
The impact of e-government on transparency in the European Union: a multivariate analysis

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Abstract: E-government emerges as a new form of interaction or relationship between the governments of different countries through the use of information and communication technologies (ICT) with the aim of achieving good government and being more transparent. This paper analyses the consequences of e-government in European Union countries. In particular, it studies whether those countries where the development of e-government is greater, are also those that are more transparent. The effects of other socio-economic variables proposed by the literature on e-government (per capita GDP, unemployment rate, educational level, population, etc.) are also examined. The statistical analysis reveals that e-government has a positive impact on transparency (measured through the corruption perception index), as well as on GDP per capita, unemployment rate and educational level.

Keywords: e-government; electronic government; European Union; transparency; public administration; socioeconomic variables; multivariate model; information and communication technologies; ICT.

Reference to this paper should be made as follows: Cifuentes-Faura, J. (2022) 'The impact of e-government on transparency in the European Union: a multivariate analysis', *Electronic Government*, Vol. 18, No. 1, pp.105–118.

Biographical notes: Javier Cifuentes-Faura graduated in Business Administration from the University of Murcia with an Extraordinary End-of-Career Award. He has carried out postgraduate studies such as the Master in Business Administration (MBA) and the Master in Commercial and Marketing Management, at the European Business School in Barcelona, both with Cum Laude recognition. He has been awarded the 'Economics and Business 2018' prize by the Official College of Economists. He received a scholarship for a stay at Georgetown University in Washington DC. He has published in journals of impact JCR and Scopus and has participated in several international conferences.

1 Introduction

The use of the internet has grown rapidly since its creation. According to data from the International Telecommunication Union (ITU) for the end of 2019, 53.6% of the population has access to the internet, with Europe being the region with the highest internet use (82.5%) (ITU, 2019). By 2023, the number of active internet users is expected to reach 5.3 billion people worldwide, which corresponds to 66% of the world's population, according to the Cisco Systems Annual Internet Report (Cisco, 2020).

The development of information and communication technologies (ICT) has changed the way people, businesses and institutions relate to each other. ICTs have provided the tools and resources necessary for governments to provide public services online and to involve citizens in the formulation of policies (licence applications, payment of taxes, public health information, advice, participation in budgets, etc.). New technologies not only make it possible to store and process information; they also enable governments to offer services, publish information on the web and communicate more quickly and easily with citizens (Stalker, 2013; Rodríguez et al., 2015). This has paved the way for the implementation of e-government systems.

The use of ICTs to disseminate information and provide government services could lead to greater transparency (Rodríguez Bolívar et al., 2010; Venkatesh et al., 2016; Mensah, 2018). E-government should focus on the inclusion of citizens in a participatory manner through ICTs, advancing the development of e-participation (United Nations, 2014) to achieve accountability (United Nations, 2019).

To measure transparency, a corruption index is used in many works. The World Bank identifies corruption as a major obstacle to economic and social development, as resources are diverted from those who need them most. Corruption hinders economic development, so it is important to combat it (Ahmad et al., 2012).

In this paper we focus specifically on analysing the potential role of e-government on transparency. We test the relationship between ICT-driven e-government and transparency, using a multivariate model, which includes other socio-economic variables such as gross domestic product per capita and unemployment.

The rest of the work is structured as follows. Section 2 presents a conceptual approach to e-government. In Section 3, the concept of transparency associated with e-government is analysed. Section 4 presents the data and methodology; Section 5 shows the results and finally Section 6 presents the conclusions.

2 Conceptual approach to e-government

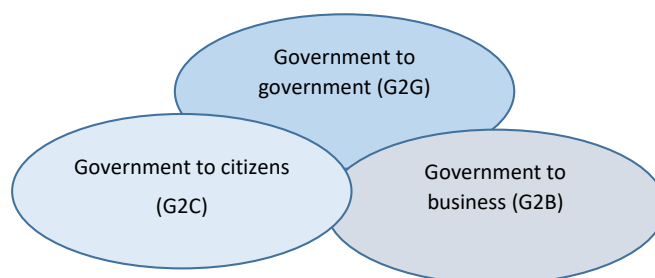
E-government can be defined as “using ICT and the internet capabilities to provide public service, improve government’s performance, and open participation and empowerment channels to serve political or democratic reasons” [Abu-Shanab, (2013), p.84]. The use of ICTs not only modernises the state, but also achieves greater efficiency and transparency in the management and provision of services in the public sector, in order to meet the needs and aspirations of all citizens (Tolbert and Mossberger, 2006; Putra et al., 2018).

The OECD refers to the term as ‘the use of ICT, particularly the internet, as a tool to achieve good governance’ (OECD, 2003). The Ibero-American Charter of e-Government, approved by the IX Ibero-American Conference of Ministers of Public Administration and State Reform in 2007, defines it as “the use of ICTs in administrative bodies to improve information and services offered to citizens, to guide the effectiveness and efficiency of public management and to substantially increase public sector transparency and citizen participation”. The European Union defines it as the use of ICT to provide and improve services, transactions and interactions of the government with citizens, businesses and other branches of government (European Commission, 2010). E-government must be a trusted digital public service for citizens (European Commission, 2019).

E-government enables the provision of information and government services to citizens through the internet and different digital media (Joseph, 2013; Dwivedi et al., 2017), while modernising public administration (Chan and Chow, 2007), and providing greater accessibility and transparency of information (Jaeger and Munson, 2010; Lindgren and Jansson, 2013; Michener and Bersch, 2013; Alcaide-Muñoz et al., 2017). It provides citizens with access to information anytime and anywhere (Schaupp et al., 2010; Luna-Reyes et al., 2012) and the possibility to be part of an open (McDermott, 2010) and more transparent government (Bertot et al., 2010; Bearfield et al., 2016; López-López et al., 2018; Milic et al., 2018). Web 2.0 is useful for providing more open, effective and legitimate interactions (Chun et al., 2010; Bonsón et al., 2012; Gandía et al., 2016).

Government interacts with citizens and the business world in a two-way way. E-government has revolutionised the way citizens and businesses interact and deliver services, establishing different types of relationships (Pandey and Gupta, 2017; Zein and Twinomurinzi, 2019): government to government (G2G), government to citizens (G2C) and government to business (G2B) (Figure 1).

Figure 1 E-government interrelationships (see online version for colours)



Source: Own elaboration

Governments to business refer to transactions between companies and the government, seeking to optimise the negotiation processes between both parties. G2B helps to improve the provision of services, save time for public administrations, as well as reduce their cost. Online government transactions provide companies with the opportunity to simplify regulation and file processing processes.

Governments to government refer to electronic data transactions (budget management, information transfers...) between public administrations and governments of any kind. It involves sharing data and electronic transactions, as well as interactions between employees, departments and even other governments. G2G seeks to improve communication, access and data exchange between governments, while reducing costs.

Government to citizen refers to the relationship between citizens and public administrations through the use of ICT. Complete security in access to systems and applications must be provided for an effective use of them, while offering a simple and intuitive process for users. G2C is used when a citizen requires or formalises an official document, makes a formal complaint or reports an incident with the administration. In this way citizens can participate in public institutions, express their opinions, complaints and suggestions and become involved in democratic processes through administrative procedures (Batara et al., 2017; Twizeyimana and Andersson, 2019). Both the

development of e-government and the training of staff in the use of digital skills are important.

3 The transparency associated with e-government

There are many definitions of the term transparency in relation to e-government. For Kim et al. (2005, p.649) “transparency implies that information is freely available and directly accessible to those who will be affected by decisions, and provides sufficient information in easily understandable forms and media”. Grigorescu (2007, p.626) gives a very simple, and perhaps scarce, definition of this term ‘is the ability to provide information from one agent to another’.

Grimmelikhuijsen and Welch (2012) define transparency as the disclosure of information by an organisation that allows external actors to monitor and evaluate its internal functioning and performance. Transparency allows citizens to monitor the government, and if they detect any illegal practices they can report them to the media or the courts (Welch, 2012). Meijer (2013) refers to this concept as the information that allows citizens to monitor government performance.

Pardo (2000) and Fang (2002) state that giving citizens access to government information is the most common e-government initiative, and in turn increases transparency (Jaeger, 2005; Kardan and Sadeghiani, 2011). E-government therefore impacts on openness, transparency, participation, communication and collaboration, and influences personal control over government policies (Twizeyimana and Andersson, 2019).

Transparency increases when new technologies are present (Colesca, 2009; Meijer, 2013), and governments must therefore use ICTs as a mechanism to convey confidence to citizens in public institutions and to demonstrate greater transparency (Moon, 2003; Ruano De La Fuente, 2014).

Various works have related transparency and e-government. Welch et al. (2005) showed that increased use of the US government website is positively associated with e-government and website satisfaction, and that increased e-government satisfaction is positively related to trust in government. Andersen and Rand (2006) study the relationship between corruption and e-government, examining a sample of countries in the period 1997–2002. They conclude that e-government through well-planned policies reduces corruption.

Shim and Eom (2008) confirm that e-government has a significant influence on the perception of corruption at the national level. Countries with better e-government have lower levels of corruption and more transparency. The results of the work of Mistry and Jalal (2012) suggest that as the use of ICTs related to e-government increases, corruption decreases. Using a longitudinal data set, Zhao and Xu (2015) analyse the relationship between e-government and corruption at country level and suggest that e-government is correlated with lower levels of perceived corruption. Similar results are provided by Nam (2018).

There is also evidence of the positive effects of e-government use on perceived transparency and trust in government (Im et al., 2014; Porumbescu, 2016). It seems, therefore, that having greater access to information through the use of e-government can

help generate greater transparency and, therefore, less corruption. Therefore, this paper hypothesises that the use of e-government will favour transparency.

4 Data and methodology

In order to analyse whether those countries that are more transparent (those perceived as less corrupt) are also those that have made the greatest progress in the development and implementation of e-government, a model which relates the level of corruption to e-government use a linear regression has been carried out. The corruption perception index developed annually by Transparency International has been used as a measure of transparency (Transp). This index measures the perception of corruption levels in the country according to citizens, businessmen and experts. It is placed in a range between 0 and 100, where 0 means that the country is very corrupt, and 100 means that the country is totally transparent (no corruption).

To measure e-government, the output of the e-government readiness index and the e-government participation index, both from the United Nations' E-Government Survey, have been calculated. The former is an index that is calculated as the average of three standardised indices: Telecommunications Infrastructure Index based on data provided by the ITU, human capital index based on data provided by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) and the Online Services Index (OSI) calculated from a questionnaire conducted by the United Nations Department of Economic and Social Affairs (UNDESA), which assesses a number of characteristics related to online service delivery, including whole-of-government approaches, open government data, e-participation, multi-channel service delivery, mobile services, user acceptance, the digital divide, as well as innovative partnerships through the use of ICTs.

This index varies between 0 and 1, the higher its value, the greater the development of e-government. The second index reflects e-information, e-consultation and e-decisions, which enable citizens to give their opinions and participate in the government policymaking process. Its score is between 0 and 1; the higher the value, the higher the level of e-participation in the country. The indicator thus constructed captures both the quantity and the quality of the online services delivered by governments (Andersen and Rand, 2006).

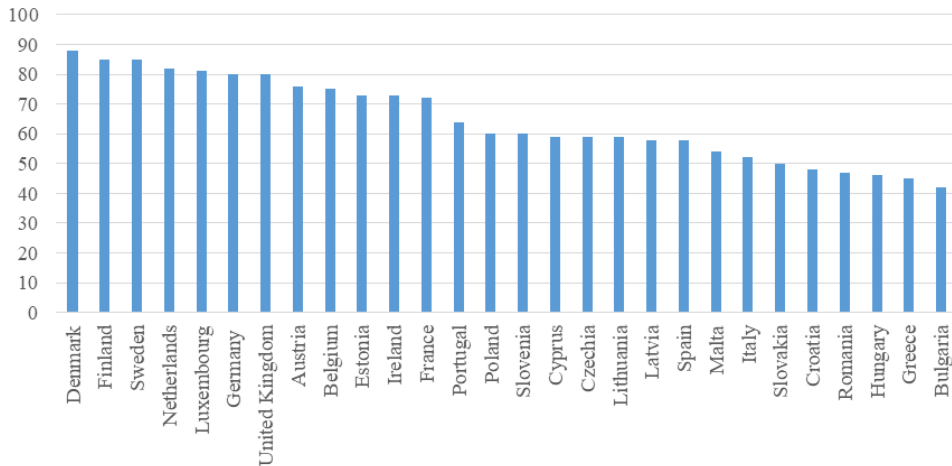
The country level data used for this comes from different sources and from three time points: 2014, 2016, and 2018. The choice of these years is determined by the fact that they are the last years with data available for the e-government index.

The following linear specification is relied upon:

$$Transp = \alpha_0 + \alpha_1 e_Gov + X' \alpha_2 + \varepsilon$$

with *Transp* being the index of perception of corruption, e-Gov the index of e-government defined above, and *X* collecting a set of control variables that affect corruption, such as gender composition, population, number of years of schooling, unemployment and GDP per capita.

Figure 2 shows the corruption perception index for the year 2018. Denmark, Finland and Sweden are the most transparent countries, which are perceived to have the lowest level of corruption. In contrast, Bulgaria and Greece are on the opposite side, being perceived as the most corrupt countries.

Figure 2 Corruption perception index of EU countries in 2018 (see online version for colours)

Source: Own elaboration based on data from Transparency International

Since the first attempt by the United Nations, in 2001, to establish a benchmark on the status of e-government there has, in general, been steady progress in improving e-government and the delivery of public services online (UNDESA, 2018). In the EU, Denmark is the leader in the provision of government services and information via the internet in 2018, followed by the UK and Finland. In addition, 12 of the 28 countries have a very high score with values in the range of 0.75 to 1.00 compared to the only three countries in 2014.

In terms of the average growth rate of e-government index in the period 2014–2018, the countries that are growing most are Bulgaria (+45.8%), Cyprus (+35.7%) and Czechia (+29.7%), which demonstrates the importance that these countries have given to accelerating technological growth and connecting their citizens to government through ICT.

The literature suggests that transparency can also be determined by different socio-economic variables, so control variables are included. In particular, log GDP per capita (taken from World Bank) has been chosen to measure the level of the economy (Mistry and Jalal, 2012). A positive relationship with transparency is expected. The unemployment rate defined as the number of unemployed in the labour force (taken from Eurostat) has also been selected.

Population (pop) and the proportion of the population that is female (gender) are other variables that are expected to influence corruption positively (Swamy et al., 2001; Dollar et al., 2001; Churchill et al., 2013; Zhao and Xu, 2015; Zheng, 2016). A higher population of females possibly leads to a lower level of corruption, considering that women are more risk averse and follow the laws more. The data are taken from the World Bank database.

For education, the average number of years of schooling of citizens has been selected (Zheng, 2016), which is part of the human development index, published annually by the United Nations. The range of the variable is between 8.9 and 14.1 years. The higher the score, the higher the level of education in the country is considered. The main statistics for these variables are shown in Table 2.

Table 1 Development of e-government in the EU in the period 2014–2018

Country	2014	2016	2018	Annual rate	Average rate
				2014–2018	2014–2018
Austria	0.4965	0.7234	0.6855	38.1%	8.4%
Belgium	0.4746	0.5071	0.6128	29.1%	6.6%
Bulgaria	0.1382	0.4431	0.6250	352.3%	45.8%
Croatia	0.2094	0.5584	0.5402	158.0%	26.7%
Cyprus	0.1869	0.3164	0.6345	239.5%	35.7%
Czechia	0.1547	0.3610	0.4378	183.0%	29.7%
Denmark	0.4481	0.6924	0.9150	104.2%	19.5%
Estonia	0.6255	0.6781	0.7723	23.5%	5.4%
Finland	0.5964	0.8070	0.8815	47.8%	10.3%
France	0.8588	0.7596	0.8494	−1.1%	−0.3%
Germany	0.5551	0.6262	0.8075	45.5%	9.8%
Greece	0.5722	0.4216	0.6865	20.0%	4.7%
Hungary	0.2993	0.3316	0.5143	71.8%	14.5%
Ireland	0.5053	0.5473	0.7728	52.9%	11.2%
Italy	0.5955	0.7106	0.7840	31.7%	7.1%
Latvia	0.5066	0.3578	0.4795	−5.4%	−1.4%
Lithuania	0.4705	0.6434	0.6053	28.7%	6.5%
Luxembourg	0.4168	0.5354	0.7819	87.6%	17.0%
Malta	0.3067	0.5788	0.6796	121.6%	22.0%
Netherlands	0.8897	0.8218	0.8659	−2.7%	−0.7%
Poland	0.3178	0.6355	0.7080	122.8%	22.2%
Portugal	0.4464	0.4722	0.7219	61.7%	12.8%
Romania	0.2650	0.3519	0.4722	78.2%	15.5%
Slovakia	0.3857	0.3208	0.5788	50.1%	10.7%
Slovenia	0.2551	0.5662	0.6284	146.3%	25.3%
Spain	0.6596	0.7583	0.8273	25.4%	5.8%
Sweden	0.4999	0.6639	0.8333	66.7%	13.6%
United Kingdom	0.8354	0.9193	0.8847	5.9%	1.4%

Source: Own elaboration based on United Nations E-Government Development Database (UNeGovDD)

The correlations between the different variables are shown in Table 3, with the highest variance inflation factor equal to 2.7, which shows the absence of multicollinearity problems. As the data come from time periods (2014, 2016, 2018), dummy variables are included in the regression for each time period except the first year in order to avoid specific time effects.

Table 2 Descriptive statistics

	<i>Mean</i>	<i>Std. dev.</i>	<i>Min</i>	<i>Max</i>
TranspI	64.5	14.5	41.0	92.0
E-government	0.5794	0.1945	0.1382	0.9193
Unemployment	8.6	4.7	2.2	26.5
Log (GDP per capita)	15.9	1.4	13.0	18.2
Education	11.9	1.1	8.9	14.1
Log (Pop)	10.2	0.6	8.9	11.7
Gender	51.3	1.1	49.4	54.2

Table 3 Correlations among dependent variable, independent variable and control variables

	<i>Transp</i>	<i>E-Gov</i>	<i>Unemp</i>	<i>Log(GDP)</i>	<i>Educ</i>	<i>Log(Pop)</i>	<i>Gender</i>
Transp	1						
E-Gov	0.518**	1					
Unemp	-0.366**	-0.167	1				
Log (GDP)	0.821**	0.509**	-0.181	1			
Educ	0.463**	0.09	-0.586**	0.233*	1		
Log (Pop)	0.05	0.331**	0.086	0.01	-0.141	1	
Gender	-0.388**	-0.186*	0.17	-0.573**	-0.028	-0.051	1

Note: * $p < 0.01$; ** $p < 0.05$

5 Results

The goodness of the regression carried out is studied, using the determination coefficient (R^2) defined as the proportion of the total variance of the dependent variable that is explained by the regression. It varies between 0 and 1, the closer to 1 the greater the fit of the model to the variable we want to explain. The value obtained, greater than 0.8, indicates the fit of the model proposed.

Table 4 shows the OLS results. Several things should be noted. First, the effect of e-government on transparency is significant. This implies that transparency is greater in those countries with a greater development of e-government. ICTs, together with citizen participation, make it possible to control the actions of governments and this mammal, improve transparency.

Moreover, the influence of GDP per capita has been found to be positive. Countries with greater economic development measured by GDP per capita are more transparent. The level of education also has a positive influence. The greater the number of years of schooling, the greater the transparency. However, the effect of unemployment on transparency is negative. It is shown that the higher the unemployment, the more corruption is perceived, and therefore the less transparency. No effect of gender or

population size on transparency has been found. On the other hand, the effect of these variables decreases over time as the coefficients of the dummies variables which have 2018 as their reference year are positive and significant.

Table 4 Least squares analysis results

<i>Variables</i>	<i>Unstandardised coefficients</i>	<i>Standardised coefficients</i>	<i>p-value</i>
(Constant)	-193.014 (59.568)		0.002
E_Gov	17.241 (6.173)	0.232	0.007
Unemp	-0.515 (0.212)	-0.168	0.018
Log(GDP)	15.932 (1.939)	0.682	0.000
Education	2.733 (0.915)	0.200	0.004
Log(Pop)	0.134 (0.602)	0.013	0.824
Gender	0.972 (0.892)	0.072	0.279
a16	5.764 (1.969)	0.188	0.005
a14	6.948 (2.436)	0.227	0.006

Note: $R^2 = 0.81$. In brackets, the standard deviation.

The population is sensitive to the efforts made by the governments of their countries to promote transparency. Therefore, to reduce the perception of corruption the development of e-government is important.

6 Conclusions

The e-government arises with the intention that citizens can participate through ICT in the actions of the government. Reducing uncertainty and improving the quality of information are factors that jointly influence citizens' intentions when using e-government.

E-government was created to strengthen transparency and to enable citizens to play a more active role as well. Transparency has become an essential component for the good development of a government.

In order to analyse whether the most transparent countries (those perceived to be least corrupt) are also the ones that have made the most progress in developing and implementing e-government, a model has been carried out that relates the level of corruption to the use of e-government through a linear regression.

The corruption perception index has been used as a measure of corruption. To measure e-government, the product of the e-government readiness index and the e-government participation index has been calculated. Transparency control variables have also been included, as transparency can also be determined by different socio-economic variables.

The influence of GDP per capita and educational level is positive on transparency. The higher the GDP and the more years of schooling, the greater the transparency. However, the effect of unemployment on transparency is negative. No effect of gender or population size on transparency has been found. The effect of these variables also decreases over time.

As limitations to this work, it should be noted that other variables of a political nature could be included, such as political force or type of political party. In addition, to make the results more robust, the study could be carried out with other transparency indicators, such as the index of control of corruption (one of the six indicators of governance developed by the World Bank). Other statistical techniques can also be explored to analyse the dependence between variables.

The importance of e-government today has become clear. The development of e-government influences the corruption perception and, consequently, the level of transparency of a country. Promoting the development of related policies through the application of new technologies in government will lead to greater transparency and control of public administrations by citizens. ICT should facilitate such collaborative and participatory initiatives, as well as increased transparency, co-responsibility and accountability. The use of ICTs, together with the change in the culture of public organisations, should be a driver for the transformation of society at a global perspective. It is necessary to promote the strengthening of public management for the formulation and implementation of open government strategies, greater transparency and collaboration in the exercise of government, and greater citizen participation in public affairs.

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