Does OSS Affect E-Government Growth? An Econometric Analysis on the Impacting Factors

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Abstract. Inspired by the OSS values, an increasing number of different forms of open initiatives have come to the fore. In the context of eGovernment the notion of open government has met wide acceptance among nations and became closely related to one of its goals. Open government shares with OSS the notions of collaboration, participation and transparency and many actions towards OSS into eGovernment reform policies, have been recorded worldwide. The study investigates the relationship between OSS growth and eGovernment. A theoretical framework of the theories of institutionalism, growth and human capital is proposed as the guiding theoretical lens to identify possible influencing factors that together with OSS are evaluated for their magnitude of impact on eGovernment growth across different economic environments.

Keywords: Open source software, eGovernment adoption, institutionalism, growth theory, human capital theory

1 Introduction

Being "computer-based innovation"[1], open source software (OSS) is marked by ideologies and values of collaboration and sharing, adopting a different value creation model, in which value is an outcome of collective intellect achieved through the OSS community. The OSS model is able to deal with costs and short product life cycles, attracting organizations and governments to use these value added services, without compromising the required levels of quality. Inspired by the OSS values, a number of other forms of open initiatives have been gaining momentum. Open source systems now extend beyond software to include open access, 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 organizations [2].

In the context of eGovernment (eGov) the notion of openness has met wide acceptance among nations and became closely related to one of its goals. eGov refers to the transformation of traditional public sector services and processes into an electronic format with greater accessibility and interactivity to citizens [3]. eGov aims at more efficient, transparent and accessible public services to citizens and businesses. Implementation of eGov initiatives requires substantial reform in public organizations because the typical form of a bureaucratic organization with conservative cultures, make it resistant to change. The choice and design of new technologies constitute important carriers of eGov reform aims and a number of actions show that OSS is one of these innovative technologies. Also, OSS diffusion as infrastructure software of the web (e.g Apache and Linux), shows that OSS establishes an advanced technological framework upon which eGov services can be build.

As a result, many actions and policies that promote OSS in the public sector have been recorded worldwide [4]. Recently, the US government has introduced the open government initiative declaration, which focuses on the institutionalization of the principles of transparency, participation, and collaboration into the culture and work of eGov [5]. Also, in Europe, the EU Ministerial Declaration [6] of eGov goals define a more open, flexible, and collaborative eGov, paying particular attention to the benefits of the use of open source model and specifications. Both declarations, contain principles (like accessibility, transparency and openness) and methodologies (like collaboration and sharing), that are obvious references to OSS. The commonalities of OSS and open government have even lead to a new political philosophy, which advocates the application of the principles of the OSS and open content movements to the democratic principles, that enable any citizen to add to the creation of policy.

Taking into account the above evidence, the relation of eGov growth and OSS technology is considered of great interest. Even though prior studies [7] have already identified technological factors that determine eGov diffusion, none has attempted to assess the impact of OSS technology. The study proposes a theoretical framework of the theories of institutionalism, growth and human capital as the guiding theoretical lens to identify possible influencing factors that together with OSS are evaluated for their magnitude of impact onto eGov growth.

2 Theoretical framework

A country is conceptualized 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, human capital and growth theory factors and is specified as:

$$eGov_{it} = F(X^{inst}, X^{hc}, X^{gr}) \quad (1)$$

Where *eGov* is the eGovernment growth determined by a vector of all factors relevant to institutional X^{inst}, human capital X^{hc} and growth X^{gr} theories, for each country *i*, at time *t*. The corresponding conceptual model is illustrated in Fig. 1.

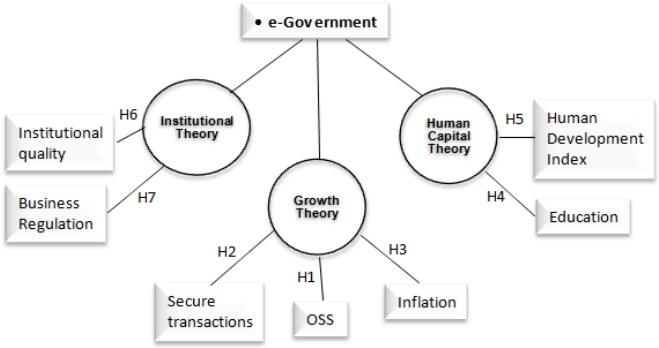

Fig. 1. Conceptual model for eGovernment growth

Growth Theory indicates that economic growth is generated from within a system as a result of internal processes [8]. This study examines the impact of technological and economic factors within a country. Firstly, as discussed in section 1, OSS is expected to have an impact on eGov growth (H1). Secondly, security in transactions is also important [9], as possible security pitfalls of eGov services could retain users from the use of electronic services (H2). Finally, economic conditions like the cost of living or a country's inflation rates could influence eGov. For instance, higher costs of internet access would hinder its use (H3).

Human Capital Theory stresses that education, health, and skills are forms of capital, the human capital, that can explain the differences in growth among individuals and nations [10]. The study examines the impact of both the education level (H4) and the quality of human capital in terms of social development (H5).

Institutionalism considers the processes by which structures, rules, norms, and routines, become established as authoritative guidelines for social behavior [11]. Prior studies [12] found that from an institutional view, public services are likely to adopt eGov due to the pressures from regulation and competition environment. Thus, the impact of institutional quality (IQ) and business regulations are evaluated. IQ is considered as an indication of government effectiveness to enact regulations and laws (H6). Also, regulations and actions that enable business creation and improve competition are assumed to improve acceptance of eGov services (H7).

3 Data Description, Statistical analysis and Results

The factors are evaluated by means of a panel data analysis of 25 countries selected so as to represent different regions and economic status[1], over the period 2003-2008. The data, measures and sources for each of the factors are provided in Table 1.

[1] Belgium, Finland, France, Germany, Greece, Italy, Netherlands, Spain, Sweden, United Kingdom (UK), Romania, Russia, Turkey, Argentina, Brazil, Canada, Mexico, United States (US), Australia, China, India, Japan, Korea, South Africa, Tunisia

Table 1. Data Labels, variables' Definitions, Measures, and Sources

	Variable	Measure	Sources
eGov	e Gov Development Index encompasses the capacity and the willingness of the public sector to deploy ICT for improving knowledge in the service of the citizen.	Measured in the range of 0 and 1.	United Nations eGov data center[2].
OSS	Number of subscribed per country users in the SourceForge portal.	Natural log	University of Notre Dame[3]
sserv	Servers using encryption technology in Internet transactions	Natural log	World Bank Indicators[4]
HDI	Human Development Index (HDI) reflects social and economic development.	Ranging between 0 and 1	United Nations [5]..
educ	Operating expenditures in education	Percentage of GNI.	World Bank Indicators
inf	Inflation, measured by the consumer price index, is the annual percentage change in the cost to the average consumer.	Percentage rate.	World Bank Indicators
IQ	Institutional quality measured by the mean value of the six dimensions of governance. Higher values indicate higher quality.	Ranging from -2.5 to +2.5 units.	Worldwide Governance Indicators[6]..
B_R	Business regulation expresses policies to improve market entry conditions and competition. Higher values indicate less restrictions and higher competition.	Values ranging from 1 to 10.	Economic Freedom Network[7].

$$eGov_{it} = a + b_1 OSS_{it} + b_2 sserv_{it} + b_3 HDI_{it} + b_4 educ_{it} + \quad (2)$$
$$b_5 inf_{it} + b_6 IQ_{it} + b_7 B\_R_{it} + u_i + \varepsilon_{it}$$

Initially, data were successfully tested for correlations among the variables. The econometric model is given by equation (2), where u_i is the country specific effect and ε_{it} is the idiosyncratic error. Next, specification tests were performed. The Hausman test [13] indicates that the fixed effects model should be preferred ($\chi^2(7)=15.89$, $p<0.05$). The Breusch and Pagan test [14] indicated the significance of the individual specific effects($\chi^2(1)=135.6$, $p=0$, H_0: $Var(u)=0$). The Durbin-Wu-Hausman test [13,15] showed no evidence of endogeneity of the regressors. Panel models often violate standard Ordinary Least Squares assumptions. The Wooldridge test [16] showed evidence of serial correlation in the idiosyncratic errors: $F(1, 24)=100.4$, $p=0$. Also, the modified Wald test [17] indicated heteroscedastic disturbances

[2] http://www2.unpan.org/egovkb/datacenter/CountryView.aspx
[3] http://zerlot.cse.nd.edu
[4] http://data.worldbank.org
[5] http://hdr.undp.org/en/
[6] http://www.govindicators.org
[7] http://www.freetheworld.com/datasets_efw.html

($\chi^2(25)=720.8$, p=0). The tests indicate that the optimal method choice is the feasible generalized least squares (FGLS), which is consistent for autocorrelation errors and panel heteroscedasticity, provided exogeneity of the independent variables [16].

Table 2. FGLS regression results

Dependent variable: eGov	**No of Observations**:150		**Wald** $\chi^2(7) = 272.26$ ***
Variables	Coef.	Std. Err.	Z
OSS	0.014	0.004	3.75***
sserv	0.012	0.004	3.21***
educ	0.012	0.006	1.95*
HDI	0.662	0.094	7.02***
inf	0.001	0.001	1.18
IQ	0.055	0.018	3.00**
B_R	-0.002	0.002	-0.7
_cons	0.045	0.072	0.63

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

Regression results are provided in Table 2. It can be deduced that there is a significant and positive impact of OSS on eGov (z=3.75 at p<0.01). Implementation of eGov initiatives requires substantial reform in public organizations, such as the bureaucratic organization with conservative cultures, and innovative technologies. OSS combines technological innovation and quality characteristics and cost efficiency. It also carries the values and ideas of collaboration, participation and code sharing, which aligns with the notions of open eGov. This philosophy is expected to increase transparency, trust and citizen's participation in electronic services. The commonalities between the two entities, show that their growth follow parallel trajectories and that countries with higher OSS penetration are more probable to exhibit higher eGov adoption. It can be elicited that OSS is an emerging technology into the eGov context, that challenges the potential of eGov reforms. This, n turn, creates new direction fields and opportunities for OSS growth and long term sustainability.

Other factors that show a positive and statistically significant impact are the use of secure servers (H2), social development (H4), education (H5) and IQ (H6). *HDI* has the highest coefficient in the regression (0.66), reflecting the importance of social development for the achievement of cultural and political leaps in the UN's five stage model. Finally, inflation and B_R variables don't show any statistical significance, rejecting hypotheses H3 and H7. It can be deduced, that well organized societies, exhibiting effectiveness in governess and in policies related to social development are more prone to lead eGov initiatives that earn citizen's trust and willingness to adopt.

4 Conclusions

The study evaluates factors for eGov adoption. Grounded on the findings, OSS showed a significant impact on eGov, indicating that OSS is an emerging technological approach into the eGov context. This, in turn, would create more opportunities for

OSS growth and long term sustainability. In addition, the use of secure servers, IQ, social development and education proved to be drivers that lead eGov growth.

Results provide with useful input for research and practice. For research it brings in a new theoretical framework for the study of eGov growth and new directions on the technological approaches for eGov reforms. For practice, it emphasizes on positive effects of the use of OSS for the implementation of eGov projects. The study constitutes an initial evaluation of country specific factors affecting eGov, limited by the small number of countries and possible missing factors. However, findings 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, by extending the current theoretical framework.

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