

Effects of the Digital Divide in E-Participation Development in the UN Countries

Explanatory Factors of E-Participation for UN Countries

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Abstract— E-government offers citizens the potential for greater access to their representatives and confers policy makers the possibility to make G2C relationships more inclusive. However, the real translation into governance outcomes will depend on policy makers' consideration of the environmental complexity and the singular characteristics of the target population. This paper analyses the relationships between e-participation development and the variables associated to the digital divide in a sample of 178 countries for the period 2008-2016. The authors use a multiple linear regression model and the UN's E-participation Index as the dependent variable. The test of the hypotheses shows the significant and positive effect of telecommunications infrastructure and age and a significant negative effect of education and rural condition. Results reveal that Gender and Political freedom and Democracy are not influential.

Keywords- E-participation; UN's E-participation Index; digital divide; linear regression

I. INTRODUCTION

E-government (EG) can be an instrument to improve the relationship between people and their government. In the achievement of public governance, EG aims at increasing participation in decision making and making public institutions more transparent and accountable. From the perspective of the principal-agent theory, EG provides citizens with a basis to decide, participate and engage with government actions, which in turn may strengthen their trust and reinforce Government-to-Citizen (G2C) relationships, increasing public authorities' legitimacy [25][26]. However, Dawes [10] pointed to a multi-dimensional digital divide that posed challenges to governments trying to provide equitable access to information and services as well as opportunities to broaden participation in political processes.

Although recognizing the growing interest and literature in the field, there is a relative low number of papers focused on the analysis of citizen e-participation from a quantitative perspective. In this context, our article wants to contribute to the existing research and enhance the understanding of the drivers affecting e-participation dynamics. With that aim, the UN's E-participation Index (EPI) is taken as indicator for e-participation in order to study its evolution over the period 2008-2016 in a sample of 178 countries. EPI measures the availability of e-participation tools on national government portals [48]. This legitimized index remains meaningful in that it enumerates the diverse levels of the online activity of civil participation. The index has been used in previous research [15][18][50].

In this research, panel data is used to conduct ordinary least squared linear regression model in order to test hypotheses as to the relationship between the evolution of EPI and that of economic and socio-demographic variables of the context, which relate to the digital divide (telecommunication infrastructures, education, location, age, gender, and political freedom and democracy).

Apart from the introduction section, the paper is structured in six more sections. Section 2 corresponds to literature review, in Section 3 we propose the model and the hypotheses developed, Section 4 describes the methodology applied, in Section 5 we show the main results, Section 6 corresponds to the discussion of the results and finally we present the main conclusions in Section 7.

II. LITERATURE REVIEW

A broad line of research have described and measured the attributes of government websites trying to assess their maturity in terms of EG development [9][12][13][19][22][36][39]. Generally, these researches have also investigated the factors affecting that development, considering politic, socio-economic and demographic variables, mainly.

A less abundant amount of publications have studied, from a quantitative perspective, the potential of EG to permit citizen participation [33][34][35]. Pina, Torres and Royo [29] in their web maturity assessment in UE local governments, obtained similar results: democratic participation and citizen dialogue presented the lowest scores. For their part, Pina, Torres and Acerete [28], Bonsón, Torres, Royo and Flores [4], Girish, Yates and Williams [15], Zhao, Ning and Collier [50] or Jho and Song [18] analyzed EG development in terms of e-participation and connected it with economic, socio-demographic, cultural and information society factors, among others.

III. CONCEPTUAL MODEL AND HYPOTHESES DEVELOPMENT

The main objective of this section is on the one hand to clarify the concepts of the E-participation and the Digital Divide and on the other hand, to raise the research hypotheses.

A. *E-participation and the digital divide.*

Generally, E-participation is defined as the use of ICT to support democratic decision [23][24]. Following Reddick [33], our research considers different forms of participation in government ranging from the one-way interaction (managerial), two-way interaction directed from government (consultative), and finally the highest form of e-participation of the two-way interaction directed from citizens to government and vice versa (participatory).

According to the UNDESA 2016 EG Survey [48], the digital divide refers to the gap among individuals, households and businesses at different socio-economic levels with regard to both their opportunities to access ICTs, and their use of the Internet for a wide variety of activities. It also refers to disparities between developed and developing countries, as well as within and among groups in a country, especially countries with greater rural populations. In general, it could be said that the digital divide refers to the unequal access of citizens to ICT, and uneven possession of skills and experience required for using it. It can take many forms and be described variously in terms of gender, location, skills, and income [1].

B. *Determinants of e-participation: hypotheses.*

From the above, it can be drawn that EG-enabled citizen participation is influenced by socio-economic and demographic and political factors that, in turn, might be associated to the existence of a digital divide [7][37]. A research question arises and leads us to investigate if governments are considering this digital divide when designing their national portals. In particular, are the variables associated to the digital divide an influential factor for the inclusion of participation tools in the webs?

Using the EPI as indicator of web maturity in terms of citizen participation, the relationship between e-participation and telecommunications infrastructure, education, age, location, gender and political freedom and democracy will be explored.

Experience suggests that the implementation of EG demands significant investments in technical and administrative infrastructures. Holzer and Kim [16] indicated that economically advanced countries had more emphasis on citizen participation, compared to less developed countries. Similarly, Siau and Long [36] and Das, Singh and Joseph [9] identified significant differences in EG development for countries with different levels of telecommunication infrastructure. Akin to them, the analysis of Jho and Song [18] showed that the level of ICT is a crucial variable in determining the level of e-participation. After this reflexion the first hypothesis in this research is set out:

H1. The investment in telecommunications infrastructure is associated with EG-enabled citizen participation.

The literature on the digital divide has claimed that internet use relates to higher educational levels [3][6][38][48]. Similarly, authors like Kim [22] refer to the need of knowledge and skills for the use of the EG-related technologies. Developing countries' lower literacy rates hamper the necessary changes that must take place for the appropriate development of EG projects, leading to their failure [8]. According to this idea, the second hypothesis is set out:

H2. Education is associated with web-enabled citizen participation

There are large regional and rural/urban differences with regard to access to and possession of information technology [2]. Rural population is often associated with lower levels of EG usage and, subsequently, e-participation.

Educational levels might be one factor behind this fact, considering that education is frequently concentrated in large cities. Taipale [38] reached this conclusion when observed that rural people, who would benefit most from EG services, are not using them, while in cities that have been able to maintain office services, people also use e-services. Taking the above into account, our third hypothesis is as follows:

H3. Location is associated with web-enabled citizen participation

The age of the population has been studied in connection with levels of political participation, citizen engagement and trust [30]. Specifically, within the abundant research on EG, it is easy to find publications that have investigated its relationships with the age factor. Literature on the digital divide points to older populations facing significant disadvantages in the use of EG compared to younger people [11][14]. The following hypothesis investigates the relationship between age and e-participation:

H4. Age is associated with web-enabled citizen participation.

Previous research has been inconclusive regarding the existence of a relationship between gender and EG. Although many discard this connection [3][6][32][38][49],

other works confirm a positive relationship between masculine gender and use of EG. Some studies point out to the fact that women in many parts of the world lack an equal access to ICT services [1]. To contribute to this debate, a fifth hypothesis is drawn:

H5. Gender is associated with web-enabled citizen participation.

The approach of deliberative democracy or pluralist democracy addresses citizens as active participants and as co-producers of policies [28]. In this regard, digital government has the power to increase citizen input to government [20]. However, unless civil liberties are widely permitted, e-government would not perform beyond a billboard as one-way communication with the public, and citizens might be afraid of voicing their opinions and monitoring government programs and services. To contribute to this debate, the last hypothesis is set out:

H6. Political freedom and democracy are associated with web-enabled citizen participation.

IV. METHOD

The research has used secondary data drawn from the E-Government Survey, published biannually by United Nations. The Survey is the most extensive world survey on EG to date, covering 191 countries [48]. Other data sources used are the World Bank and the World Bank Group.

A panel data has been compiled for the period 2008-2016, for a group of 178 countries. The number of cases observed is 890. The high number of countries studied and the longitudinal character of the analysis allows our research contribute to understanding the e-participation development factors on a global scale. Figure 1 shows the variables analysed, their correspondent indicators and the data source.

Variable	Indicator	Description	Source
E-Participation	E-Participation Index (EPI)	UN e-Participation indicator	UNDESA (2008, 2010, 2012, 2014 and 2016)
Technology and telecommunications infrastructure	Telecommunications Infrastructure Index (TII)	UN telecommunication infrastructure indicator	UNDESA (2008, 2010, 2012, 2014 and 2016)
Education	Human Capital Index (HCI)	UN education indicator	UNDESA (2008, 2010, 2012, 2014 and 2016)
Location (rural vs urban)	%Rural	% rural population vs total population	WB (2006, 2008, 2010, 2012 and 2014)
Age	% Pop.>65	% population > 65 years vs total population	WB (2006, 2008, 2010, 2012 and 2014)
Gender	% Female	% women vs total population	WB (2006, 2008, 2010, 2012 and 2014)
Political freedom and democracy	Voice Account Rank	WBG freedom and democracy indicator	WBG (2006, 2008, 2010, 2012 and 2014)

Figure 1. Variables, indicators and source

In order to study the e-participation, the EPI has been selected as the dependent variable. As it was explained before, the EPI is elaborated by the UN within the EG surveys [40] [41][42][43][48].

As regards the independent variables, the first one is the level of telecommunications infrastructure of a country, which is measured by the Telecommunications Infrastructure Index (TII), also extracted from the UN’s EG surveys, yet the primary data source is the ITU. The second independent variable is the level of education of a country’s population, measured by the Human Capital Index (HCI), which is extracted from the UN’s EG surveys as in the previous cases. Data to measure the next three independent variables have been extracted from the World Bank. The predictor variable Location reflects the percentage of rural population over the total population. The variable Age takes as indicator the percentage of population above 65 years over the total population of a country. The variable Gender is measured by the percentage of females over a country’s total population. Political freedom and Democracy makes up the last independent variable, measured by the indicator “Voice Account Rank”. This is one of the Worldwide Governance Indicators calculated by Kaufmann, Kraay and Mastruzzi in 2010 [21] for the World Bank Group.

In addition to this, the variable Year has been included as a controlling factor in order to reflect the variations derived from the economic scenarios.

V. RESULTS

The ordinary least squared multiple regression model for EPI has been conducted using R statistical program [31]. Figure 2 offers the results for the Ordinary Least Squares (OLS) model.

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Call:
lm(formula = f1, data = base)

Residuals:
    Min       1Q   Median       3Q      Max
-57.599 -12.397  -1.517  11.401  60.349

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  22.103613  14.215708  1.555  0.1205
TII           0.555048  0.064551  8.599 < 2e-16 ***
HCI          -0.090973  0.042739  -2.129  0.0337 *
%Pop>65      0.352334  0.168725  2.088  0.0372 *
%Rural       -0.252103  0.042882  -5.879  6.74e-09 ***
%Female      0.205721  0.303203  0.678  0.4977
VoiceAccounrank 0.006618  0.037604  0.176  0.8604
Year         2.359904  0.300548  7.852  1.80e-14 ***
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Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 18.48 on 621 degrees of freedom
(261 observations deleted due to missingness)
Multiple R-squared:  0.5697, Adjusted R-squared:  0.5648
F-statistic: 117.4 on 7 and 621 DF, p-value: < 2.2e-16
    
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Figure 2. Linear Model

From the results, it can be observed that about 68% of the countries in the sample started the period with an EPI value of 22 ± 14 points and increased almost 2.36 % every year.

The seven variables included explain a 56.4 % of the variance of EPI, according to its adjusted R squared. The beta coefficients shows the significant positive influence of Year, TII and %Pop.>65 and the significant negative influence of HCI and %Rural. The 95% confidence intervals for their coefficients are [0.43, 0.68] for TII, [0.17, -0.00] for HCI, [0.02, 0.68] for %Pop.>65 and [-0.33, -0.17] for %Rural.

VI. DISCUSSION

In this section, our results will be explained and discussed against literature of reference in the general field of EG and in the particular area of e-participation.

Focusing on our results, the variable Year positive influence reflects that, in a good proportion of the sample, EPI improves over the time for the period considered.

The coefficients for TII (beta 0.55) are statistically significant at the 0.05 level and indicate that throughout the period 2008-2016, there is a strong connection between the telecommunications infrastructure of a country and the level of e-participation allowed on national government portals. When holding all other variables constant, a one-unit increase in a country's TII increases a country's score on the EPI by 0.55. Consequently, hypothesis 1 is verified. This positive and significant influence of technology and telecommunications on the specific topic of e-participation has not been confirmed by any of the works consulted, yet Jho and Song [18] identified a positive effect of a country's online population over EPI. Notwithstanding, Siau and Long [36], Pina et al. [28] and Das et al. [9] concluded TII was influential on EG development in general.

As regards the second predictor variable, Education, measured through Human Capital Index, it results significant with a beta value of -0.09. According to the digital divide phenomenon, educational levels affected positively e-participation, but with a different sign. Our second hypothesis is confirmed but not in the expected way. One possible explanation would be that education solely is not enough to increase e-participation, meaning that governments need to work to make citizens aware of the benefits of using EG [17].

Following the results, the indicator used to measure Location, % Rural population, shows a significant negative influence in EPI (beta -0.25) along the period of study, confirming our third hypothesis that belonging to rural areas is associated to lower levels of e-participation and vice versa. These results support the digital divide paradigm [48] that conveys that rural areas are generally associated with low levels of ICT and telecommunications [39] and education [38], which, in turn, generate barriers for EG access and usage. Besides, our results are consistent with those obtained by previous research [15][22].

As far as the variable Age is concerned, the results point to a significant and positive influence of the percentage of population over 65 in EPI (beta 0.35), at the 0.05 level. In other words, when holding all other variables constant, a one-unit increase in a country's %Pop.>65 increases a country's score on the EPI by 0, 35. This strong connection confirms our fourth hypothesis, although in a different sense from the expected according to the digital divide approach, which claims that older populations face significant disadvantages in the use of EG compared to younger people [11][14]. On the contrary, our results suggest that ageing relates to increased e-participation in government portals. Piewtrosky and Van Ryzn [27] could not confirm that older people demanded more transparency from Governments. The authors have not found previous works that tested the effect of ageing on the specific area of e-participation, with the exception of Reddick [33], who also pointed to the not significant effect of age in the participatory model constructed by the author.

Focusing now on the values obtained for the indicator percentage Female, used to measure the effect of Gender. The results do not permit to verify the fifth hypothesis. This contradicts the existence of a digital divide between men and women, in the sense that women in many parts of the world lack an equal access to ICT services [1] or men are more prone to use EG services than women [5]. Reddick [33] also discarded a statistically significant influence of the gender in e-participation.

Finally, political freedom and democracy come up as not significant according to our research. It is surprising that civil liberties are not required for the full development of EG. It cannot be confirmed that countries that do not guarantee civil liberties and democracy are associated with low levels of EPI. Consequently, our last hypothesis is rejected. Previous work is inconclusive about this issue. Girish et al. [15] and Jho et al. [18] have studied the topic in relation to EPI. The former detected a significant and negative influence for the political freedom variable coupled with a positive coefficient for democracy aspects. As Das et al. [9] pointed out; the evidence that EG can develop without significant dependence on governance alerts us that the type EG that is being developed is primarily for the billboard.

As a synthesis of the above, Figure 3 collects the test of the hypotheses put forward in this research.

Hypothesis	Expected sign	Result
H1. The investment in telecommunications infrastructure is associated with EG-enabled citizen participation.	Positive	Confirmed
H2. Education is associated with web-enabled citizen participation.	Positive	Not confirmed
H3. Location is associated with web-enabled citizen participation.	Negative	Confirmed
H4. Age is associated with web-enabled citizen participation.	Negative	Confirmed (positive)
H5. Gender is associated with web-enabled citizen participation.	Negative	Not confirmed
H6. Political freedom and democracy are associated with web-enabled citizen participation.	Positive	Not confirmed

Figure 3. Summary of the test of the hypothesis

VII. CONCLUSIONS

From the test of the hypotheses, some practical implications may be drawn:

In general, it is important for governments to identify demographic groups with unequal access to the benefits of EG services. This will provide them with the ability to target future policies and initiatives to narrow the digital divide and increase the population that can actively engage with public services.

The positive and significant coefficient of the TII permits to verify the first hypothesis. In this regard, inclusive EG polices should be supported with investment plans in ICT in order to raise the number of people with Internet access.

The results for the HCI predictor were significant but unexpected. It could be argued that education is only a minimum requirement but does not imply use of EG. Governments must consider this fact and implement policies to increase awareness about the benefits of the use of EG for citizens.

The percentage of rural population over all population resulted significant with a negative influence on EPI. Interpretation of this finding advises policy makers to pay appropriate regard to the special condition of the rural population, normally associated to reduced government size and budget to develop e-participation tools.

The results for the older population go against the existence of a digital divide due to age. However, interpretation must be careful. More aged countries are also associated to higher degrees of life expectancy, ICT infrastructure and education, which may be behind these results. It seems that the elderly living in developed countries are increasingly adopting EG, reducing the digital divide.

As regards for the gender, the results lead to discarding an influence of this variable in the level of e-participation. Similar conclusions apply for the “voice account rank”.

Civil liberties and democratic institution are not necessarily associated to EPI scores, which seems

incoherent with the foundations and objectives of EG and e-governance in particular.

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