What drives eGovernment growth? An econometric analysis on the impacting factors

Spyridoula Lakka* and Teta Stamati

Department of Informatics and Telecommunications,
University of Athens,
Panepistimioupolis, Ilisia 15784,
Athens, Greece
Email: lakka@di.uoa.gr
Email: teta@di.uoa.gr
*Corresponding author

Christos Michalakelis

Department of Telematics and Informatics,
Harokopio University,
89, Harokopou Str. Kallithea 17671,
Athens, Greece
Email: michalak@di.uoa.gr

Draculis Martakos

Department of Informatics and Telecommunications,
University of Athens,
Panepistimioupolis, Ilisia 15784,
Athens, Greece
Email: martakos@di.uoa.gr

Abstract: This study contributes to the current literature of eGovernment adoption, by proposing a parsimonious, yet comprehensive model, based on three socio-economic theories namely, institutionalism, endogenous and exogenous growth. Using this framework as the guiding theoretical lens, critical factors are identified, while their impact is evaluated with an econometric analysis on secondary, country level data. The study especially highlights on the use of OSS technology and its implications into the eGov context. Findings suggest that countries with advanced technologies, education, technological openness and effective governance and regulation lead eGovernment adoption.

Keywords: eGovernment; open source software; policy factors; institutional theory; endogenous growth theory; exogenous growth theory; technology diffusion; econometric analysis; panel data models; adoption factors.

Biographical notes: Spyridoula Lakka holds a degree in Mathematics from the University of Athens (Greece) and an MSc degree in Computer Science from the University of Liverpool (UK). She has a working experience in management position at the Managing Authority of the Greek Ministry of Education and a teaching experience in Information Technology in secondary education and vocational training. She is currently conducting research in the field of Open Source Software (OSS). Topics of research interest include diffusion and adoption of OSS, impact of OSS on software market structures and competition, OSS business models, OSS and eGovernment.

Teta Stamati holds a degree in Computer Science from the University of Athens (Greece) in 1998. She also holds an MPhil degree in Information Systems from University of Manchester (UMIST) (UK), an MBA degree from Lancaster University Business School (UK) and a PhD in Information Systems from the University of Athens (Greece). She has extensive experience in top management positions in leading ICT companies of the Greek and European private sector. She is currently Research Associate at the University of Athens. Her current research interests include information systems, business models, electronic and mobile government, service science, e/m-commerce, SOA and cloud computing.

Christos Michalakelis is a Lecturer at the Department of Informatics and Telematics of the Harokopeio University (Greece). He holds a Mathematics degree from the University of Athens (Greece), an MSc degree in Software Engineering (The University of Liverpool, UK). He also holds an MSc degree in "Administration and Economics of Telecommunication Networks" and a PhD from the University of Athens, in the field of techno-economics. He worked for 7 years for the Greek Ministry of Education, as an IT manager. His research interests include diffusion and forecasting of innovative technologies, market competition, price modelling and indexing in high technology markets and economic theories.

Draculis Martakos is an Associate Professor at the Department of Informatics and Telecommunications at the National and Kapodistrian University of Athens. He received his BSc in Physics, MSc in Electronics and Radio Communications and PhD in Real-Time Computing from the same university. He is a consultant to public and private organisations and a project leader in numerous national and international projects. He serves on the Board of the Hellenic Chapter of the Association of Information Systems (AIS) and is the author or co-author of more than 70 scientific publications and a number of technical reports and studies.

1 Introduction

eGovernment (eGov) refers to the transformation of traditional public sector services and processes into an electronic format with greater accessibility and interactivity to citizens (Huang and Bwoma, 2003). An increasing number of government initiatives for the implementation of eGov projects with the view of better and more accessible services to citizens are recorded worldwide (Weerakkody and Dhillon, 2008).

As a result, the interest in the study of eGov has increased in recent years and researchers are developing theoretical and conceptual models to understand different aspects of eGov. Research has focused into three main aspects: (i) evolution and

development (Kunstelj and Vintar, 2004; Layne and Lee, 2001), (ii) adoption and implementation (Teo et al., 2009) and (iii) its impact on citizens, businesses and other stakeholders by transforming government and administration (Gil-García and Pardo, 2005; Moynihan, 2004; Srivastava and Teo, 2007; Stamati and Karantjias, 2011; Stamati and Martakos, 2011; West, 2004).

Most eGov adoption models offered so far in the academic literature are mainly conceptual (Ebrahim and Irani, 2005; Klievink and Janssen, 2009; Kumar et al., 2007) while empirical studies to validate and generalise the models are very few. Gilbert et al. (2004) proposed the integration of the service quality, technology, and behavioural aspects of the eGov adoption framework. Warkentin et al. (2002) investigated the effect of trust on the adoption of eGov. A great number of studies have found significant impact of technological factors (Siau and Long, 2004; Singh et al., 2007; Srivastava and Teo, 2007).

However, different researchers (Kumar et al., 2007; Shareef et al., 2011) emphasised that eGov adoption should be examined beyond a mere technological aspect, as it is influenced by many factors, including organisational, human, economic, social, behavioural and cultural issues. This statement is confirmed by investigating the social (Ho, 2002; Singh et al., 2007), economic (La Porte et al., 2001; Shareef et al., 2009), political and institutional (Azad et al., 2010; Ifinedo, 2011; Wong and Welch, 2004), organisational (Srivastava and Teo, 2010), cultural (Khalil, 2011), public administrative (Moon and Norris, 2005; Stamati and Karantjias, 2011) and behavioural (Shareef et al., 2009) factors that drive eGov adoption. These perspectives provide important speculations for analysing the eGov structure that reflects government nature and its responsibility in society and calls for the creation of a comprehensive framework of eGov adoption.

Moreover, Heeks and Bailur (2007) through an extensive literature review of eGov, pointed that methodologically most eGov adoption models are not grounded on a strong theoretical framework. Following this, a number of researchers have utilised different theoretical perspectives to identify factors critical for eGov adoption. Such theories are the Technology-Organisation-Environment (TOE) framework (Srivastava and Teo, 2010), Human Capital Theory (Siau and Long, 2004), endogenous growth and institutional theories (Ifinedo, 2011), while Shareef et al (2011) borrowed elements from the diffusion of innovations theory and the theory of planned behaviour.

Taking into account this multi-dimensional nature of eGov, as well as the need for a comprehensive framework towards eGov adoption, the study proposes a theoretical framework consisting of the theories of institutionalism, exogenous and endogenous growth. The three theories are selected so that to cover all of the different aspects of eGov, that is technological, social, economic, organisational, political and institutional. The framework is used as the guiding theoretical lens for the investigation of factors relevant to all these aspects of eGov that drive eGov growth.

The contribution of the study to the literature of eGov adoption is twofold: Firstly, it brings in the theoretical perspective of exogenous growth. Though the theories of endogenous growth and institutionalism have already been utilised in the literature of eGov adoption, the exogenous growth has not been considered for the case of eGov. The use of the exogenous growth perspective creates a more comprehensive theoretical framework for the study of the factors determining eGov adoption.

Secondly, the study taking into account the fact that innovative technologies positively affect eGov growth (Ifinedo, 2011), it focuses on the impact of a specific

innovative technology, the use of open source software (OSS). Although the impact of technological factors has been extensively investigated in the literature of eGov adoption, the impact of specific technologies has not yet been examined. The research especially highlights on the role of OSS technology and assesses its impact on eGov as an emerging trend into eGov technology reforms.

The remainder of the paper is structured as follows. Section 2 provides some background information on eGov models, while Section 3 discusses the relation of OSS and eGov. Section 4 describes the theoretical and conceptual frameworks, together with the research hypotheses. The data used in the empirical analysis is presented in Section 5. Statistical analysis and discussion of the corresponding results are illustrated in Section 6. Finally, conclusions, limitations of the study and future research are provided in Section 7.

2   eGov adoption models

eGov researchers and bodies have proposed differing maturity models for eGov evolution (Layne and Lee, 2001; Shareef et al., 2011; UN Public Administration Programme, 2011; Valdés et al., 2011). In general, eGov models are build in a stage-wise manner from immature (one-way communication) to the mature (digital democracy) stage, so that at the aggregate level technological and organisational sophistication to be continuously added.

However, not all of these models provide with means by which national eGov efforts can be compared. Due to the international nature of eGov, research has attempted to develop rigorous measures that represent the quality and level of eGov at a national level. Moon (2005) reviewed the relevant literature and found two major elements to be considered in the development of global eGov measures. One element represents the content, functions, and sophistication of official government websites (e.g. La Porte et al., 2002; UN Public Administration Programme, 2011; West, 2001). The other element considers the overall enabling factors that promote development of eGov as well as societal readiness and utilisation of eGov services (e.g. Kirkman et al., 2002; UN Public Administration Programme, 2011).

This current research uses the United Nations (UN) eGov indices Web Measure Index (WMI) and E-participation Index (UN Public Administration Programme, 2011). The combination of the two indices is used to provide a better picture of a nation's eGov maturity, as it not only captures the sophistication level of eGov, but also the willingness and capacity of the government to improve eGov services. The full reports containing more details on the methodology for the calculation of both the indices can be found in the UN's reports (UN eGov Global Reports, 2011).

E-participation Index is indicative of both the capacity and the willingness of the state in enhancing e-information, e-consultation and e-decision to citizens, so that to enable participatory processes and citizens in decision making. WMI is measured upon a four stage model, according to scale of progressively sophisticated citizen services. Countries are coded in consonance with what they provide online and the stage of eGov evolution they are presently in. The first stage is the *emerging presence* in which an official online government presence is established. The next stage, *enhanced presence*, corresponds to the provision of greater public policy and governance sources. The third stage is *transactional presence* and enables a two-way interaction between the citizen and his/her

government. Finally, the *connected presence* stage is the most sophisticated level in the online eGov services, where the government encourages the participation of citizens and other stakeholders and actively solicits citizens' views on public policy, law making, and democratic participatory decision making. At this level, eGov services aim at higher transparency, participation and collaboration.

3   eGov and OSS

OSS is an innovative technology that has become a major component of the web infrastructure, having proved quality and consistency through years of testing and validation. Its cost effective nature has leaded to an increasing number of private and public organisations opting for OSS, yet without compromising to quality. Due to its merits, OSS is increasingly gaining momentum into the public sector around the world (Comino and Manenti, 2005; Ghosh, 2006; Lewis, 2010; Maldonado, 2010; Wong, 2004).

For the case of the electronic public services, OSS is considered as an important technological tool for the implementation of eGov reforms (EU-Ministerial-Declaration, 2009; McDermott, 2010; Zissis and Lekkas, 2011). As for instance, in Europe, the EU Ministerial Declaration (2009) pays particular attention to the benefits resulting from the use of open specifications and promotes OSS model in eGov projects. In addition, previous studies have showed that innovative technologies positively affect eGov growth (Ifinedo, 2011). As a result, the use of the OSS technology in the eGov reforms is expected to positively affect eGov growth.

Apart from a technological innovation, OSS is a collaborative model of software production, where code is open, offered for modification and reuse. This, in turn, enables transparency and users' participation in the production process. As a result, OSS apart from its technological dimension, it carries the values and notions of collaboration, transparency and participation that also drive the eGov reform aims of the fourth evolution stage. It is often claimed that OSS notions have impacted a number of sectors other than software, that are turning 'open', such as open education, open documents, open innovation, open government and more. Open government is defined as the governmental response to citizens' demands for information and services from government organisations (La Porte et al., 2002). It contains principles (like accessibility, transparency and openness) and methodologies (like collaboration and sharing), that are obvious references to open source. Many of these orders stand out as opportunities for open source developers, to demonstrate how the OSS development model can help the administration improve towards the two principles of collaboration and participation.

As eGov substantially entails the open government principles, it can be claimed that eGov has been affected by these open values. The latter distinguishes OSS among innovative technologies and makes the study of its impact on eGov growth, a topic of particular interest and an innovative element of this research.

4   Theoretical framework

The study of eGov growth is viewed under three theoretical perspectives: endogenous growth theory, exogenous growth theory and institutional theory.

Endogenous Growth Theory outlines the potential of economic growth that is generated within a system, as a result of internal processes, as for example technological advancements (Romer, 1986; Romer, 1994) and not external, as for instance through trade. The concept of *exogenous growth theory* grew out of the neoclassical growth model and the works contributed by Robert Solow (1956). It assumes that economic prosperity is primarily determined by external rather than internal factors, such as the flow of goods, ideas, capital and technology innovations. According to the theory, three driving forces, namely labour, capital and technology can account for steady economic growth rate. When a new technology becomes available, labour and capital need to be adjusted to maintain growth equilibrium (Kaldor, 1961). *Institutional Theory* (Scott, 2004) reflects the deeper and more resilient aspects of social structure. It refers to the processes that establish structures, rules, norms, and routines, as authoritative guidelines for social behaviour; some examples include rule of law and political rights (North, 1990).

4.1 Conceptual model

A country is conceptualised as a socio-economic system within which eGov growth occurs. The model is based on the idea that the forces of growth to an economic system comprise of institutional, endogenous and exogenous factors and is specified as:

$$eGov_{it} = F(X^{en}, X^{ex}, X^{inst}) \qquad (1)$$

where *eGov* is the eGovernment growth determined by a vector of all factors relevant to endogenous growth X^{en}, exogenous growth X^{ex} and institutional X^{inst} theories, for each country *i*, at time *t*. The corresponding factors were selected not only under the prism of the three socio-economic theories, but also on the outcomes received out of the eGov characteristics and previous research in eGov adoption. The following paragraphs present the associated hypotheses set for each theoretical perspective. The resulting conceptual model is graphically illustrated in Figure 1.

Figure 1 Conceptual model
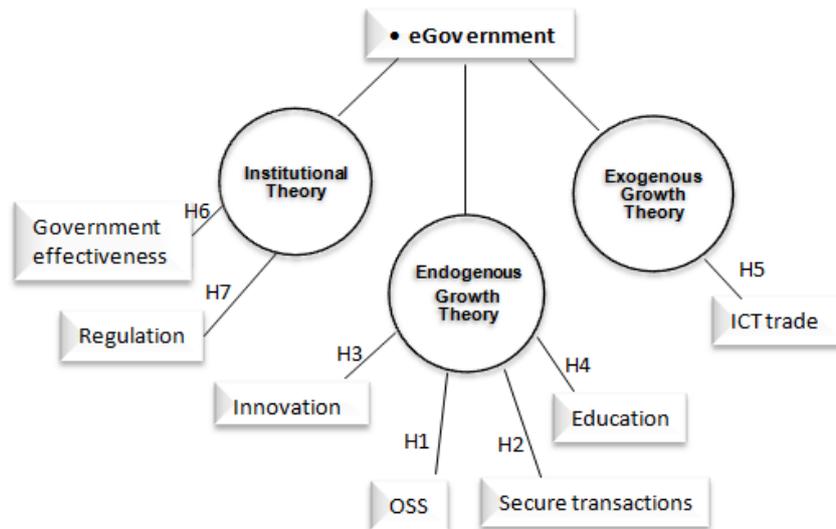
Endogenous factors. Under the prism of this theory, factors can be social, economical, environmental, organisational, or technological, describing the growth mechanisms within a country. Warkentin et al. (2002) stressed the role of information and computer technology in stimulating the advancement of eGov development from one stage to the next. eGov growth, in particular, heavily depends on sufficient ICT infrastructure (Pudjianto and Hangjung, 2009; Relly and Sabharwal, 2009; Siau and Long, 2004) and the lack of their availability would make its adoption impractical (Srivastava and Teo, 2007). However, none of these studies had a focus on specific technologies. This study examines the effects of two specific technologies as part of advanced ICT infrastructure: (i) OSS technology, (ii) technology that enables secure transactions.

As explicitly described in Section 3, OSS is a sophisticated technology that aligns with the ideas and goals of eGov. Thus, eGov is expected to have a positive impact on eGov diffusion, not only as a technological innovation, but also as a carrier of eGov notions of collaboration participation and transparency.

H_1: OSS is expected to have a positive impact on eGov growth.

Another important technological requirement is security in transactions (Smith and Jamieson, 2006). Several critics have warned the public against possible security pitfalls of eGov (Jaeger, 2002). End users would be reluctant to commit eGov transactions, when they feel uncomfortable with system security. As a result the use of technology that provides secure transactions adds to the user's trust and consequently to eGov adoption.

H_2: Secure transactions play a critical role on eGov growth.

Moon and Norris (2005) found an association between a culture of innovation (i.e. managerial innovation orientation) and the adoption of eGov at the local level. The latter together with the fact that innovation plays a crucial role in accelerating development and growth in any country, implies that innovation could have a positive effect on eGov.

H_3: Innovation positively affects eGov diffusion.

Moreover, a number of studies demonstrate that the average level of education (Kiiski and Pohjola, 2002) are influential drivers for individual technology adoption. From the eGov perspectives, Burn and Robins (2003) stated that IT learning capability, and knowledge capability are potential factors affecting its diffusion.

H_4: Citizens' education level has an impact on eGov.

Exogenous factors. Under the prism of this theory, a country's openness can be perceived as the external force that captures knowledge spillovers among countries (Grossman and Helpman, 1991). In general, openness can be defined as the degree to which a country is open to business and economic influences through trade activities. A number of studies consider trade as a channel for the transfer of technological knowledge (Rivera-Batiz and Romer, 1991). The study assumes that a country's technological openness can leverage eGov adoption among countries and considers ICT trade as the channel for achieving such spillovers.

H_5: A country's technological openness positively affects eGov growth.

Institutional factors. Institutional theory has been extensively used as a theoretical lens for the study of electronic services in the public sector (Azad et al., 2010; Ifinedo, 2011; Kim et al., 2009; Welch et al., 2010; Wong and Welch, 2004). Azad (2010) showed that

the existing national governance institutions shape the diffusion and assimilation of eGov in any country via associated institutions in three key sectors: government, private sector and non-governmental organisations.

Moreover, it has been shown that in order to efficiently implement public reforms into the eGov context, effective governance and administration should be in place (InfoDev, 2004; Moon et al., 2005; Wong and Welch, 2004), as efficient governments easily appreciate the need to use advanced eGov features and reform tools to improve governance. This study considers government effectiveness in terms of the quality of public services and policy formulation and implementation, the degree of its independence from political pressures and the credibility of the government. Such qualities are elements that add to the citizen's trust towards her government. This, in turn, would add to the trust towards electronic services and become an adequate lever of eGov adoption.

H_6: *Government effectiveness is a primary factor of eGov growth.*

In addition, regulatory support is a critical factor that tends to affect eGov usage (Pudjianto and Hangjung, 2009). Taking into account that eGov does not only refer to citizens, but also to business and other stakeholders, this study considers effective regulation in terms of credit, labour, and product markets. High quality in regulation concerning these entities enhances economic growth and development. It is assumed that this quality can also be reflected into the eGov context.

H_7: *Effective regulation promotes eGov.*

5 Data, measures and variables

In order to evaluate the impact of the factors participating in the conceptual model (Figure 1), a panel data analysis on 25 countries over the period 2003–2008 is performed. The countries were selected so that to reflect different regions and economic status. More particularly, there were 13 countries from Europe (Belgium, Finland, France, Germany, Greece, Italy, Netherlands, Spain, Sweden, UK, Romania, Russia, Turkey), 5 countries from America (Argentina, Brazil, Canada, Mexico, USA), 5 countries from Asia Pacific (Australia, China, India, Japan, Korea) and 2 countries from Africa (South Africa, Tunisia). Table 1 summarises information about all of the factors of the econometric model. Some more details on the operationalisation of some of the factors are following.

OSS penetration is reflected by the number of subscribed users/developers in the SourceForge.net portal. SourceForge is the world's largest OSS development website, with the largest repository of OSS code and applications available on the internet. SourceForge has shared certain data with the University of Notre Dame (UND) for academic and scholarly research purposes. Our study relies on data extracted from the UND's platform (OSS research portal, 2010) under written permission. The number of users were calculated by aggregating (counting) the number of users, for each capital city. Although results correspond to the number of OSS users of the capital city, rather than the entire country, they can still be regarded as an indication of OSS penetration at a country level.

Innovation is operationalised by the use of the indicator royalty and license fees payments and receipts (World Bank Indicators), which counts the royalty and license fees payments and receipts between residents and nonresidents for the authorised use of intangible, nonproduced, nonfinancial assets and proprietary rights (such as patents, copyrights, etc.) and for the use, through licensing agreements, of produced originals of prototypes. The indicator reflects the amount of patents, copyrights, trademarks, etc., which can be considered as an indication of the innovations produced within a country.

Table 1   Data labels, definitions, measurements, and sources

Labels	Constructs	Measurements	Sources
Endogenous Growth Theory Variables – X^{it}			
eGov	Average of the Web Presence Index and the E-participation Index.	Measured in the range of 0 and 1	(UN eGov Global Reports)
oss	*OSS users* is reflected by the number of subscribed per country users in the SourceForge portal.	Natural log number	(OSS research portal, 2010)
secserv	Secure servers are servers using encryption technology in internet transactions	Natural log number	(World Bank Indicators)
educ	*Education expenditure* refers to the current operating expenditures in education	Expressed in percentage of GNI	(World Bank Indicators)
innov	*Innovation* is measured by the indicator 'royalty and license fees payments and receipts'. Data are in current US dollars.	Natural log number	(World Bank Indicators)
Exogenous Growth Theory Variables – Y^{it}			
ICTtrade	*ICT goods trade* is calculated by the ratio of exports plus imports per GDP: ICT goods include telecommunications, audio and video, computer and related equipment; electronic components; and other information and communication technology goods.	Calculated per GDP	(World Bank Indicators)
Institutional Theory Variables – Z^{it}			
gov_eff	*Government effectiveness* is one of the six Worldbank governance indicators. Higher values indicate higher quality.	Ranging from –2.5 to +2.5 units	(Worldwide Governance Indicators)
regul	*Regulation:* Index that focuses on regulatory restraints that limit the freedom of exchange in credit, labour, and product markets.	Measured on a scale from 0 to 10	(Gwartney et al., 2010)

Government effectiveness is one of the six governance indicators of the Worldwide Governance Indicators project and measures the quality of public services, the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government. The indicator is explicitly described by Kaufmann et al. (2010).

Regulation component is reflected by the regulation index of the Economic Freedom of the World report (Gwartney et al., 2010). The index focuses on regulatory restraints that limit the freedom of exchange in credit, labour, and product markets and is measured as the average of these three components. In order to score high in this portion of the index, countries must allow markets to determine prices and refrain from regulatory activities that retard entry into business and increase the cost of producing products. They also must refrain from using their power to extract financial payments and reward some businesses at the expense of others. More details about the methodology and calculation of the index can be found in the work of Gwartney et al. (2010).

Table 2 Descriptive statistics of the dataset

Variable	Obs	Mean	Std. Dev.	Min	Max
eGov	150	0.657	0.158	0.323	0.927
oss	150	6.493	1.274	1.946	10.228
secserv	150	7.757	2.024	2.565	12.786
educ	150	4.451	1.131	1.801	6.853
innov	136	21.038	1.747	15.642	24.005
ICTtrade	148	20.225	13.358	6.343	59.473
gov_effect	150	0.828	0.971	–2.219	2.191
regul	150	6.847	0.943	4.376	8.507

6 Statistical analysis and discussion of results

Panel data analysis endows regression analysis with both a spatial and temporal dimension. The spatial dimension pertains to a set of cross-sectional units of observation. The temporal dimension pertains to periodic observations of a set of variables characterising these cross-sectional units over a particular time span. The model of this study corresponds to a panel of $i = 25$ countries and $t = 8$ years.

The model evaluates the ceteris paribus effect of each of the national level factors described in Table 1 on the eGov maturity as defined in Section 2. The corresponding econometric model is given by (2).

$$eGov_{it} = a + b_1 oss_{it} + b_2 secserv_{it} + b_3 innov_{it} + b_4 educ_{it} + b_5 ICTtrade_{it}$$
$$+ b_6 gov\_eff_t + b_7 regul_{it} + u_i + \varepsilon_{it} \tag{2}$$

In euation (2), $eGov_{it}$ is the dependent variable, while the right hand side variables are its explanatory variables. In panel data models there are two types of errors. The first is the individual specific effect u_i, which captures all unobserved, time-constant factors that affect $eGov_{it}$ and are due to a country's individual characteristics. The other is the idiosyncratic error ε_{it} of the equation or time-varying error that represents unobserved factors that change over time and country. The coefficient a corresponds to the equation's intercept and is used for the estimation of the predicted values of $eGov_{it}$, while the coefficients b_j, $j=1$ to 7 reflect the relative impact of each of the constructs on the dependent variable $eGov_{it}$.

In order for the regression to produce consistent and unbiased estimations, the explanatory variables should be independent, thus the possibility of possible correlations should be checked before performing the regression.[1] All correlations were lower than 80%, the criterion level suggested by Kennedy (2003). The correlation matrix is illustrated in Table 3.

Secondly, specification tests were performed. In panel data models a usual question that arises is whether to treat the individual effect u_i as fixed over time, or sections, or as a random variable. The Hausman specification test (Hausman, 1978) between random and fixed effects model, indicated that the fixed effects model should be preferred ($\chi^2(7) = 25.54$, $p < 0.001$). Also, the Breusch and Pagan Lagrangian multiplier (*LM*) test for random effects (Breusch and Pagan, 1980) indicates that the variance of the country specific effect u_i, is significantly different from zero ($\chi^2(1) = 155.99$, $p = 0$, under the null hypothesis that Var(u)=0), showing the significance of the individual-specific effects.

Table 3   Correlation matrix

	oss	*secserv*	*educ*	*innov*	*ICTtrade*	*gov_eff*	*regul*
oss	1						
secserv	0.504	1					
educ	–0.231	0.266	1				
innov	0.741	0.695	–0.218***	1			
ICTtrade	0.104*	0.178	–0.220	0.434	1		
gov_eff	0.249***	0.463	0.444	0.470	–0.121*	1	
regul	0.130*	0.651	0.491	0.345	0.086*	0.574	1

Note: All significance levels are at the $p<0.01$, except where denoted by: *=$p>0.1$,
        **=$p<0.1$, ***=$p<0.05$.

The next specification test explores the case of endogeneity. A variable is endogenous, when it is correlated with the error term ε_{it}. The Durbin-Wu-Hausman (DWH) test (proposed by Durbin, 1954 and separately by Wu, 1973 and Hausman, 1978), showed no evidence of endogeneity for any of the regressors.

Apart from the above specification tests, panel models often violate standard ordinary least squares (OLS) assumptions. Two post-estimation tests for serial correlation and heteroscedasticity for the 25 panels were performed. The result of the Wooldridge (2002) test for autocorrelation in panel data showed evidence of serial correlation in the idiosyncratic errors, as it was $F(1, 22)=83.991$, $p=0$. The p-value rejects the hypothesis H_0 of no first-order autocorrelation. The modified Wald test as performed by Greene (2000) for groupwise heteroskedasticity in fixed effect regression model, clearly indicated that disturbances are heteroscedastic ($\chi^2(23)=710.81$, $p=0$ which rejects the hypothesis H_0 of homoskedasticity).

The above tests indicate that the optimal method choice is the feasible generalised least squares (FGLS). FGLS assume strict exogeneity of the independent variables and provides results consistent for autocorrelation errors and panel heteroscedasticity. GLS is equivalent to applying OLS to a linearly transformed version of the data, which requires minimising. The GLS estimator is unbiased, consistent, efficient, and asymptotically normal. Thus, just as the OLS estimates measure the marginal impact of each of the independent variables on eGov, so do the FGLS estimates (Wooldridge, 2002). The regression results are provided in Table 4.

The estimated coefficients of the regression provide with the interpretation of the relative relation of each of the regressors on eGov.

Firstly, the use of OSS shows to have a positive and significant impact on eGov ($z=3.19$ at $p=0$ significance level), verifying hypothesis H_1. Countries with higher OSS adoption are more aware of the OSS notions of collaboration, participation and transparency and as thus, governments, citizens and other stakeholders are influenced by these notions as well. As for instance, citizens that participate in OSS projects are more familiar with participating and would expect more transparency and collaboration form their governments in eGov initiatives. Governments, on the other hand, influenced by the open source values are more probable to become open and enhance eGov initiatives by increasing transparency levels and encouraging citizens' collaboration. Moreover, OSS is an innovative and advanced technology and apart from cost effective, would be a more sophisticated solution for the implementation of eGov technology reforms.

Table 4 FGLS regression results

Dependent variable: eGov			
No. of Observations: 135			
Wald $\chi^2(7) = 560.97$***			
Variables	*Coef.*	*Std. Err.*	*Z*
oss	0.015	0.005	3.19***
secserv	0.011	0.007	1.70*
innov	0.005	0.006	0.92
educ	0.016	0.005	2.90***
ICTtrade	0.001	0.000	2.73**
gov_effect	0.046	0.011	4.17***
regul	0.052	0.008	6.70***
_cons	–0.208	0.133	–1.56

Note: Significance levels are denoted by: *=$p<0.1$, **=$p<0.05$, ***=$p<0.01$.

Secondly, the use of secure servers also show a positive impact on eGov ($z=1.7$ at $p<0.1$), confirming H_2. This is an expected outcome, as security in transactions adds to citizen's trust towards the use of a system, and thus willingness to adopt. Overall, it can be deduced that the use of the advanced technologies OSS and secure servers positively affects eGov.

Apart from the technological efficiency, a country's education levels, also shows to have a positive impact on eGov ($z=2.9$ at $p=0$). Thus, eGov is better diffused in countries, where citizens are more educated (H_4). This is quite expected as skills and education enable easier access and use of new technologies. On the contrary, innovation levels within a country showed no statistical significance ($z=0.9$ at $p>0.1$), rejecting hypothesis H_3.

Technological flows and spillovers expressed by ICT trade show a positive and significant ($z=2.73$ at $p=0.01$) relationship with eGov growth. This, in turn, confirms hypothesis H_5, that ICT trade and the free exchange of knowledge and ideas can leverage eGov adoption from one country to another.

Finally, the higher relative impact in the econometric equation (2), was reflected by effective governance and regulation, verifying both hypotheses H_6, H_7. Effective

regulation recorded the highest statistical significance (z=6.7, p=0) and the highest coefficient in the equation (0.052). The second highest coefficient (0.046) is attributed to the effective governance and is highly significant (z=4.17) at a p=0 level. Statistical results show the importance of policy factors on the potential adopters' decisions. Effectiveness in governance and regulation add to the citizen's trust towards their government, encouraging their participation in processes like an eGov transaction.

7   Conclusions

The study grounded on the framework of the endogenous, exogenous growth and institutional theories attempts to shed light on the factors affecting eGov assimilation.

Findings suggest that the use of advanced technologies, education, technological openness and institutional quality in terms of government effectiveness and regulation are important drivers that lead eGov growth. Results can be helpful input for policy makers that want to evaluate country conditions that affect eGov acceptance potential.

More particularly, it was shown that effective governance and regulation highly affect eGov growth. Effective governance is very important for the successful eGov implementation, because more effective administration practices and policies would be exercised. This, in turn, enables the necessary bureaucratical and technological reforms in the public sector and particularly in the eGov sector to be effectively implemented. The same applies for governments that enact regulations effective in terms of labour, credit and product markets. Regulatory restrains in these sectors, create unfavorable conditions for economic growth and social development, thus refraining citizens and other stakeholders from the use and acceptance of public services.

In terms of technology factors, the study focused on the use of two particular technologies, each of them offering different qualities in the advancement of eGov. OSS and secure servers, both proved to be effective technological tools, if used into the eGov implementations. Secure servers positively add to the issue of security in eGov transactions, adding to the trust of potential users.

OSS, on the other hand, is not merely an advanced technological tool. OSS carries the notions and values of collaboration, participation and transparency, which align with the eGov goals and notions. These values tend to positively influence both the demand and supply sides of eGov implementations, that is citizens who are encouraged to participate and accept eGov projects and their governments who are encouraged towards openness and transparency into the context of eGov.

Another important factor is a country's technological openness. The increased imports and exports of technologies positively influence countries as a spillover effect, creating favourable conditions to implement and use new technologies, like eGov services and applications. Finally, education is a societal factor that was also found to be affecting eGov assimilation. Higher education adds to social development enabling the achievement of cultural and political leaps among eGov stages.

One of the limitations of this study is the limited sample of 25 countries. Yet, the sample has been selected so that to be evenly distributed among all continents. Countries with large number of population were preferred, so as to cover greater part of the world's population. Moreover, as this was an initial evaluation of country specific factors that affect eGov, missing factors may also exist. The findings of current research, however,

are still important, as they give an insight of the factors that positively affect the diffusion mechanism. Future research, could explore more inhibitory or favouring factors for eGov assimilation, by extending the current theoretical framework.

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Note

1   All the statistical tests and calculations were derived with the STATA software.