNMENT INITIATIVES AND ECONOMIC GROWTH IN THE EU MEMBER STATES

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ABSTRACT. Nowadays, the digitalisation of all sectors, including public administration, has influenced the way people and government agencies interact through various digital platforms, that offer different public services and enable e-participation. Consequently, technological change has accelerated the economic growth of individual EU Member States. Therefore, the main objective of the paper is to analyse the impact of e-government initiatives (e-services and e-participation) on economic growth in the EU by comparing old and new EU Member States. The first research hypothesis is therefore that e-services and e-participation have a positive effect on economic growth. The second hypothesis is that e-services and e-participation have a greater effect in the new EU member states than in the old ones. By applying a panel data analysis to a sample of EU-27 Member States for the period 2003-2022, the empirical results confirmed both research hypotheses. Based on the results, several recommendations were made for policy makers to build a resilient digital economy in the EU.

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Introduction

The rapid digital revolution has fundamentally changed the processes for providing services in public administration. The public administrations of the EU Member States have therefore reacted quickly and efficiently to these dynamic changes. This has also had an impact on public administration by introducing a new concept – digital administration. This concept is characterised by the fact that services are provided online and are highly personalised. It also significantly reduces bureaucracy and transaction costs. This makes the public sector more transparent and effective. As a result, technological change has accelerated economic growth in individual EU countries. This is in line with economic theories such as Solow's neoclassical theory, Romer's endogenous growth theory and Freeman's evolutionary growth theory. They all agree that technological change influences economic growth. This gave rise to an instrument, e-government, to reduce economic inequalities and promote wealth creation at the public level. The concept, developed in the late 1990s and early 2000s. This was the phase of eGovernment 1.0 and its significance lay in the provision of online services and the establishment of government websites and information systems for public administration. The main feature of the second phase – eGovernment 2.0 was collaborative Web 2.0 technologies. Subsequent developments and the COVID-19 pandemic have brought the importance of digitalisation more to the fore, as digital tools enable important services such as medical care, online shopping or e-government services, including e-participation.

Various methods have therefore been developed worldwide to monitor the digitalisation of public services. The most important of these for Europe is the eGovernment Benchmark. This is a study that measures the digital transformation of EU governments with a particular focus on public services. Fourteen different indicators under four main dimensions (user-centricity, transparency, key enablers and cross-border services) were used to monitor the system. According to the results of the eGovernment Benchmark Report (2023), 84% of government services are fully online, compared to 81% in 2022. This is an indicator that users are purchasing services online without having to physically visit government institutions. When analysing the dimension of cross-border services, the results show that 84% of services for national users and 49% of services for cross-border users are fully online. Furthermore, the EU countries leading in all four dimensions are Malta (96 points) and Estonia (92 points). Other countries lagging behind are Luxembourg (89 points), Iceland (88 points) and Finland (86 points). All these results are due to the priorities of the EU eGovernment Action Plan, which aims to deliver high-quality public services through digital interactions (e.g. eParticipation) between citizens, businesses and the public administration. The EU has also launched the Digital Decade programme to achieve the 2030 target of all key public services being online. As part of the Digital Decade programme, the two most important indicators - Digital Public Services for Citizens and Digital Public Services for Businesses - are 77 and 84 respectively, according to the eGovernment Benchmark Report (2023). To meet these challenges, three important factors must also be resolved: the gap between cross-border users and national users, the gap between citizens and entrepreneurs, and the gap between local and regional governments and central governments. Consequently, this will have an impact on society by increasing digital skills and competences as well as economic growth.

Therefore, the paper aims to examine the effect of e-government initiatives, with a particular focus on e-services and e-participation, on economic growth in the EU by comparing old and new EU Member States. It also analyses how the adoption and use of technology-enabled solutions by government drives economic progress and improves the delivery of public services in the digital age. Furthermore, the analysis was conducted for all EU-27, old EU-14, and new EU-13 Member States between 2003 and 2022. In order to obtain meaningful empirical

results, a panel analysis was conducted. The contribution of the paper to the existing literature is twofold. First, the relationship between digital government initiatives (i.e., e-services and e-participation) and economic growth in the old and new EU Member States is still largely unexplored. Second, we have empirically demonstrated that e-services and e-participation have a greater impact in the new EU Member States than in the old EU Member States. The novelty of the paper lies in the empirical analysis of the relationship between e-services and e-participation, supported by e-government, and economic growth in the old and new EU Member States.

The rest of the paper is organised as follows. After a brief introduction, Section 1 presents a theoretical framework and previous empirical studies on the e-government concept. In addition, determinants and pitfalls are also described in this section. The data and research methods are presented in Section 2, while the results derived from the empirical analysis are presented in Section 3. The concluding remarks and policy implications for decision-makers are part of the last section.

1. Theoretical and empirical review

The link between public administration and digital government initiatives, also known as the e-government concept, has aroused great interest on both sides – among government institutions and researchers. Therefore, it can be approached from different angles – administration, management, economics, human resources and others. However, the focus of this paper is on analysing it from an economic perspective, with the main objective being to examine its effect on economic growth and to define the main components and determinants of the e-government concept.

1.1. Theoretical framework for e-government concept

When reviewing the academic literature, it becomes clear that there is a lack of a comprehensive definition of e-government. As such, it represents a key instrument for administrative modernisation in the 21st century. It is a key tool for the modernisation of public administration in the 21st century. Its main task is to improve the work of existing public institutions and to reorganise the system of interaction between the government and its constituents, the government and citizens, and businesses and employees. The most recognised definition of e-government comes from the World Bank (2015), which states: "e-government refers to the use by government agencies of information technologies (such as wide area networks, the Internet, and mobile computing) that are capable of transforming relationships with citizens, businesses, and other government entities. These technologies can serve a variety of purposes: better delivery of government services to citizens, better interaction with business and industry, empowerment of citizens through access to information, or more efficient administration." Furthermore, the OECD (2003) defines e-government as "the use of information and communication technologies, especially the Internet, to achieve better government" and believes that e-government is more about government than about "e" (p. 11). Similarly, Riley (2007) defined e-government as "a central theme in the information society at all levels, such as local, national, regional and global, that has or can reshape the internal and external relationships of the public sector through the use of information and communication technologies to promote greater government accountability, increase efficiency and cost-effectiveness, and achieve greater constituency participation" (p. 1). On the other hand, the European Commission (2007) defines e-government as a combination of ICT, organisational change and new public administration capabilities. Therefore, e-government aims to increase

the efficiency, openness, and quality of public administration through the digital transformation of public administration. Consequently, this will boost administrative processes, improve the quality of services, and accelerate the internal efficiency of the public sector. This will significantly improve government efficiency at all levels, transparency, and accountability through citizen engagement and participation. Therefore, governments need to implement e-government strategies, that will lead to a more responsive, efficient, transparent, and citizen-centred public administration.

In order to create an efficient digital single market, the EU has created a policy instrument called the eGovernment Action Plan to promote and modernise public administration in all EU Member States. The vision of this plan is clear: to develop and deliver better services in public administration and public institutions that meet the needs and demands of citizens and businesses. In line with economic theory, there are four e-government models, each with its own characteristics and objectives. The models comprise four main types, as shown in Figure 1.

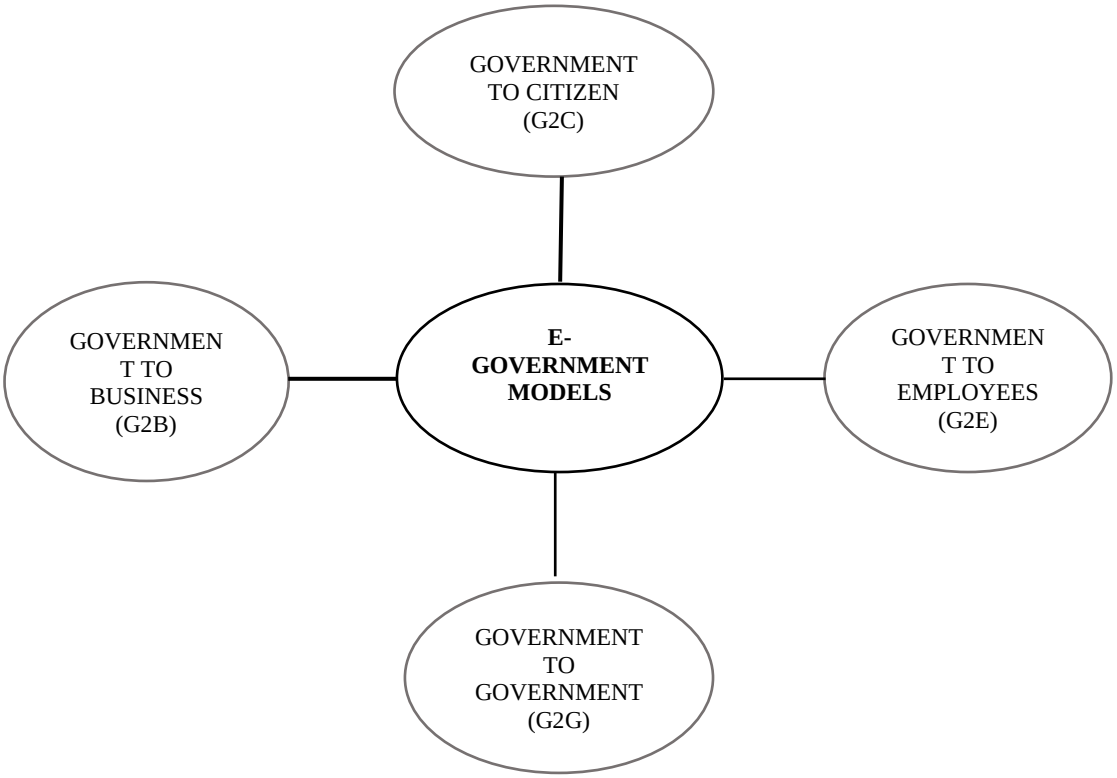

Figure 1. The structure of e-government models
Source: Own elaboration based on Riley (2007)

All these models have their own characteristics and objectives. The G2C model delivers government services and information directly to citizens via digital channels. This model gives citizens the right to create and disseminate information on important topics, such as online tax returns, budget procedures, online permit applications, and much more. The second model, G2B, refers to the interaction between government agencies and businesses. The aim of this model is to simplify processes for businesses, such as online tax systems, business registration, procurement portals, online licences and certificates, and digital permit services. As online services continue to increase, this will lead to greater competitiveness for businesses in the country. The third model, G2G, plays an important role in raising the level of public administration and all levels of government. The characteristics of this model are co-operation,

data sharing, and co-ordination between all government departments and various public institutions. By applying this model, costs are reduced as better and faster coordination between public institutions has been identified. The last model, the G2E model, refers to the distribution of services and information to government employees. As a result, the development of the labour market and employee satisfaction will increase. This will support transactions such as payroll and pension schemes, which will have an impact on the budget. The choice of model depends heavily on factors such as the country's government structure, technological structure and economic development. On the other hand, according to Ndou (2004), e-government initiatives fail due to insufficient understanding of the e-government concept, processes, and functions. Therefore, the effect of e-government development and its key determinants are not yet clear.

1.2. Determinants and pitfalls of e-government

Analyzing the current scientific literature, numerous researchers (Devadoss et al., 2003; Von Haldenwang, 2004; Streib & Navarro, 2006; Dietz et al., 2007; Nour et al. 2008; Hsu et al. 2010; Nurdin et al. 2011; Stanimirović et al., 2013; Zhang et al. 2014; Elbahnasawy, 2014; Ferreira et al., 2015; Nica, 2015; Gautam et al., 2017; Gustova, 2017; Straková et al., 2022; Frățilă et al., 2023; Chen & Chen, 2024; Hashim, 2024; Bartuseviciene & Butkus, 2024;) investigated the key determinants and pitfalls affecting the effective adoption of e-government in the public and private sectors. To obtain meaningful empirical results, most of the above researchers have used variables such as gross domestic product per capita, ICT utilisation, government efficiency, e-participation, inflation, trade, human development index, adjusted net savings, employment, and others.

In a study, Corsi et al. (2006) found that the development of e-government at EU level accelerates the efficiency of the public sector and has a positive effect on economic growth. Consequently, this improves labour productivity, the efficiency of public administration, increases overall demand and the growth of public sector output. The study was conducted between 2005 and 2010. They also proposed policy recommendations that the efficiency of public administration and the development of specific tools to evaluate adopted projects are necessary. However, the positive impact of e-government on GDP is questionable for all countries, considering their different levels of development. In a broader sense, Castro & Lopes (2022) examined the impact of e-government on sustainable development for 103 countries from 2003 to 2018. The results of the analysis showed that countries with higher e-government development are more likely to have sustainable development, as the predicted probability of non-negative adjusted net savings increases when e-government is more developed. On the other hand, developing and emerging countries should invest more in the use of ICT by the government.

Linhartova (2022) analysed the relationship between the quality of a country's governance and the extent of e-government use at EU level for the period 2003 to 2020, and the results showed that e-government is not the only factor influencing the quality of public administration. Indeed, it is only one tool available to all citizens and businesses for more transparent and faster digital public services. It is important to mention that e-government influences public sector productivity through five key effects (McCombie, 2002; Carnevali et al., 2019; Corsi & D'Ippoliti, 2010):

1. "The Smith effect or the effect of market expansion – it states that the growth rate of labour productivity is a positive function of the growth rate of the economy or the industries under consideration.

2. Ricardo's effect or the substitution effect – according to this effect, an increase in the relative cost of labour leads companies to replace workers with machines.
3. Back-office reorganisation effect – it includes the impact on reorganisation processes triggered by ICT implementation initiatives, taking into account the potentially greater rigidity of the public sector towards modernisation phenomena compared to the private sector.
4. Schumpeter effect or investment-driven effect – it explains how the real level of investment influences labour productivity. The impact of investment on productivity is twofold. In the short term, it can have a negative impact on productivity, as new machines need time to be utilised effectively. In the medium to long term, however, investments are expected to improve labour productivity.
5. Other "take-up driven effects" or "take-up effect" explain how environmental conditions enable the introduction of e-government and how they determine its effectiveness.

Therefore, with this paper, we fill a gap in the literature by analysing the effect of e-services and e-participation provided by e-government on economic growth in the old and new EU Member States. Two main hypotheses can be derived from the above: 1) e-services and e-participation have a positive effect on economic growth; and 2) e-services and e-participation have a greater effect in the new EU member states than in the old ones.

2. Data and research methods

The paper focuses on assessing the effect of e-government initiatives, i.e., e-services and e-participation, on economic growth in the old and new EU Member States. It uses a dataset compiled from two main sources. The first source is the World Bank database, which contains information on the dependent variable (i.e., GDP per capita) and selected control variables (i.e., employment, government spending, inflation and trade). The second source is the United Nations database, which contains information on two important independent variables of interest (i.e., e-services and e-participation index).

In order to provide a novelty in the paper and to analyse the impact of e-government initiatives, i.e., e-services and e-participation, the two most important key dimensions of e-government, the values of their indicators were used.

The variable e-services index or the so-called Online Services Index in the United Nations E-Government Survey (2022) measures the availability of online services for citizens and businesses via national government portals and websites. As such, it consists of five sub-indices - institutional framework (10%), service provision (45%), content provision (5%), technology (5%) and e-participation (35%). Normalisation and Z-score standardisation methods were applied to the total score of each country. The total score of each country is normalised to a range of 0 to 1. The online index value for a given country is the actual total score minus the lowest total score divided by the range of total scores for all countries.

The e-participation index (EPI) variable refers to the participation of citizens in public decision-making, administration and service provision, with participatory processes being highly recommended. Following the definition used by the United Nations in the E-Government Survey (2020), the EPI refers to "the process of involving citizens through ICT in policy, decision-making, and the design and delivery of services to make them participatory, inclusive, and deliberative" (p.115). The EPI describes the online provision of information (e-information), the interaction of citizens and businesses with public institutions (e-consultation) and the active participation of residents in decision-making (e-decision-making). The EPI is calculated by taking the total score for a particular country, subtracting the lowest score for a

country and dividing by the range of totals for all countries. Based on the EPI values, there are four EPI group levels – very high EPI level (0.75 to 1.00), high EPI level (0.50 to 0.75), medium EPI level (0.25 to 0.50), and low EPI level (0.0 to 0.25).

The data for the variables presented are available for the period between 2003 and 2022. While the World Bank data is available on an annual basis, the United Nations data is provided semi-annually (especially after 2008). To address this limitation, a linear interpolation of the data for e-services and the e-participation index was performed for each country. Missing annual values for the e-services and e-participation indices were estimated using standard linear interpolation. This means that for a variable x observed at two known points, x_0 in year t_0 and x_1 in year t_1, the interpolated value in each year t between these two points is given by (Equation 1) (McElroy & Politis, 2022):

$$x(t) = x_0 + \frac{x_1 - x_0}{t_1 - t_0} * (t - t_0) \quad (1)$$

This approach assumes a constant rate of change between t_0 and t_1, resulting in a straight line between known values. While this method preserves overall trends and maximises temporal coverage for econometric analysis, short-term fluctuations may be underestimated, especially for countries experiencing rapid policy changes or infrastructure shifts. Nevertheless, this approach resulted in a balanced panel dataset with 540 observations for the EU-27 Member States over the last 20 years. An overview of all variables can be found in Table 1.

Table 1. Overview of variables

Label	Variable	Measurement	Source
gdppc	GDP per capita	Natural logarithm	World Bank
eservices	E-services index	Index from 0 (low performance) to 100 (high performance)	United Nations
eparticip ation	E-participation index	Index from 0 (low performance) to 100 (high performance)	United Nations
employm ent	Employment to population ratio (modeled ILO estimate)	% of the total population	World Bank
govexp	General government final consumption expenditure	% of GDP	World Bank
inflation	Inflation by consumer prices	Annual %	World Bank
trade	Trade (sum of exports and imports of goods and services)	% of GDP	World Bank

Source: Own elaboration based on World Bank and United Nations data.

The estimation for each independent main variable of interest is performed separately for all EU-27 (old EU-14 and new EU-13) Member States (see Appendix 1), which allows a comparative perspective on the impact of e-government initiatives (i.e., e-services and e-participation) and economic growth. However, e-government initiatives are often seen as a driving force for future economic growth. Therefore, a lag of one year is used for these two variables of interest to account for the time required for such initiatives to begin to have a noticeable impact on the economy. The control variables include factors such as employment, government spending, inflation, and trade, which were selected to isolate the effect of e-government initiatives from other drivers of economic growth. Due to the expected high correlations between the key independent variables of interest, that capture e-services and e-participation, each of the key independent variables of interest is considered separately in a

multiple regression analysis. The regression models are shown in equation (2) for e-services and in equation (3) for e-participation:

$$gdppc_{i,t} = a_0 + \beta_1 eservices_{i,t-1} + \beta_2 employment_{i,t} + \beta_3 gocexp_{i,t} + \beta_4 inflation_{i,t} + \beta_5 trade_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$gdppc_{i,t} = a_0 + \beta_1 eparticipation_{i,t-1} + \beta_2 employment_{i,t} + \beta_3 gocexp_{i,t} + \beta_4 inflation_{i,t} + \beta_5 trade_{i,t} + \varepsilon_{i,t} \quad (3)$$

In order to determine the most suitable econometric estimation technique for analysing the relationship between e-government initiatives and economic growth, three different specification tests were carried out according to a three-step procedure (Hausman, 1978). The first step involves conducting the Lagrange multiplier (LM) test to decide between the random effects model and the pooled regression model. In the second step, the F-test is used to compare the pooled regression model with the fixed effects model. Finally, the Hausman test is performed to determine whether the random effects model or the fixed effects model is more appropriate. The results of these tests for each model and the subsample of EU Member States are presented in Table 2.

Table 2. Tests for appropriate econometric estimation technique selection

	All member states		Old member states		New member states	
Model	e-services	e-participation	e-services	e-participation	e-services	e-participation
LM test	2034.01***	2511.04***	255.08***	456.00***	151.04***	261.48***
F test	223.38***	230.64***	128.31***	62.17***	42.07***	41.64***
Hausman test	56.87***	23.48***	21.17***	8.66	54.74***	39.83***

Note: 1) Significance: ***p<.001, **p<.01, *p<.05.
Source: *Own calculation.*

According to the tests, the results of the LM test are significant for all (sub)samples and models, suggesting that the random effects model may be more appropriate in these cases. However, the results of the F-test and Hausman test indicate that the fixed-effects model is a better fit for all models and subsamples compared to the random-effects or pooled regression models. This result is reasonable, because the fixed-effects model accounts for unobserved heterogeneity by controlling for factors within countries that may influence the predictor or outcome variables, which is particularly important given the different economic conditions in each countries (Torres-Reyna, 2007).

Consequently, the fixed effects model serves as the basis in this paper, as it accounts for unobserved time-invariant country-specific heterogeneity that can influence both e-government initiatives and economic growth. To ensure the robustness of the results, two alternative panel estimators were also applied: the random effects model and the pooled OLS regression. The random effects model is appropriate when unobserved heterogeneity is assumed to be uncorrelated with the regressors, which may lead to more efficient estimates. The pooled OLS model, which ignores country-specific effects, serves as a benchmark to illustrate the impact of omitting unobserved heterogeneity. Using all three approaches allows an assessment of whether the estimated effects are sensitive to different assumptions about the error structure and unobserved factors (Torres-Reyna, 2007; Hausman, 1978). This multi-model strategy is consistent with the robustness testing approaches used in previous empirical studies (Wang et al., 2024; Zou et al., 2023).

3. Empirical results

Table 3 shows the results of the descriptive statistics of the variables, which provides a comprehensive overview of the most important key figures such as the number of observations, the mean value, the standard deviation and the minimum and maximum values for each variable. This detailed statistical summary reveals significant differences between EU Member States, indicating different levels of development and performance for different indicators.

Above all, the results emphasise the remarkable differences in the adoption and implementation of digital government initiatives, especially e-services and e-participation, which are the main independent variables of interest in this study. For example, countries such as Estonia, the Netherlands, Finland, and Denmark emerge as leaders in 2022, as they consistently lead in terms of their advanced e-service offerings and robust e-participation platforms. These countries have successfully integrated digital tools into public administration, enabling higher levels of citizen participation and more efficient public services. On the other hand, the data shows that Belgium, Slovakia, Hungary, and Lithuania are lagging behind in e-services due to potential challenges in digital infrastructure, policy implementation, or citizen acceptance. Similarly, the Czech Republic, Romania, Belgium, and Bulgaria are the weakest performers in terms of e-participation, suggesting that there are barriers to effective citizen participation in government by digital means in these countries. These results highlight the varying levels of maturity of digital government services across the EU, and point to areas where some Member States excel, while others face significant barriers.

Table 3. Results of descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
gdppc	540	10.418	0.460	8.931	11.865
eservices	540	0.673	0.174	0.114	100
eparticipation	540	0.545	0.270	0.017	100
employment	540	53.203	5.279	37.720	63.754
govexp	540	19.908	2.988	11.244	27.935
inflation	540	2.556	2.945	-4.478	19.705
trade	540	124.604	65.847	45.419	388.120

Source: *Own calculation.*

The pairwise correlations between the variables are shown in Table 4, and provide a clear representation of the relationships between the various factors considered in the study. The simple correlations between the dependent variable, GDP per capita, and the main independent variables of interest, namely the e-services and e-participation indices, initially indicate a positive relationship between e-government initiatives and economic growth. This result suggests that countries with more advanced digital government services and a higher level of citizen participation through eParticipation tend to experience greater economic prosperity. Furthermore, the correlations between the remaining variables are well in line with initial expectations, and confirm the expected relationships based on the theoretical framework of the study. These correlations support the hypotheses, and show that the variables behave as expected in the analysis. Importantly, the correlations do not indicate strong linear relationships between the independent variables, suggesting that there is no problem with multicollinearity in the data. The absence of multicollinearity ensures that the variables can be analysed independently of each other, allowing a better understanding of their individual effects on GDP per capita and increasing the reliability of the study's conclusions.

Table 4. Pairwise correlations

	gdppc	eservices	eparticipation	employment	govexp	inflation	trade
gdppc	1.000						
eservices	0.551***	1.000					
eparticipation	0.550***	0.853***	1.000				
employment	0.484***	0.337***	0.286***	1.000			
govexp	0.168***	0.343***	0.273***	0.117***	1.000		
inflation	-0.146***	-0.050	-0.186***	0.079	-0.130***	1.000	
trade	0.415***	0.036	0.067	0.232***	-0.316***	0.034	1.000

Note: 1) Significance: ***p<.001, **p<.01, *p<.05.
Source: *Own calculation.*

The results of the multiple regression analysis are shown in Table 5 for the fixed-effects model, in Table 6 for the random-effects model, and in Table 7 for the pooled regression model. In terms of the main independent variables of interest, it is evident that e-services and e-participation have a positive and significant impact on GDP per capita, which confirms the first research hypothesis. However, the comparison between old and new EU Member States shows that the impact of both eGovernment initiatives is greater in the new EU Member States, which confirms the second research hypothesis. As far as the control variables are concerned, the results correspond to the original expectations.

Table 5. Multiple regression analysis results (fixed effects)

	All member states		Old member states		New member states	
lag_eservices	0.5577***		0.4846***		0.6357***	
	(0.0538)		(0.0629)		(0.0912)	
lag_eparticipation		0.4707***		0.4016***		0.5319***
		(0.0308)		(0.0367)		(0.0533)
employment	0.0310***	0.0284***	0.0119**	0.0154***	0.0374***	0.0308***
	(0.0026)	(0.0024)	(0.0040)	(0.0036)	(0.0038)	(0.0037)
govexp	0.0114*	0.0091	0.0033	0.0052	0.0199*	0.0118
	(0.0054)	(0.0048)	(0.0061)	(0.0055)	(0.0089)	(0.0083)
inflation	-0.0051*	-0.0004	0.0100*	0.0121**	-0.0089**	-0.0031
	(0.0024)	(0.0022)	(0.0046)	(0.0042)	(0.0030)	(0.0028)
trade	0.0071***	0.0055***	0.0065***	0.0053***	0.0069***	0.0053***
	(0.0004)	(0.0004)	(0.0006)	(0.0005)	(0.0007)	(0.0010)
constant	7.3155***	7.8057***	8.8746***	8.8859***	6.5119***	7.3571***
	(0.1786)	(0.1682)	(0.2610)	(0.2380)	(0.2609)	(0.2693)
R^2	0.3712	0.4214	0.7636	0.7925	0.5024	0.5836
Observations	513	513	266	266	247	247

Note: 1) Significance: ***p<.001, **p<.01, *p<.05; 2) Standard errors in parentheses.
Source: *Own calculation.*

Table 6. Multiple regression analysis results (random effects)

	All member states		Old member states		New member states	
lag_eservices	0.6596***		0.6060***		0.7465***	
	(0.0549)		(0.0581)		(0.0958)	
lag_eparticipation		0.5148***		0.4389***		0.5900***
		(0.0303)		(0.0332)		(0.0508)
employment	0.0310***	0.0284***	0.0080**	0.0127***	0.0413***	0.0336***
	(0.0026)	(0.0024)	(0.0030)	(0.0040)	(0.0038)	(0.0036)
govexp	0.0121*	0.0101*	0.0010	0.0031	0.0117	0.0117
	(0.0054)	(0.0048)	(0.0054)	(0.0051)	(0.0089)	(0.0080)
inflation	-0.0049	-0.0000	0.0160***	0.0153***	-0.0093**	-0.0034
	(0.0026)	(0.0023)	(0.0045)	(0.0044)	(0.0034)	(0.0028)
trade	0.0055***	0.0045***	0.0050***	0.0043***	0.0032***	0.0029***
	(0.0004)	(0.0004)	(0.0003)	(0.0004)	(0.0004)	(0.0004)
constant	7.4354***	7.8924***	9.2600***	9.1588***	6.7850***	7.5223***
	(0.1834)	(0.1682)	(0.2049)	(0.2045)	(0.2627)	(0.2541)
R^2	0.4254	0.4614	0.7938	0.8054	0.6256	0.6700
Observations	513	513	266	266	247	247

Note: 1) Significance: ***p<.001, **p<.01, *p<.05; 2) Standard errors in parentheses.
Source: *Own calculation.*

Table 7. Multiple regression analysis results (pooled regression)

	All member states		Old member states		New member states	
lag_eservices	1.0295***		0.7552***		0.6446***	
	(0.0890)		(0.0654)		(0.0999)	
lag_eparticipation		0.6507***		0.4913***		0.4913***
		(0.0539)		(0.0395)		(0.0395)
employment	0.0221***	0.0233***	0.0057**	0.0087***	0.0419***	0.0087***
	(0.0028)	(0.0028)	(0.0020)	(0.0019)	(0.0033)	(0.0019)
govexp	0.0145**	0.0194***	-0.0045	-0.0046	0.0304***	-0.0046
	(0.0052)	(0.0050)	(0.0035)	(0.0034)	(0.0077)	(0.0034)
inflation	-0.0212*	-0.0182***	0.0173**	0.0174**	-0.0129**	0.0174
	(0.0046)	(0.0046)	(0.0052)	(0.0051)	(0.0039)	(0.0051)**
trade	0.0026***	0.0025***	0.0038***	0.0036***	0.0017***	0.0036***
	(0.0022)	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0002)
constant	8.0239***	8.1961***	9.4756***	9.5866***	6.8138***	9.5866***
	(0.1598)	(0.1610)	(0.1038)	(0.1015)	(0.2320)	(0.1015)
R^2	0.5368	0.5452	0.8045	0.8144	0.6518	0.6953
Observations	513	513	266	266	247	247

Note: 1) Significance: ***p<.001, **p<.01, *p<.05; 2) Standard errors in parentheses.
Source: *Own calculation.*

The study provides convincing evidence that e-government initiatives, in particular e-services and e-participation, have a significant and positive impact on GDP per capita in the European Union. This result is consistent in all models — fixed effects, random effects, and pooled regression which proves the robustness of the results. The positive coefficients for these digital government variables emphasise their role as a key driver of economic growth. These results are consistent with the findings of Corsi et al. (2006), who identified several pathways through which e-government increases economic performance, such as improved labour productivity, higher public sector performance and greater efficiency of public administration. These benefits contribute to a more competitive and dynamic economy overall, as demonstrated by the projected 2% increase in GDP at EU level attributable to eGovernment in the period 2005-2010.

A key finding of the study is the stronger impact of e-government initiatives in the new EU Member States compared to the older members. The coefficients for e-services and e-participation are consistently higher in the new Member States, suggesting that these countries derive greater economic benefit from digital administrative tools. This result supports the second research hypothesis and emphasises the potential of the newer EU members to use e-government as a catalyst for accelerated economic growth. This could be due to their more adaptable infrastructures or their significant catch-up process that allows them to maximise the benefits of digital transformation in public administration.

The findings of the study also emphasise the broader impact of e-government on national competitiveness and public trust. Building on the work of Srivastava et al. (2008), which demonstrated the link between e-government maturity and business competitiveness, this research confirms that higher levels of e-government contribute directly to improved national competitiveness. Furthermore, the positive impact on GDP per capita emphasises the potential of e-government to increase the productivity of public services, simplify government processes, and increase trust in government institutions. As governments continue to invest in and expand digital services, these benefits are likely to become even more pronounced, and contribute to sustainable economic growth and competitiveness across the EU.

In all three model specifications — fixed effects, random effects, and pooled OLS**,** the coefficients for e-services and e-participation remain positive and statistically significant, with magnitudes that are largely consistent. While the pooled OLS estimates tend to yield slightly larger coefficients, the direction and significance of the relationships are stable, suggesting that the results are not due to a particular model choice. Minor differences between models can be attributed to the trade-off between bias and efficiency inherent in panel data estimators, with fixed effects emphasising consistency and random effects allowing for greater efficiency under more restrictive assumptions. This convergence of results between estimators strengthens confidence in the robustness of the reported relationships between e-government initiatives and economic growth, which is consistent with previous panel data evidence on digitalisation and economic performance (Srivastava & Teo, 2008; Kamal et al., 2023).

Conclusion

Through the implementation of the EU development strategies – eGovernment Action Plan 2016-2020 and Digital Single Market Strategy 2014-2019, it has become clear that the EU emphasises the importance of eGovernment for the provision of adequate e-services and efficient e-participation. It also poses major challenges for public administration, as it requires internal and external openness, transparency, automation of daily bureaucratic tasks, and flexibility. Overcoming these challenges will ultimately lead to better administration, cost savings, a better quality of life for citizens and a better business environment for companies. The following six dimensions should be considered in order to realise and effectively shape digital maturity in public administration. These are "digital by design", "data-driven public sector", "government as a platform", "open by default", "user-centred" and "proactive" (OECD, 2020). The overarching goal of e-government is to deliver better services, respond to citizen demand, and restore citizens' trust in their governments. E-participation, i.e. the access of citizens and businesses to information and public services and the promotion of participation in public decision-making, is, therefore, an important factor. It includes electronic services such as electronic information exchange, electronic consultations and electronic decision-making. This enables broader knowledge sharing, collaborative research and transparent consultations for governments, citizens and businesses.

The first step in implementing the eGovernment strategy and initiatives, is to actively promote the benefits of digitalisation and continuously educate citizens and businesses, and invest in the ICT sector. It will also help both public administration employees and the general public to adapt to new technologies and e-government initiatives. Therefore, e-government initiatives such as e-services and e-participation should be developed and implemented for different social and age groups of the population. It is, therefore, necessary for each EU Member State to create a national legal framework that complies with European directives and regulations.

In order to assess the effect of e-government initiatives, i.e., e-services and e-participation, on economic growth in the old and new EU Member States in the period 2003 to 2022, a panel data analysis was carried out. The empirical results confirm both research hypotheses, and indicate that e-services and e-participation have important effects on economic growth, with the effects of both e-government initiatives being greater in the new EU Member States. Accordingly, the first recommendation for policy makers is to increase trust in public administration, i.e., quality, and to be more open to citizens' suggestions and initiatives. The second recommendation is to share best practises with other public administrations in the EU in order to gather knowledge and experience on specific topics. In order to improve the factors that strengthen the potential of e-government, additional measures to raise the level of education and digital skills of the population, and to increase the number of digital services, are essential.

Like any research, this one has limitations. The first limitation is the limited amount of data for the variables analysed and the second is the restriction to a specific area, namely the EU Member States. Therefore, the recommendation for further research is to compare the EU with other non-EU countries, such as the United States of America, Japan, China and Korea, and to extend the model with additional variables. Furthermore, it would be important to identify the opinions and needs of regional and local authorities in each EU country in order to customise future policies and e-government services. Finally, despite the use of fixed effects and relevant controls, possible endogeneity cannot be completely ruled out. Possible simultaneity (e.g., higher growth driving greater e-government investment), biases due to unobserved time-varying factors, and measurement errors in composite indices (partly due to interpolation) may remain. Future studies could address these econometric concerns by using instrumental variables, difference-in-difference designs, or other causal inference methods to better isolate the impact of e-government initiatives on economic growth.

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Appendix 1.
List of old and new EU member states

OLD EU member states	NEW EU member states
Austria	Bulgaria
Belgium	Croatia
Denmark	Cyprus
Finland	Czechia
France	Estonia
Germany	Hungary
Greece	Latvia
Ireland	Lithuania
Italy	Malta
Luxembourg	Poland
Netherlands	Romania
Portugal	Slovak Republic
Spain	Slovenia
Sweden	