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INTRODUCTION

Electronic participation (e-participation) has the potential to facilitate citizens' involvement in public affairs, whether through information provision, expanded consultation or in-depth deliberative decision-making processes. An early definition of e-participation describes it as "ICT-supported participation in processes involved in government and governance" (OECD, 2003). Saebø et al. (2008, p.402) define e-participation to include all forms of "technology-mediated interaction between the civil society sphere and the formal political sphere and between civil society sphere and the administration sphere". Highlighting the massive growth in academic research and governmental practice of e-participation, Wirtz, Daiser, & Binkowska (2018, p. 3) define it as "a participatory process that is enabled by modern information and communication technologies" and involves "stakeholders in the public decision-making processes through active information exchange, and thus fosters fair and representative policy-making".

Often portrayed as a field lacking consistency, e-participation has become increasingly popular over the past few years (Medaglia, 2012). In fact, with globalization and technological innovations, participatory processes are being challenged and the evolving technology requires stakeholders to continuously 'chase the digital wave' (Gibson, Römmele, & Williamson, 2014) and to foster ways of promoting 'creative citizenship' (Rodríguez Bolívar, 2018). The participation literature highlights individual resources and the role of institutional and political factors as determinants of participation (Verba, Schlozman, & Brady, 1995). More recently, revisited versions of this theory encompass the role of digital technologies and the positive correlation between individual resources and the likelihood of online engagement (Anduiza, Gallego, & Cantijoch, 2010). More generally, the academic literature in the field reports positive effects of e-participation for democracy, inclusion, transparency, accountability and good governance (Bertot, Jaeger, & Grimes, 2012; Medaglia, 2012; Noveck, 2009; Wirtz et al., 2018).

Following the United Nations E-Government Survey, it is possible to identify three dimensions of e-participation, namely e-information, e-consultation and e-decision-making (United Nations, 2018). E-information reflects government uses of digital technology to provide information to citizens. Information made available through Information and Communication Technologies (ICTs) can then be used as evidence for the advancement of the next stages in e-participation: consultation and decision-making. Public policies and the provision of services can incorporate the suggestions and commentaries of citizens directly or indirectly affected. When government elicits citizen participation in the formation of public policies and service delivery choices using ICTs, the process is defined as e-consultation. Once the consultation period is over, public officials "analyze the comments received and publish overall findings" (Scott, 2006, p. 350). The third stage of e-participation involves citizen participation in decision-making employing ICTs, including e-voting, online deliberation systems, and the evaluation of public policy proposals using social media (United Nations, 2018).

Early research on the determinants of the progress of e-government and e-participation in countries around the world highlights the role of technical infrastructure, economic development, and education levels as prime explanations (Åström, Karlsson, Linde, & Pirannejad, 2012; Siau & Long, 2009). However, prior empirical analyses have largely failed to take into account the institutional framework under which these progresses have been accomplished (Gulati, Williams, & Yates, 2014). More importantly, these analyses have neglected the fact that political institutions are not only affecting the expansion of digital government, but also often interact with more structural conditions to constrain or incentivize the adoption and expansion of e-participation (Gulati, Williams, & Yates, 2014; Kneuer & Harnisch, 2016).

This work contributes to the literature in several ways. First, it investigates how institutional differences – autocracies vs. democracies, public trust in elected officials, absence of corruption, freedom of the press, and government effectiveness – account for the variation in e-participation scores across countries and over time. This builds on and extends prior work by Bussell (2011) and Kneuer & Harnisch (2016) assessing the differences in the expansion of e-government in democracies and autocracies. Second, this aggregate analysis allows the examination of not only

the direct effects of institutional variation on e-participation, but also the interactions between institutional conditions and other factors affecting the development of e-participation across countries. Third, by focusing the analysis on the political and institutional determinants of e-participation at the country level, this chapter fills in an important lacuna in prior empirical studies, which have focused primarily on socioeconomic resources and internet skills as individual drivers of e-participation (Khoirunnida, Hidayanto, Purwandari, Kartika, & Kosandi, 2017; Vicente & Novo, 2014). Lastly, our contribution is also methodological. The analyses employ fractional regression models (Papke & Wooldridge, 1996) as the main empirical method to avoid the pitfalls entailed in using ordinary least square regression on a censored dependent variable like the UN E-Participation Index.

In particular, this research analyses the effects of institutional factors in encouraging or constraining e-participation across countries over a period of ten years (2008-2018) through a quantitative approach. The dependent variable of the analysis is a proxy for e-participation readiness, the UNDESA's E-Participation Index (EPI). This index evaluates 193 countries every two years, based on three main dimensions: provision of information by governments to citizens (e-information), interaction with stakeholders (e-consultation), and engagement in decision-making processes (e-decision making). The key explanatory variables of this research are the institutional and political factors affecting e-participation.

After the introduction, the theoretical model is presented, and the hypotheses supported by the literature on e-participation are discussed. The following section introduces the data and methods employed in this research and then the empirical analyses are presented. The next part of this chapter is devoted to a discussion of the findings. Lastly, the authors focus on a set of conclusions and directions for future research.

THEORETICAL MODEL

This chapter builds on prior studies of factors affecting e-government development and proposes a theoretical model to examine how the performance of political institutions impacts the adoption and implementation of e-participation in a comparative perspective. The model highlights not only the direct effects of political institutions, but also how their performance interacts with technology penetration and socio-economic development to account for specific levels of e-participation both across space and over time. Concretely, the model posits that both variables mediate the positive effects of the quality of political institutions on e-participation.

Early work in the field of Information Systems has identified a series of factors that impact e-government development in countries around the world. Several studies have shown that technology penetration and human development levels are positively associated with a country's e-government development (Siau & Long, 2009), performance (Stier, 2015), and maturity (Ifinedo, 2012; Ifinedo & Singh, 2011; Larosiliere & Carter, 2016; Singh, Das, & Joseph, 2007). These efforts have proven useful for the theoretical developments attempting to explain the expansion of e-participation. One of the most comprehensive pieces of research by Krishnan et al. (2017) combines the analysis of the determinants of e-government maturity and e-participation in a single article and confirms the positive association of both ICT infrastructure and human capital development with the expansion of digital government. If a country's human and socio-economic development is an indicator of a stronger civil society and more active grassroots movements, it is also likely that these countries will display higher commitment to e-participation (Reddick and Norris, 2013).

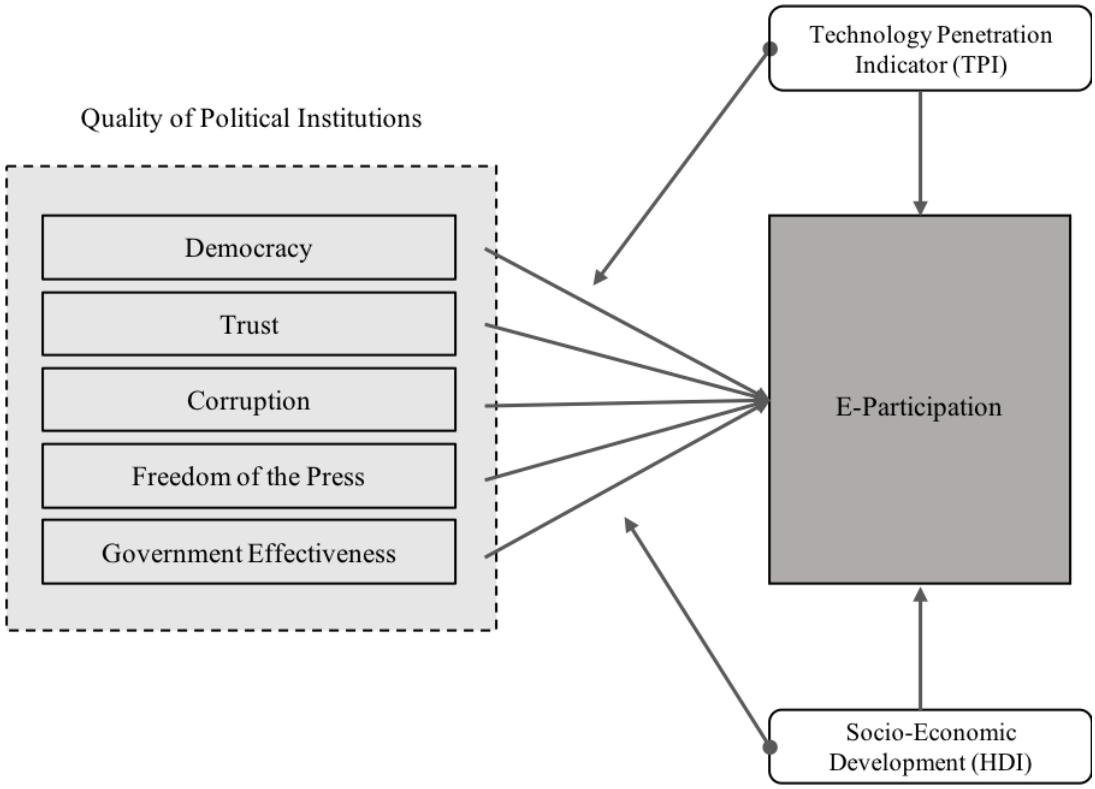
Early work by Milner (2006, p. 178) suggests that "political institutions in particular matter for the adoption of new technologies because they affect the manner and degree to which winners and losers from the technology can translate their preferences into influence". Democracies are also more likely to experience citizen pressure and transparency norms capable of stimulating the use of e-participation tools (Kneuer & Harnisch, 2016). In a similar vein, Stier (2015) suggests

that liberal democracies with competitive elections are more likely to be concerned with citizen-centric deliberation and therefore promote e-participation. Democratic governments are also more likely to encourage multiple forms of political expression and checks on power (Gulati, Williams, & Yates, 2014). This willingness to promote transparency will find in e-participation tools the obvious means to attain these goals.

Milner (2006, p. 178) also argues that "the Internet can provide civil society with uncensored information, costless sharing of that information, and tools to overcome collective action problems for organizing opposition". Logically, other indicators of the quality of political institutions are just as likely to be related to e-participation. Just as e-government in general, e-participation has also been associated with perceived transparency (Zheng & Schachter, 2017), reduced corruption (Bussell, 2011), improved trust in government (Zolotov, Oliveira, & Casteleyn, 2018), and enhanced legitimacy of political systems through the involvement of citizens in the political and administrative debate (Åström et al., 2012; Stier, 2015).

All these indicators of the quality of political institutions have been associated with e-participation, but their interaction with more infrastructural conditions is less understood. In other words, the quality of political institutions is likely to have varying effects on e-participation across countries with different levels of technology penetration and socio-economic development. Authors investigating the determinants of e-participation have failed to explore this possibility, since they have only tested the direct (or additive) effects of these variables. However, it is reasonable to expect that countries with similar political institutions or comparable democratic performance indicators will perform very differently if the penetration of technology or human capital levels are substantially different. In fact, high quality political institutions are more likely to rely on e-participation tools if their infrastructure and human capital performance is also high. Conversely, autocracies with large investments in technological infrastructure and penetration may fare better in terms of e-participation than autocracies where this investment has not occurred. In theory, both technology penetration and socio-economic development are likely to mediate the relationship between the quality of political institutions and the reliance on e-participation. Figure 1 displays these theoretical relationships. The next part of this chapter operationalizes the concepts included in the model and translates the theoretical connections into hypotheses.

Figure 1. Theoretical Model of E-participation



HYPOTHESES

The model posits a positive association between higher quality of political institutions and the levels of e-participation. Research exploring these effects on e-participation has employed a diverse set of indicators to operationalize the quality of political institutions (Stier, 2015), including democratic performance, corruption levels, trust in government, government effectiveness, and freedom of the press, and obtained mixed findings. This part of the chapter reviews this literature and employs it to support the hypotheses to be tested in the empirical section. The first part of this section discusses the additive hypotheses linking the quality of political institutions and e-participation. In the second part, we present the interactive hypotheses arguing that the relationship between political institutions and e-participation is mediated by the countries' structural conditions, namely varying levels of technology penetration and socioeconomic development.

Additive hypotheses

Aggregate analyses of the effects of democratic performance at the country level report interesting but somewhat limited findings. Kneuer & Harnisch (2016) found substantive differences in e-participation levels between democracies and autocracies. Democracies are early adopters of e-participation and remain above all other regime categories defined by the authors, including flawed democracies, multiparty, single party and military regimes. Åström *et al.* (2012) employ ordinary least squares regressions to analyze the effect of a country's democratic performance on e-participation levels over time. They find a positive association between their measure of democracy based on the Freedom House and Polity IV Indexes and the 2003 UN E-Participation Index. This effect disappears in the remaining years of the analysis (2004, 2005, 2008 and 2010). A similar finding is reported by Stier (2015), who finds positive associations between the level of democracy and e-government performance for the years of 2002, 2003, 2004 and 2007 and null findings after that (2009, 2011, and 2013). This dynamic analysis also shows that autocratic

governments may be the ones most interested in improving the interaction with citizens using e-participation tools. Gulati et al. (2014) use multiple regression analysis to explain e-participation capabilities across countries and fail to find the expect positive effect of a democratic political structure. A study by Jho & Song (2015) uncovers a positive association between the level of democracy and e-participation, but the same authors fail to confirm a similar effect for the level of institutionalization of free speech and association. Despite these mixed findings, the hypothesis regarding democratic performance reflects the theoretical expectations stated above (Stier, 2015):

H1a: More consolidated democracies display higher levels of e-participation.

In contrast with the aggregate analyses mentioned above, individual-level analyses report important links between political variables and individual e-participation. Porumbescu (2016) employs a sample of 1100 Seoul residents and finds a positive relationship between citizen perceptions of public sector trustworthiness and the use of public sector social media accounts. Zolotov et al. (2018) conducted a meta-analytical review of e-participation adoption models and found that generalized trust, and more specifically, trust in government are significant predictors of the likelihood of adoption of e-participation. Novo Vázquez & Rosalía Vicente (2019) analyze e-participation in Spanish municipalities and find that political interest, external political efficacy, and associational membership are relevant predictors of individual e-participation. We extend these tests to the aggregate level by hypothesizing that:

H1b: Higher levels of trust in politicians have a positive effect on a country's level of e-participation

Bussell (2011) investigated the association between the corruption scores measured by Transparency International's Corruption Perceptions Index and a country's e-government quality as assessed by the UN E-government Index. The author finds a robust relationship between both variables, therefore supporting the idea that corruption levels dampen countries efforts to promote "higher quality technology-enabled service reforms" (p.275). Given the limited evidence linking corruption levels and e-participation, we might expect a similar relationship:

H1c: Higher corruption levels have a negative effect on a country's level of e-participation.

To our knowledge, no empirical study has yet linked freedom of the press levels with e-participation. However, early work by Sylvester and McGlynn (2010) analyzed data from the 2007 Pew Internet and American Life project and found an association between using the newspaper for information and the likelihood of contacting government by email. Hollyer, Rosendorff and Vreeland (2014) developed the HRV government transparency index and applied it to 149 countries from 1980-2008. The authors test the effect of daily newspaper circulation on the HRV index using World Bank data and found support for a strong positive effect. While both articles are not testing the relationship between freedom of the press and e-participation, they provide anecdotal evidence supporting our next hypothesis:

H1d: Freedom of the press is positively associated with a country's level of e-participation.

In contrast with the mixed findings reported for the association between democratic performance and e-participation levels, higher government effectiveness is systematically associated with e-participation (Gulati et al., 2014; Stier, 2015). In fact, Stier's analyses indicate an increasing impact of this explanatory factor over time. Gulati, Williams, & Yates (2014) investigate the determinants of e-participation in 158 countries reported by the 2010 UN E-Participation Index. The authors find that countries with a more effective public sector governance display higher scores of e-participation. This result underscores how the professionalization of public administration helps governments to embrace novel online participatory tools. Conversely, it also suggests that weak government institutions compromise the best intentions to undertake innovative e-participation opportunities. This suggests that:

H1e: Better government performance (effectiveness) is positively associated with a country's level of e-participation.

The diffusion of e-government (and e-participation) can be hindered by restricted access to broadband internet bandwidth, mobile network coverage, and technological interoperability (Zhang, Xu, & Xiao, 2014). Sound and reliable ICT infrastructure is even more crucial for the implementation of e-participation tools, since it facilitates access to information, reduces physical and geographical barriers to participation, improves the quality of feedback in public consultations, and empowers citizens to engage in deliberative policy-making (DiMaggio, Hargittai, Neuman, & Robinson, 2001; Saebø et al., 2008). Several empirical studies have investigated the impact of technology infrastructure on e-government development and maturity levels (Ifinedo & Singh, 2011; Siau & Long, 2009; Singh et al., 2007; Stier, 2015). Åström et al. (2012) investigate the determinants of e-participation in over 100 countries between 2003 and 2010 and find that internet users per 100 citizens – a proxy for access to technology infrastructure – is the strongest predictor of e-participation. Krishnan, Teo & Lymm (2017) employ cross-sectional data from 183 countries and find a positive effect of ICT infrastructure on both e-government maturity levels and a government's willingness to implement e-participation. Given the strength of these findings, we predict that:

H2: The level of technology penetration in a country is positively associated with its e-participation levels.

Developed in the field of Economics, human capital theory argues that investments in education, training, knowledge and health of the individuals in the labor force lead to economic growth over time (Becker, 1964; Schultz, 1961). E-government development has been linked to these indicators of socioeconomic development in past empirical works (Siau & Long, 2009; Stier, 2015). However, prior attempts to test the relationship between socioeconomic development levels and e-participation have failed to provide consistent results. The study by Åström et al. (2012) finds no association between the Human Development Index (HDI) and the UN's E-Participation Index. Jho & Song (2015) find a positive correlation between the same variables for the 2010 version of the e-participation index, but their models are severely misspecified, so this result is unconvincing. Lastly, Gulati et al. (2014) examine several indicators of sociodemographic development (education, urbanization and land area) and find positive associations between these indicators and the e-participation index. The overall set of findings suggests that socioeconomic development is likely to predict the levels of e-participation, but this association seems largely contingent on the indicators employed to measure socioeconomic development. Hence, we hypothesize that:

H3: The level of socioeconomic development in a country is positively associated with its e-participation level.

The following paragraphs focus on the moderating effects that technology penetration and socio-economic development can have on the impact of the quality of political institutions.

Interactive hypotheses

Prior attempts have been developed to explore the interaction between political institutions and other factors affecting e-participation levels. Jho & Song (2015) investigate the moderating effects between technology and institutions, but their analysis is based on a single point in time (data from the 2012 UN E-Participation Index). The authors find that technology reinforces the positive effect of political institutions on e-participation. Despite these earlier efforts, none of the empirical studies investigated multiple moderating effects between explanatory variables both across countries and over time.

The theoretical model portrayed in Figure 1 argues that technology penetration and the levels of human and socio-economic development of countries is likely to enhance the positive effects of the quality of political institutions on e-participation levels. In other words, it can be expected that better technology penetration and human capital will reinforce the relationship between political institutions and e-participation, whereas poor technology penetration and insufficient

human capital are unsurmountable obstacles to any attempts at increasing e-participation levels. More concretely, we predict that:

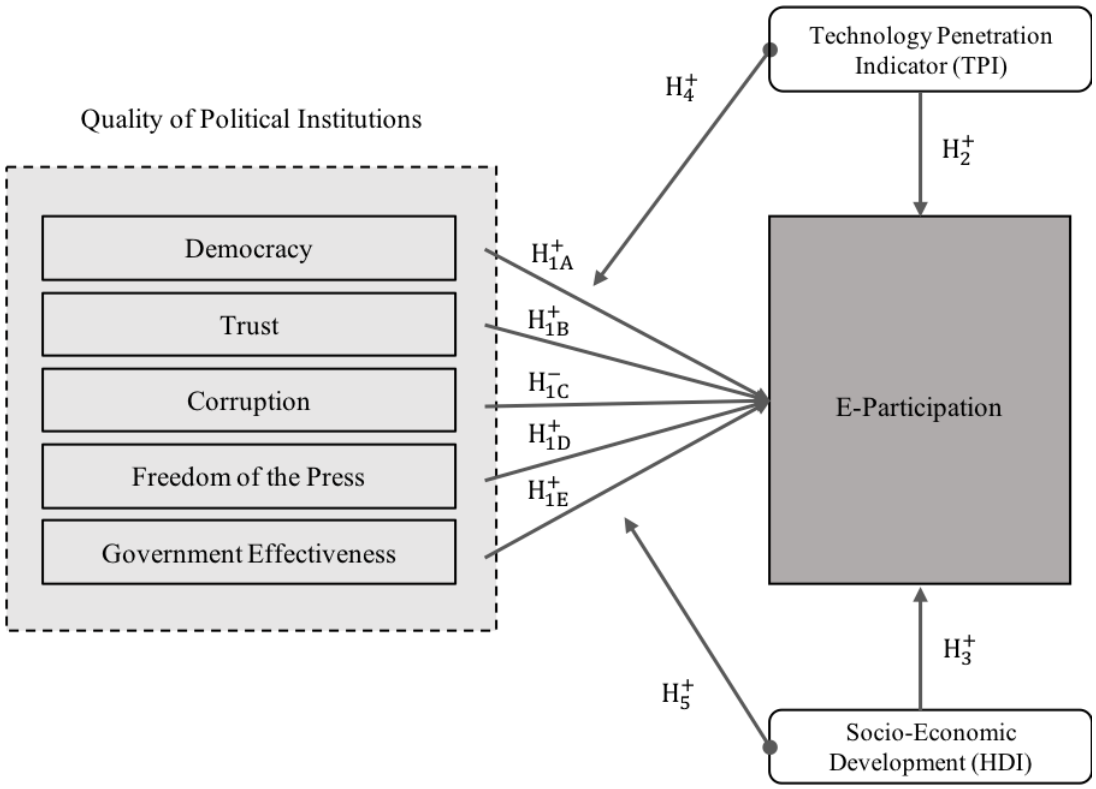
H4: The positive association between the quality of political institutions and e-participation will be stronger in countries with better technology penetration.

And:

H5: The positive association between the quality of political institutions and e-participation will be stronger in countries with better human capital development.

Figure 2 displays the empirical model of e-participation to be tested in the remaining sections of this chapter.

Figure 2. Comprehensive Research Model for Empirical Studies



DATA AND METHODS

The dependent variable of the analysis is the UNDESA's E-Participation Index (EPI). The index is currently a biannual publication that evaluates 193 countries on three main dimensions: provision of information by governments to citizens (e-information), interaction with stakeholders (e-consultation), and engagement in decision-making processes (e-decision making). The collection of the data in which the EPI is based is performed by a group of more than 100 researchers, through a survey that evaluates the websites and portals of the central government, ministries and other governmental agencies of all UN member states.

In order to test the hypothesis related with relationship between institutional indicators and e-participation, the analysis employs five independent variables, assessing different dimensions of the political institutions, namely:

- The Autocracy-Democracy Index of the Polity IV database (*autocracy-democracy*);
- The Public Trust in Politicians Index by the World Economic Forum (*trust_politicians*);

- The Control of Corruption Index of the Worldwide Governance Indicators (*corruption*);
- The Freedom of the Press Index by Reporters Without Borders (*pressfree*);
- The Government Effectiveness Index of the Worldwide Governance Indicators (*gov_effectiveness*).

As a technology penetration indicator, the number of mobile cellular subscriptions per 100 inhabitants (*mobile_cellular*), taken from the World Development Indicators of the World Bank, is used. To proxy the socio-economic development, the Human Development Index (HDI), compiled every year by the United Nations Development Program is used. Besides the income dimension, this index also contemplates life expectancy and education, what makes it a broader measure of development than the real GDP per capita (Åström et al., 2012; Stier, 2015).

As additional control variables, economic and demographic indicators are used, following the previous literature on the determinants of e-participation and e-government maturity. The degree of economic globalization has been linked to increased investments in e-government, particularly among market-oriented autocracies, as suggested by Stier (2015). The rationale is two-fold. On one hand, autocracies hope to diffuse political criticism by delivering on the economic development front. Significant investments in e-government infrastructure and services are likely to accomplish this goal. On the other hand, authoritarian governments' search for legitimacy, both domestically and internationally, may stimulate the relaxation of information restraints through limited promotion of e-participation tools (Åström et al., 2012; Egorov, Guriev, & Sonin, 2009; King, Pan, & Roberts, 2013; Noesselt, 2014). Consequently, we use the KOF Index of economic globalization (*eco_global*) developed by Dreher, Gaston & Martens (2008) as independent variable. Lastly, the analyses also include the size of a country's population (*pop*) to capture economies of scale entailed by the fixed costs associated with the implementation of e-government programs (Bussell, 2011; Milner, 2006; Norris & Moon, 2005; Stier, 2015). Table 1 presents the descriptive statistics for all variables.

Table 1. Descriptive Statistics for the period 2008-2018

Variable		Mean	Standard Deviation	Observations
EPI	Overall	0.340	0.290	N=1145
	Between		0.220	n=191
	Within		0.190	
autocracy-democracy	Overall	0.699	0.312	N=1931
	Between		0.305	n=162
	Within		0.069	
trust_politicians	Overall	0.435	0.171	N=1642
	Between		0.157	n=149
	Within		0.061	
corruption	Overall	0.513	0.199	N=2265
	Between		0.197	n=189
	Within		0.030	
press_free	Overall	0.719	0.159	N=2017
	Between		0.144	n=172
	Within		0.067	

gov_effectiveness	Overall	0.487	0.197	N=2265
	Between		0.195	n=189
	Within		0.030	
mobile_cellular	Overall	89.131	42.656	N=2235
	Between		36.525	n=190
	Within		22.537	
HDI	Overall	0.689	0.156	N=2205
	Between		0.155	n=185
	Within		0.019	
pop (billions)	Overall	0.037	0.138	N=2274
	Between		0.138	n=190
	Within		0.005	
eco_global	Overall	0.585	0.155	N=2002
	Between		0.153	n=182
	Within		0.028	

Notes: N – total number of observations for each variable; n – number of observed countries for each variable.

As the EPI is a censored variable, defined in a scale where 0 represents the lowest possible score and 1 the highest possible score, the analyses employ fractional regression models (Papke & Wooldridge, 1996) as the main empirical method. This allows us to overcome a pitfall of previous studies that use the least squares estimator (e.g. Åström et al., 2012; Jho & Song, 2015; Stier, 2015): the possibility of predicting outcome values for the dependent variable that are lower than 0 or higher than 1, violating the boundaries of the index. As a strategy to avoid multicollinearity and given the high correlation amongst some of the institutional variables, the H1 sub-hypotheses (H1a to H1e) are tested by estimating different models for each institutional dimension. Additionally, as the EPI is coded in the year prior to the index's release[1], as a strategy to prevent reverse causality and minimize endogeneity concerns, the independent variables of the models are lagged by two periods.Variance inflated factors are calculated at each stage of the analysis to control for the possibility of multicollinearity and robust standard errors are also used to avoid heteroscedasticity. At last, for purposes of coherency and to facilitate the interpretation of the regression coefficients, all the indexes that are originally in a different scale were rescaled to a 0 to 1 scale. For all the indexes that are used, 0 represents the lowest possible score and 1 the highest possible score. Therefore, in each of those indexes the value of 1 is obtained by the countries with the most democratic institutions (*autocracy-democracy*), the highest trust in politicians (t*rust_politicians*), the highest corruption levels (*corruption*), the highest freedom of the press (*press_free*), the highest level of government effectiveness (*gov_effectiveness*), the highest human development (*HDI*) or the highest level of economic globalization (*eco_global*).

Within the empirical framework mentioned above, the procedure can be divided in three main steps: first, cross section regressions for the different years to which the EPI is available in the sample period are estimated; second, panel regressions are considered; third, the interactive hypotheses are tested, using panel data models that consider interaction terms between the

[1] The survey questionnaire in which the 2018 index is based, was implemented in 2017. The same happens in the remaining years to which the EPI is available.

political-institutional variables and either the technology penetration or the human development variables.

A general model that summarizes the first step of the approach is represented by equation (1):

$$EPI_{i,t} = \beta_0 + \beta_1.Institutional_{i,t-2} + \beta_2.mobile\_cellular_{i,t-2} + \beta_3.HDI_{i,t-2} + \gamma.Control'_{i,t-2} + \varepsilon_{it} \quad (1)$$

where $EPI_{i,t}$ represents the EPI index of country i in the year t, $Institutional_{i,t-2}$ is a two-period lagged variable that proxies one of the proxies for the five political institutional dimensions considered in the theoretical model. $mobile\_cellular_{i,t-2}$ relates to H2 and stands for the two-period lagged mobile cellular penetration rate, while $HDI_{i,t-2}$ relates to H3, standing for the two-period lagged value of the human development index. $Control'_{i,t-2}$ is a vector of two-period lagged control variables that contains the remaining economic and demographic variables. Finally, ε_{it} stands for the error term, while β_0, β_1, β_2, β_3 and γ represent the parameters, or vectors of parameters, to be estimated.

In the second step, six observations in time (2008, 2010, 2012, 2014, 2016 and 2018) are used, and controls for time effects and country-level fixed effects are added to the model, as represented in equation (2).

$$EPI_{i,t} = \beta_0 + \beta_1.Institutional_{i,t-2} + \beta_2.mobile\_cellular_{i,t-2} + \beta_3.HDI_{i,t-2} + \gamma.Control'_{i,t-2} + \lambda_t + \mu_i + \varepsilon_{it} \quad (2)$$

In this case, λ_t represents time effects, defined as a set of year dummy variables, μ_i stands for country-level fixed effects and everything else remains as in equation (1). To decide whether we include fixed effects or not, we rely on Hausman specification tests (Hausman, 1978). The null hypothesis of the test is the absence of significant differences between the coefficients of a consistent estimator, the fixed effects one, and an alternative efficient estimator, typically the random effects one. The rejection of the null indicates that the inclusion of fixed effects is needed.[2] As, to be best of the authors' knowledge, there is no standard way of including random effects in the fractional probit framework, a model with no fixed nor random effects was used in the cases of no rejection of the Hausman test's null. In such cases, the results obtained via the fractional regression and the random effects estimates were compared to make sure that the absence of random effects did not substantially affected the results.

To test the interactive hypothesis, extensions of the model represented in equation (2) are estimated. These consider either interactions between the institutional and the technology penetration variable (H4), or interactions between the first and human development (H5). To test H4, the following extension was considered:

$$EPI_{i,t} = \beta_0 + \beta_1.Institutional_{i,t-2} + \beta_2.mobile\_cellular_{i,t-2} + \beta_3.Institutional * mobile\_cellular_{i,t-2} + \beta_4.HDI_{i,t-2} + \gamma.Control'_{i,t-2} + \lambda_t + \mu_i + \varepsilon_{it} \quad (3)$$

[2] To implement the test, auxiliary fixed effects and random effects regressions are estimated. A correction to base both (co)variance matrices on disturbance variance estimate from the efficient estimator is applied whenever the covariance matrix of the test did not reveal to be positive definite and the rank of the differenced variance matrix was equal to the number of coefficients being tested.

where $\text{Institutional} * \text{mobile\_cellular}_{i,t-2}$ represents the interaction between the institutional and the technology penetration-related variable and everything else remains as in equation (2).

Equation (4) represents the extension that allows to test H5:

$$EPI_{i,t} = \beta_0 + \beta_1.\text{Institutional}_{i,t-2} + \beta_2.HDI_{i,t-2} + \beta_3.\text{Institutional} * HDI_{i,t-2} + \beta_4.\text{mobile\_cellular}_{i,t-2} + \gamma.\text{Control}'_{i,t-2} + \lambda_t + \mu_i + \varepsilon_{it} \quad (4)$$

where $\text{Institutional} * HDI_{i,t-2}$ represents the interaction between the institutional variables and the human development variable and everything else remains as in equation (2).

FINDINGS

Cross Section Results

As explained previously, the analysis starts by contemplating cross sectional models for the different years of the sample period. When scattering the values for the EPI and the autocracy-democracy index, no linear relationship arises[3], so the chosen specification of the model considers two dummy variables: autocracy-democracy_>p75 is equal to 1 whenever, in a given year, the country's score in the autocracy-democracy index is above the percentile 75 of that year scores' distribution, and 0 otherwise; autocracy-democracy_<p25 is equal to 1 whenever, in a given year, the country's score in the autocracy-democracy index is below the percentile 25 of that year scores' distribution, and 0 otherwise. Table 2 presents the results for the average marginal effects of the fractional probit regressions of the models that follow equation (1) and include the variables related to democracy (H1a), with each column corresponding to a different year.

Table 2. Average marginal effects of the fractional probit regressions – democracy (H1a) – dependent variable: EPI

Variables	(1) 2018	(2) 2016	(3) 2014	(4) 2012	(5) 2010	(6) 2008
autocracy-democracy_>p75	0.091**	0.045	0.035	-0.003	0.030	0.002
	(0.036)	(0.035)	(0.050)	(0.048)	(0.035)	(0.044)
autocracy-democracy_<p25	-0.012	0.020	-0.008	0.011	-0.030	-0.041
	(0.034)	(0.034)	(0.035)	(0.043)	(0.030)	(0.034)
mobile_cellular/100	-0.036	-0.037	0.010	0.014	-0.106**	0.039
	(0.061)	(0.054)	(0.059)	(0.055)	(0.052)	(0.061)
HDI	0.974***	1.189***	1.091***	1.112***	1.031***	0.622***
	(0.141)	(0.167)	(0.177)	(0.206)	(0.184)	(0.210)
pop (billions)	0.573**	0.310***	0.260***	0.120	0.131***	0.223***
	(0.251)	(0.068)	(0.067)	(0.079)	(0.031)	(0.054)
eco_global	0.239*	0.101	0.039	0.010	0.091	0.055

[3] The scatter plot may be provided by the authors upon request. Moreover, when using a panel model with random effects, one of the dummies reveals to be statistically significant, but the same does not happen with the original variable.

	(0.137)	(0.132)	(0.133)	(0.148)	(0.118)	(0.149)
Observations	158	157	157	158	156	156
Pseudo R2	0.162	0.144	0.126	0.169	0.148	0.108
Log-likelihood	-88.72	-93.12	-93.97	-74.23	-70.24	-72.92
AIC	191.4	200.2	201.9	162.5	154.5	159.8
SIC	212.9	221.6	223.3	183.9	175.8	181.2

Notes: All models were estimated with a constant. Robust standard errors in parentheses. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

The results reveal that the more democratic countries are, when compared to countries whose EPI is between the sample percentile 25 and 75, associated with higher EPI scores. However, that is only true for the last year of the sample. In contrast no significant results were obtained for the dummy variable that identifies the most autocratic countries (autocracy-democracy_<p25).

Regarding the results for the remaining variables, strong support for H3 was found. The HDI's coefficient is positive and significant for all the years. Moreover, the magnitude of the coefficient reveals to be stable, except for the year of 2008, where the coefficient drops from a value around 1 to approximately 0.6. Population also exerts a positive and significant impact on EPI, and only for 2012 its coefficient is not significant. In contrast, no support for H2 is found, neither for the relationship between the level of economic globalization and e-participation.

The results for the average marginal effects of the fractional probit regressions of the models that follow equation (1) and include the variables related to public trust in politicians are presented in Table 3. Once again, each column corresponds to a different year.

Table 3. Average marginal effects of the fractional probit regressions – trust (H1b) – dependent variable: EPI

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	2018	2016	2014	2012	2010	2008
trust_politicians	0.092	0.034	0.076	0.237**	0.078	0.118
	(0.089)	(0.086)	(0.115)	(0.098)	(0.100)	(0.083)
mobille_cellular/100	-0.045	-0.068	-0.061	0.015	-0.125*	0.034
	(0.058)	(0.054)	(0.060)	(0.061)	(0.068)	(0.066)
HDI	1.009***	1.212***	1.151***	1.127***	1.168***	0.627***
	(0.133)	(0.169)	(0.168)	(0.207)	(0.216)	(0.232)
pop (billions)	0.466**	0.294***	0.244***	0.092	0.131***	0.233***
	(0.195)	(0.064)	(0.078)	(0.092)	(0.042)	(0.058)
eco_global	0.208	0.136	0.020	-0.156	0.064	0.035
	(0.139)	(0.155)	(0.147)	(0.179)	(0.167)	(0.171)
Observations	136	140	141	136	129	148
Pseudo R2	0.141	0.122	0.0920	0.128	0.116	0.0944
Log-likelihood	-74.48	-84.65	-88.48	-71.78	-64.68	-72.11
AIC	161	181.3	189	155.6	141.4	156.2
SIC	178.4	199	206.6	173	158.5	174.2

Notes: All models were estimated with a constant. Robust standard errors in parentheses. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

The cross-sectional results do not provide a strong support to H1b. In spite of always exhibiting positive coefficients, meaning that a higher public trust in politicians is associated with higher e-

participation levels, the *trust_politicians* variable is only significant in the year of 2012. For that year, it is estimated that on average, an increase of one point in the Public Trust in Politicians index is associated with an increase of approximately 0.24 points in the EPI.

Regarding *mobile_cellular* and HDI, the variables related with H2 and H3, the scenario is consistent with the one described for Table 2. The same applies to the two control variables, pop and *eco_global*.

Table 4 presents the results for the models where corruption is an independent variable. In this case, to make the interpretation of the results more intuitive and consistent with the sign predicted in H1c, the scale of the corruption index was inverted, in a way that higher values of the index correspond to higher perceived corruption levels.

As hypothesized, the results point to a negative relationship between corruption and e-participation levels. The coefficients of the corruption variable are significant for two of the six years considered: 2008 and 2018. For those years, it is estimated that, on average, a one-point increase in the corruption index is associated with a 0.26 and 0.31 decrease in the EPI.

Table 4. Average marginal effects of the fractional probit regressions – corruption (H1c) – dependent variable: EPI

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	2018	2016	2014	2012	2010	2008
corruption	-0.305***	-0.137	-0.171	-0.110	-0.087	-0.261***
	(0.111)	(0.100)	(0.112)	(0.103)	(0.084)	(0.101)
mobile_cellular/100	0.034	0.019	0.018	0.014	-0.085*	0.021
	(0.054)	(0.048)	(0.050)	(0.050)	(0.047)	(0.056)
HDI	0.827***	1.057***	0.934***	0.959***	0.898***	0.352*
	(0.155)	(0.169)	(0.173)	(0.203)	(0.173)	(0.187)
pop (billions)	0.685**	0.383***	0.313***	0.156*	0.163***	0.246***
	(0.344)	(0.093)	(0.086)	(0.083)	(0.041)	(0.063)
eco_global	0.097	0.029	0.010	-0.021	0.115	0.075
	(0.137)	(0.130)	(0.136)	(0.143)	(0.120)	(0.140)
Observations	180	179	179	180	180	179
Pseudo R2	0.143	0.125	0.109	0.155	0.135	0.107
Log-likelihood	-104.6	-108.5	-108	-82.80	-77.98	-80.19
AIC	221.1	229	228	177.6	168	172.4
SIC	240.3	248.1	247.1	196.8	187.1	191.5

Notes: All models were estimated with a constant. Robust standard errors in parentheses. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

All the remaining variables in the model follow the pattern of the previous tables: no support for the importance of technology penetration and economic globalization and strong support for the importance of socioeconomic development and the size of population on predicting e-participation levels.

Table 5. Average marginal effects of the fractional probit regressions – freedom of the press (H1d) – dependent variable: EPI

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	2018	2016	2014	2012	2010	2008
pressfree	0.255	0.097	0.040	-0.048	0.095	0.175
	(0.161)	(0.165)	(0.076)	(0.110)	(0.094)	(0.112)
mobile_cellular/100	-0.012	-0.019	0.013	0.017	-0.112**	0.013
	(0.057)	(0.052)	(0.054)	(0.053)	(0.052)	(0.064)
HDI	0.980***	1.186***	1.097***	1.096***	1.024***	0.642***
	(0.132)	(0.150)	(0.153)	(0.174)	(0.173)	(0.206)
pop (billions)	0.662**	0.348***	0.285***	0.126	0.153***	0.250***
	(0.302)	(0.076)	(0.075)	(0.084)	(0.038)	(0.066)
eco_global	0.237*	0.104	0.021	0.011	0.123	0.021
	(0.137)	(0.127)	(0.132)	(0.147)	(0.123)	(0.160)
Observations	166	164	164	165	161	156
Pseudo R2	0.149	0.136	0.114	0.159	0.138	0.102
Log-likelihood	-94.82	-98.25	-99.21	-77.85	-72.40	-72.90
AIC	201.6	208.5	210.4	167.7	156.8	157.8
SIC	220.3	227.1	229	186.3	175.3	176.1

Notes: All models were estimated with a constant. Robust standard errors in parentheses. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

As in the corruption index case, the scale of the Freedom of the Press index was inverted to make the interpretation of the coefficients easier and consistent with the hypotheses presented earlier in this chapter. Therefore, higher values of the index correspond to higher freedom of the press and positive coefficients associated with *pressfree* mean that more freedom of the press is associated with higher e-participation levels. Table 5 presents the results for the average marginal effects of the fractional probit regressions of the models that include the variable related to press freedom (H1d).

The results reveal that, although mostly positive as hypothesized, the coefficients of the *pressfree* variable are never significant. Therefore, H1d is not supported. Regarding the remaining four independent variables of the model, nothing substantially new arises when comparing the results of Table 5 with the ones reported in Tables 2 to 4.

Lastly, Table 6 presents the results for the average marginal effects of the fractional probit regressions of the models that include the variable related to government effectiveness (H1e). As in the remaining tables of this section, each column corresponds to a different year.

Table 6. Average marginal effects of the fractional probit regressions – government effectiveness (H1e) – dependent variable: EPI

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	2018	2016	2014	2012	2010	2008
gov_effectiveness	0.696***	0.587***	0.360***	0.325**	0.279***	0.396***
	(0.142)	(0.130)	(0.136)	(0.133)	(0.095)	(0.124)
mobile_cellular/100	0.035	0.032	0.016	0.018	-0.093**	0.008
	(0.049)	(0.043)	(0.047)	(0.049)	(0.046)	(0.056)
HDI	0.473***	0.660***	0.787***	0.759***	0.753***	0.260
	(0.166)	(0.178)	(0.174)	(0.199)	(0.157)	(0.177)

pop (billions)	0.545**	0.316***	0.281***	0.122	0.130***	0.209***
	(0.270)	(0.077)	(0.081)	(0.078)	(0.040)	(0.059)
eco_global	-0.021	-0.136	-0.076	-0.113	0.036	0.022
	(0.133)	(0.126)	(0.141)	(0.153)	(0.122)	(0.145)
Observations	180	179	179	180	180	179
Pseudo R2	0.153	0.134	0.112	0.161	0.141	0.110
Log-likelihood	-103.3	-107.4	-107.6	-82.25	-77.48	-79.86
AIC	218.6	226.7	227.3	176.5	167	171.7
SIC	237.8	245.9	246.4	195.6	186.1	190.9

Notes: All models were estimated with a constant. Robust standard errors in parentheses. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

The hypothesis that higher government effectiveness is associated with higher e-participation levels (H1e) is strongly supported by the results. The coefficients associated with gov_effectiveness are positive and significant for all the years under studied. It is also worth mentioning that the magnitude of the coefficients exhibits a positive trend over time. From 2008 to 2014, it is estimated that, on average, a one-point increase in the government effectiveness index, is associated with an increase of 0.28 to 0.4 points in the EPI. However, in the most recent years, 2016 and 2018, the estimated coefficients are respectively around 0.59 and 0.7.

Once again, the results for the remaining independent variables are similar to the ones reported in Tables 2 to 5.

Panel Results

The second step of the empirical analysis considers panel regressions, with six observations in time (2008, 2010, 2012, 2014, 2016 and 2018). Time effects and, in some cases, fixed effects, were added, as described by equation (2) above. As high variance inflated factors were found for the *eco_global* variable and it was almost never statistically significant in the cross-sectional regressions, it is excluded here. Table 7 contains the results for the average marginal effects of the fractional probit regressions. Column (1) includes the democracy-related dummy variables, column (2) the public trust in politicians index, column (3) the corruption index, column (4) the freedom of the press index and column (5) the government effectiveness one.

Table 7. Average marginal effects of the panel fractional probit regressions– dependent variable: EPI

	(1)	(2)	(3)	(4)	(5)
Variables	democracy	trust	corruption	press freedom	gov_effec
autocracy-democracy_<p25	-0.016				
	(0.014)				
autocracy-democracy_>p75	0.038**				
	(0.017)				
trust_politicians		0.006			
		(0.065)			
corruption			-0.176***		
			(0.040)		
pressfree				-0.069	
				(0.055)	
gov_effectiveness					0.380***
					(0.048)

mobile_cellular/100	0.010	-0.014	0.037*	-0.025	0.029
	(0.022)	(0.029)	(0.019)	(0.027)	(0.019)
HDI	1.002***	0.766	0.788***	0.363	0.561***
	(0.062)	(0.551)	(0.065)	(0.426)	(0.067)
pop (billions)	0.232***	0.701	0.285***	0.839	0.256***
	(0.032)	(0.558)	(0.038)	(0.522)	(0.037)
year: 2010	-0.013	-0.006	-0.018	0.001	-0.014
	(0.019)	(0.017)	(0.018)	(0.014)	(0.018)
year: 2012	0.009	0.032	0.004	0.030*	0.010
	(0.022)	(0.020)	(0.021)	(0.017)	(0.020)
year: 2014	0.179***	0.213***	0.168***	0.206***	0.176***
	(0.023)	(0.024)	(0.021)	(0.021)	(0.020)
year: 2016	0.240***	0.283***	0.228***	0.283***	0.240***
	(0.023)	(0.028)	(0.021)	(0.023)	(0.020)
year: 2018	0.332***	0.384***	0.325***	0.381***	0.339***
	(0.024)	(0.031)	(0.022)	(0.026)	(0.021)
Observations	948	830	1,095	986	1,095
# of countries	160	148	184	170	184
Hausman statistic	9.29	19.55	9.60	29.81	7.83
Fixed Effects	No	Yes	No	Yes	No
Pseudo R2	0.202	0.253	0.189	0.268	0.194
Log-likelihood	-499.2	-419.5	-575.6	-476.3	-572
AIC	1020	1153	1171	1311	1164
SIC	1074	1894	1221	2187	1214

Notes: All models were estimated with a constant. Robust standard errors in parentheses. 2008 is the base category of the set of year dummy variables. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

Regarding the hypothesis related with the political institutional variables, the panel results are consistent with H1a, H1c and H1e, but not with H1b and H1d. From column (1), it is possible to observe that it is estimated that countries on the top of the distribution of the autocracy-democracy index are, on average, associated with an increase of approximately 0.04 points in the EPI. In turn, a one-point decrease in the corruption index is estimated to be associated with an increase of approximately 0.18 points in the EPI. Lastly, one additional point in the government effectiveness index is estimated to be associated with an increase of 0.38 points in the e-participation score.

Unlike in the cross-sectional regressions, where no support was found for H2, column (3) of Table 7 reports some anecdotal evidence of a possible impact of the technology penetration in the EPI. Regarding socioeconomic development (H3), positive and significant results are found in columns (1), (3) and (5), but not in columns (2) and (4), the model where fixed effects are used. A similar landscape is found for population, with no significant results in the models that use fixed effects, but positive and significant results in the remaining models. In both cases, it is not the magnitude of the coefficient that drops dramatically when fixed effects are included; it is the standard error that increases. Recalling the descriptive statistics of Table 1, it is likely that such occurrence is explained by the low within variation that both HDI and *pop* exhibit along the sample period. Finally, the results for the year dummy variables point to a global increase in the EPI levels in the most recent years of the sample. From 2014 onwards, all the coefficients associated with these variables display positive and significant coefficients, following the pattern of a positive trend.

Interaction Terms

Interactions between institutions and technology penetration

In this subsection, we report the results of the models that were estimated to test H4, the interactive hypothesis that posits that the impact that political institutional factors exert on the e-participation levels may vary according to the sophistication of the technology penetration.

Table 8 presents the fractional probit regression coefficients for six different models that follow the previously presented equation (3). Columns (1) and (2) are related to the interactions between the autocracy-democracy dummies and the mobile cellular penetration. The remaining columns present, in this order, the results for the interactions between *mobile_cellular* and public trust in politicians, corruption levels, freedom of the press and government effectiveness. For reasons of parsimony, only the results for the variables involved in the interaction terms are presented.[4]

Table 8. Fractional probit regressions coefficients including interaction terms – dependent variable: EPI

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	democracy	democracy	trust	corruption	press freedom	gov_effec
autocracy-democracy_<p25	-0.220**	-0.052				
	(0.099)	(0.049)				
autocracy-democracy_<p25* wdi_mobile/100	0.203**					
	(0.101)					
autocracy-democracy_>p75	0.141**	0.230				
	(0.058)	(0.158)				
autocracy-democracy_>p75* wdi_mobile/100		-0.093				
		(0.129)				
trust_politicians			-0.103			
			(0.312)			
trust_politicians* wdi_mobile/100			0.158			
			(0.276)			
corruption				0.031		
				(0.308)		
corruption* wdi_mobile/100				-0.604**		
				(0.271)		
pressfree					0.043	
					(0.332)	
pressfree* wdi_mobile/100					-0.357	
					(0.333)	

[4] The results for the remaining variables of the six models will be provided by the authors upon request.

gov_effectiveness						0.797**
						(0.315)
gov_effectiveness * wdi_mobile/100						0.471*
						(0.268)
wdi_mobile/100	-0.046	0.045	-0.119	0.445***	0.159	-0.119
	(0.080)	(0.078)	(0.155)	(0.159)	(0.273)	(0.135)
Observations	948	948	830	1,095	986	1,095
# of countries	160	160	148	184	170	184
Fixed effects	No	No	Yes	No	Yes	No
Pseudo R2	0.203	0.202	0.253	0.190	0.268	0.195
Log-likelihood	-498.9	-499.2	-419.5	-575.2	-476.3	-571.8
AIC	1022	1022	1155	1172	1313	1166
SIC	1080	1081	1901	1227	2193	1221

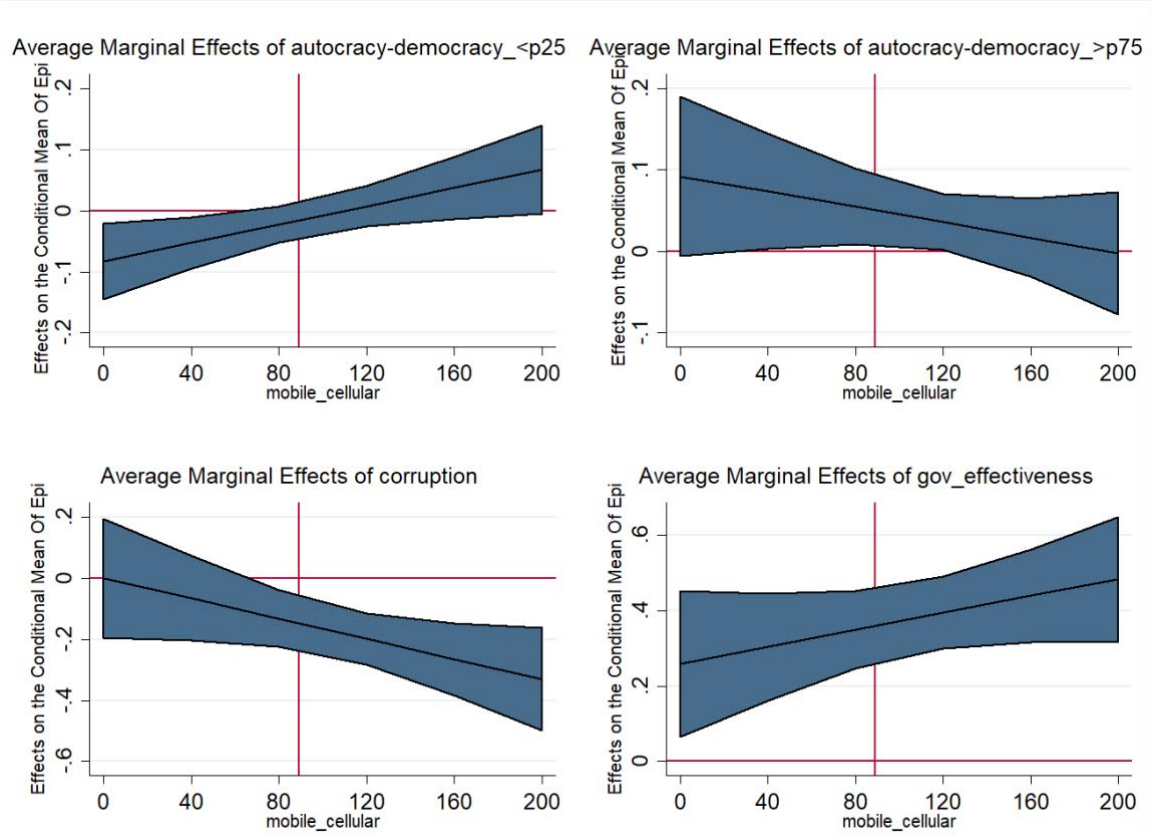
Notes: All models were estimated with a constant. Robust standard errors in parentheses. Year dummies included: 2008 is the base category of the set of year dummy variables. HDI and *pop* as additional independent variables. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

The results presented in Table 8 reveal that the interactions between the democracy and the technology penetration-related variables are statistically significant. The same happens for the interactions between the latter and the corruption index, as well as the government effectiveness index. Therefore, the evidence suggests that the impact that democratic institutions, corruption levels and government effectiveness exert in the e-participation levels varies according to the technology penetration in each country.

To get additional information about how technology penetration mediates the relationship between the institutional variables and e-participation, the average marginal effects of the institutional variables on the EPI along the *mobile_cellular* distribution were plotted. Figure 3 presents the plots for the four interactions terms where some regions of statistical significance were found.[5] The black line inside the blue area represents the estimated average marginal, effects. The blue area represents the 95% confidence interval. The red vertical line stands for the mean value of *mobile_cellular* over the entire sample period.

Figure 3. Average Marginal Effects of the institutional variables with 95% confidence intervals. Effects on the conditional mean of EPI in the vertical axis. Values of mobile_cellular in the horizontal axis. Mean value of mobile_cellular in the red vertical line.

[5] For reasons of parsimony, the remaining two plots are not presented. They will be provided by the authors upon request.



The upper left plot presents the average marginal effects of the variable autocracy-democracy_<p25 along the *mobile_cellular* distribution. It reveals that harsh autocracies result in poorer EPI scores, but only when technology penetration is low. On the contrary, the upper right plot reveals that the positive effect that solid democracies may have on the EPI is only valid for values around the mean of *mobile_celullar*. Both plots point to the idea that the democratic degree of the institutions is neutral in contexts of higher technology penetration. In the lower left plot, it is possible to observe that the negative effect on EPI associated with high levels of corruption is stronger when technology penetration is higher. At last, the lower right plot indicates that, although always positive and significant, the average marginal effect of *gov_effectiveness* on e-participation is higher when technology penetration is higher.

Interactions between institutions and socioeconomic development

H5 postulates that the impact that political institutional factors exert on e-participation may vary according to the socio-economic development of each country. Following equation (4), Table 9 presents the results for six models that consider interaction terms between the institutional variables and the human development index. The first two columns report the interactions between the autocracy-democracy dummies and HDI. Columns (3) to (6) present, in this order, the results for the interactions between the human development index and public trust in politicians, corruption levels, freedom of the press and government effectiveness. As in the table of the previous subsection, for reasons of parsimony, only the results for the variables involved in the interaction terms are presented.

Table 9. Fractional probit regressions coefficients including interaction terms – dependent variable: EPI

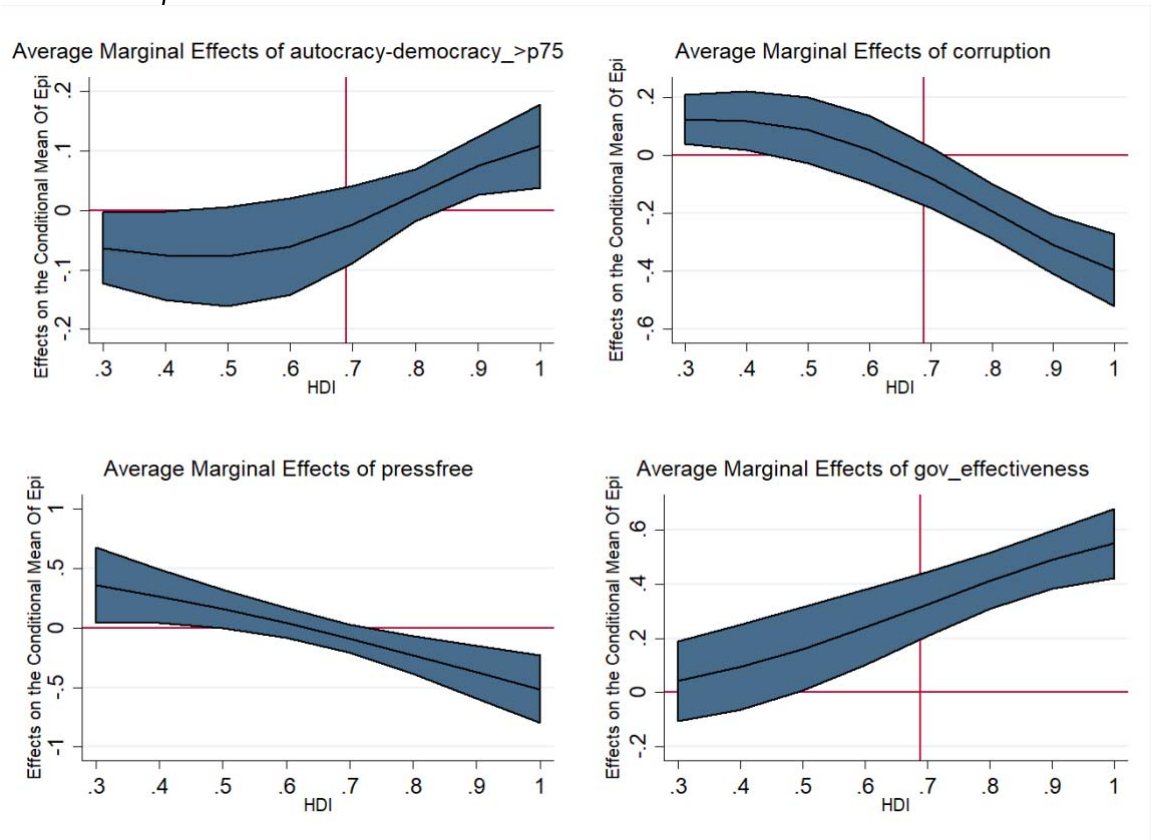
Variables	(1) democracy	(2) democracy	(3) trust	(4) corruption	(5) press freedom	(6) gov_effec
autocracy-democracy_<p25	0.288	-0.049				
	(0.237)	(0.048)				
autocracy-democracy_<p25* HDI	-0.507					
	(0.351)					
autocracy-democracy_>p75	0.104*	-1.063**				
	(0.061)	(0.492)				
autocracy-democracy_>p75* HDI		1.417**				
		(0.586)				
trust_politicians			-0.999			
			(0.912)			
trust_politicians* HDI			1.465			
			(1.293)			
corruption				1.945***		
				(0.614)		
corruption* HDI				-3.122***		
				(0.726)		
pressfree					2.893***	
					(0.926)	
pressfree* HDI					-4.582***	
					(1.336)	
gov_effectiveness						-0.349
						(0.608)
gov_effectiveness * HDI						1.961***
						(0.703)
HDI	3.463***	3.211***	2.198	4.386***	4.536***	1.104***
	(0.234)	(0.227)	(1.989)	(0.497)	(1.716)	(0.339)
Observations	948	948	830	1,095	986	1,095
# of countries	160	160	148	184	170	184
Fixed effects	No	No	Yes	No	Yes	No
Pseudo R2	0.203	0.203	0.253	0.192	0.268	0.195
Log-likelihood	-499	-498.7	-419.4	-574	-475.9	-571.4
AIC	1022	1021	1155	1170	1312	1165
SIC	1080	1080	1901	1225	2193	1220

Notes: All models were estimated with a constant. Robust standard errors in parentheses. Year dummies included: 2008 is the base category of the set of year dummy variables. *Mobile_cellular* and *pop* as additional independent variables. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

From Table 9, it is possible to observe that the results support H5. In particular, the interactions between the HDI and the high democracy score dummy, as well as with the corruption index, the freedom of the press, and government effectiveness are statistically significant.

As in the previous section, the following Figure presents the plots for the terms where regions of statistically significant average marginal effects of the institutional variable on the EPI along the distribution of the HDI were found. Once again, the black line inside the blue area represents the estimated average marginal effects, while the blue area represents the 95% confidence interval. The red vertical line stands for the mean value of HDI over the entire sample period.

Figure 4. Average Marginal Effects of the institutional variables with 95% confidence intervals. Effects on the conditional mean of EPI in the vertical axis. Values of HDI in the horizontal axis. Mean value of HDI in the red vertical line.



The upper left plot presents the average marginal effects of the variable autocracy-democracy_>p75. It reveals that the positive effect that is found for solid democracies on the EPI only holds for contexts in which the socioeconomic development is high. The upper right plot stands for the average marginal effects of corruption. Regarding the corrosive effect that corruption may have on the EPI only occurs when socioeconomic development is above the mean. In fact, there is even anecdotal evidence of the contrary for very low values of the HDI. Despite no significant relationship being found between freedom of the press and e-participation in the previous sections, the lower left graph provides anecdotal evidence that freedom of the press may exert a positive effect in contexts where socioeconomic development is low, and work the other way around when socioeconomic development is high. Finally, as in the technology penetration case, the lower right plot suggests that governmental effectiveness exerts a higher positive impact on e-participation when socioeconomic development is higher.

DISCUSSION

The overall picture emerging from the findings confirms and extends prior studies on the determinants of e-participation. Among the variables assessing the quality of political institutions, government effectiveness is the strongest predictor of higher EPI levels, thus confirming the idea expressed in Gulati *et al.* (2014) that higher professionalization of public administration supports the adoption and implementation of e-participation tools. The other variables addressing different aspects of the quality of political institutions are less consistent over time and only appear as relevant predictors in the panel model. Nevertheless, they confirm the hypothesized relationships: higher EPI levels appear in countries characterized by better democratic performance, freedom of the press, and lower corruption levels. Overall, the findings indicate that the quality of political institutions is a crucial contextual element to nurture e-participation initiatives.

Another important finding of the analyses included in this chapter is the rejection of technological determinism when it comes to e-participation (Susha & Grönlund, 2012). Better technological penetration, as measured by mobile cellular phone subscriptions per 100 citizens in a country, does not appear to be associated with higher e-participation levels. If anything, there is a quality threshold beyond which technology penetration is unrelated to e-participation. More importantly, the results show that technology penetration mediates the relationship between several indicators of the quality of political institutions. First, higher mobile penetration reinforces the positive association between government effectiveness and e-participation levels, which is consistent with the idea that technological access is important in taking advantage of effective public sectors promoting electronic participation tools. Second, the finding that more corrupt countries also display lower levels of e-participation is not surprising in itself. However, the idea that better technological penetration has a dampening effect on this relationship is discouraging, since it suggests that technology may actually contribute to deepen the already negative effects of corruption. Finally, as with prior empirical work, the evidence presented here regarding the interactions of democratic performance, technology penetration and EPI levels is unclear. The worst autocracies with low mobile penetration display the lowest EPI levels, but beyond that the evidence becomes mixed. The empirical analysis does not provide incontrovertible support to the argument advanced by Stier (2015) for e-government performance that autocracies with better technology penetration perform better in the EPI, but it does suggest that this scenario is more likely than the opposite one. In other words, technology penetration levels are likely relevant for the relationship between a country's placement in the autocracy-democracy continuum and its EPI level.

These findings contrast with the result for the socio-economic development variable. The HDI is an important predictor in every single-year specification and in all but two of the panel models. More importantly, the interactive terms support the theoretical argument that e-participation is most successful in countries which have high quality political institutions and higher socio-economic development simultaneously. While this is not exactly a surprising result, the fact that the effect is true for four out of five measures of quality of political institutions is quite remarkable. Socio-economic development also reinforces the expected positive effects of higher democratic performance, lower corruption levels and better government effectiveness on EPI levels.

CONCLUSION

This chapter employed data from the E-Participation Index (EPI) developed by the United Nations Department of Economic and Social Affairs (UNDESA) to analyze the role of the quality of political institutions in promoting e-participation over the period of 2008-2018. The findings indicate that countries with better democratic performance, lower corruption levels and higher government effectiveness are associated with higher EPI scores. While these results are not entirely robust to all model specifications and all years under analysis, they are largely supportive

of the argument that better political institutions contribute to promote more electronic participation at the country level.

The results also support the main argument included in the theoretical model that this positive effect of the quality of political institutions is mediated by more contextual factors, such as technology penetration and socio-economic development. Concretely, socio-economic development reinforces this positive effect of the quality of institutions, which reaches the strongest impact in countries with higher HDI scores. The mediating effect of technology penetration, while present, it is far less evident and more mixed. Technology penetration enhances the positive impact of government effectiveness and the absence of corruption on e-participation, but no clearly discernible trend is present in its interaction with the remaining indicators of the quality of political institutions.

Given the set of findings reported in this chapter, national governments aiming to promote the 2030 UN Agenda for Sustainable Development Goals (SDG's) will have to consider additional efforts into the adoption of e-participation tools capable of enhancing the availability of information, involving citizens in broad consultation processes and promoting deliberative decision-making. The successful implementation of these initiatives and the outcomes they are likely to generate will be crucial, not only for the legitimacy goals of elected officials but also to accomplish the ambitious sustainable development goals. Congruent and concerted national agendas for e-participation, while a core concept for e-democracy, shall be considered. The ultimate objective will thus be to contribute for the achievement of goals proclaimed in SDG 16, namely helping in the reduction of corruption, enhancement of transparency and accountability of institutions, promotion of inclusive and participatory processes and policies, and strengthening of good governance principles.

Limitations

The analyses included in this chapter may suffer from a number of limitations, primarily related to the nature of the dependent variable: the E-Participation Index. First, the EPI is questioned on the grounds of validity issues discussed at length in Lidén (2015). However, Lidén's piece assumes the EPI is a measure of e-Democracy and that e-Democracy and e-Participation can be conflated. Given the content of the EPI, this is not an accurate assumption. The second problem relates to the concept of e-participation itself. The EPI does not include outcomes, so the scores may be the result of a search for legitimacy on the part of elected officials rather than a genuine goal of improving e-participation, particularly in authoritarian regimes. Lastly, the analysis is focused on the EPI as a whole, not considering its different dimensions, namely the three main components of the index. This may also be a direction for future research despite of it being contingent on and constrained by the availability of more detailed data.

Another set of limitations relates to the independent variables, particularly those aimed at measuring the quality of political institutions. There is a high persistency on the values of the institutional variables within countries. Institutions typically change slowly and a sample period of ten years, while longer than what most (or all) the previous studies have considered, it is still limited to measure institutional change. A higher variability and a longer sample period would benefit the robustness of the statistical inference and make it more accurate in providing a causal interpretation of the results. Additionally, the range of variables to be considered when conceptualizing the quality of political institutions might be seen as a limitation. They are representative measures to assess the quality of political institutions but are neither exhaustive nor exclusive.

Directions for Future Research

The richness of the panel data included in this chapter should allow the expansion of this comparative analysis to consider different dimensions of e-participation and/or the regional variation of the EPI country scores. Pending data availability, future research can also investigate the adoption (or the "demand side") of e-participation tools.

This study identifies broad trends in e-participation across the globe based on single country scores. However, as discussed above, the EPI is not without its limitations, so these tendencies need to be explored with more in-depth analyses through regional comparisons and country case studies. Without these more fine-grained efforts, it is likely that the picture of the country trends in e-participation will be incomplete at best.

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REFERENCES

Anduiza, E., Gallego, A., & Cantijoch, M. (2010). Online political participation in Spain: The impact of traditional and internet resources. *Journal of Information Technology and Politics*, *7*(4), 356–368. https://doi.org/10.1080/19331681003791891

Åström, J., Karlsson, M., Linde, J., & Pirannejad, A. (2012). Understanding the Rise of e-Participation in Non-democracies: Domestic and International Factors. *Government Information Quarterly*, *29*(2), 142–150. Retrieved from http://www.sciencedirect.com/science/article/pii/S0740624X12000093

Becker, G. S. (1964). *Human capital: a theoretical and empirical analysis, with special reference to education*. University of Illinois at Urbana-Champaign: Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship.

Bertot, J. C., Jaeger, P. T., & Grimes, J. M. (2012). Promoting Transparency and Accountability through ICTs, social media, and collaborative e-government. *Transforming Government: People, Process and Policy*, *6*, 78–91.

Bussell, J. (2011). Explaining Cross-National Variation in Government Adoption of New Technologies. *International Studies Quarterly*, *55*(1), 267–280. https://doi.org/10.1111/j.1468-2478.2010.00644.x

DiMaggio, P., Hargittai, E., Neuman, W. R., & Robinson, J. P. (2001). Social Implications of the Internet. *Annual Review of Sociology*, *27*, 307–336.

Dreher, A., Gaston, N., & Martens, P. (2008). *Measuring Globalisation: Gauging Its Consequences*. New York: Springer.

Egorov, G., Guriev, S., & Sonin, K. (2009). Why Resource-poor Dictators Allow Freer Media: A Theory and Evidence from Panel Data. *American Political Science Review*, *103*(4), 645–668. https://doi.org/10.1017/S0003055409990219

Gibson, R., Römmele, A., & Williamson, A. (2014). Chasing the Digital Wave: International Perspectives on the Growth of Online Campaigning. *Journal of Information Technology & Politics*, *11*(2), 123–129. https://doi.org/10.1080/19331681.2014.903064

Gulati, G. J. "Jeff", Williams, C. B., & Yates, D. J. (2014). Predictors of On-line Services and e-Participation: A Cross-national Comparison. *Government Information Quarterly*, *31*(4), 526–533. https://doi.org/10.1016/j.giq.2014.07.005

Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica: Journal of the Econometric Society*, 1251–1271.

Hollyer, J. R., Rosendorff, B. P., & Vreeland, J. R. (2014). Measuring Transparency. *Political Analysis*, *22*(4), 413–434. https://doi.org/https://doi.org/10.1093/pan/mpu001

Ifinedo, P. (2012). Drivers of E-Government Maturity in Two Developing Regions: Focus on Latin America and Sub-Saharan Africa. *Journal of Information Systems and Technology Management*, *9*(1), 5–22. https://doi.org/10.4301/s1807-17752012000100001

Ifinedo, P., & Singh, M. (2011). Determinants of eGovernment Maturity in the Transition Economies of Central and Eastern Europe. *Electronic Journal of E-Government*, *9*(2), 166–182.

Jho, W., & Song, K. J. (2015). Institutional and Technological Determinants of Civil e-Participation: Solo or Duet? *Government Information Quarterly*, *32*(4), 488–495. https://doi.org/10.1016/j.giq.2015.09.003

Khoirunnida, Hidayanto, A. N., Purwandari, B., Kartika, D., & Kosandi, M. (2017). Factors Influencing Citizen's Intention to Participate Electronically: The Perspectives of Social Cognitive Theory and e-Government Service Quality. *2017 International Conference on Advanced Computer Science and Information Systems, ICACSIS 2017*, 166–171. https://doi.org/10.1109/ICACSIS.2017.8355028

King, G., Pan, J., & Roberts, M. (2013). How Censorship in China Allows Government Criticism but Silences Collective Expression. *American Political Science Review*, *107*(2), 326–343. https://doi.org/10.1017/S0003055413000014

Kneuer, M., & Harnisch, S. (2016). Diffusion of e-government and e-participation in Democracies and Autocracies. *Global Policy*, *7*(4), 548–556. https://doi.org/10.1111/1758-5899.12372

Krishnan, S., Teo, T. S. H., & Lymm, J. (2017). Determinants of Electronic Participation and Electronic Government Maturity: Insights from Cross-country Data. *International Journal of Information Management*, *37*(4), 297–312. https://doi.org/10.1016/j.ijinfomgt.2017.03.002

Larosiliere, G. D., & Carter, L. D. (2016). Using a Fit-viability Approach to Explore the Determinants of e-Government Maturity. *Journal of Computer Information Systems*, *56*(4), 271–279. https://doi.org/10.1080/08874417.2016.1163995

Lidén, G. (2015). Technology and Democracy: Validity in Measurements of e-Democracy. *Democratization*, *22*(4), 698–713. https://doi.org/10.1080/13510347.2013.873407

Medaglia, R. (2012). E-Participation Research: Moving Characterization Forward (2006-2011). *Government Information Quarterly*, *29*(3), 346–360. https://doi.org/10.1016/j.giq.2012.02.010

Milner, H. V. (2006). The Digital Divide: The Role of Political Institutions in Technology Diffusion. *Comparative Political Studies*, *39*(2), 176–199.

Noesselt, N. (2014). Microblogs and the Adaptation of the Chinese Party-State's Governance Strategy. *Governance*, *27*(3), 449–468.

Norris, D. F., & Moon, M. J. (2005). Advancing E-Government at the Grassroots: Tortoise or Hare? *Public Administration Review*, *65*(1), 64–75.
Noveck, B. S. (2009). *Wiki government: How technology can make government better, democracy stronger, and citizens more powerful*. Washington, D.C.: Brookings Institution Press.
Novo Vázquez, A., & Rosalía Vicente, M. (2019). Exploring the Determinants of e-Participation in Smart Cities. In M. P. Rodríguez Bolívar & L. Alcaide Muñoz (Eds.), *E-Participation in Smart Cities: Technologies and Models of Governance for Citizen Engagement* (pp. 157–178).
OECD. (2003). Promise and Problems of E-Democracy: Challenges of Online Citizen Engagement. Retrieved 26 July 2017, from http://www.oecd.org/gov/digital-government/35176328.pdf
Papke, L. E., & Wooldridge, J. M. (1996). Econometric methods for fractional response variables with an application to 401 (k) plan participation rates. *Journal of Applied Econometrics*, *11*(6), 619–632.
Porumbescu, G. A. (2016). Comparing the effects of e-government and social media use on trust in government: evidence from Seoul, South Korea. *Public Management Review*, *18*(9), 1308–1334.
Rodríguez Bolívar, M. P. (2018). Creative Citizenship: The New Wave for Collaborative Environments in Smart Cities. *Academia, Revista Latinoamericana de Administración*, *31*(1), 277–302. https://doi.org/10.1108/ARLA-04-2014-0047
Saebø, Ø., Rose, J., & Flak, L. S. (2008). The shape of eParticipation: Characterizing an emerging research area. *Government Information Quarterly*, *25*, 400–428.
Schultz, T. W. (1961). Investment in human capital. *American Economic Review*, *51*(1), 1–17.
Scott, J. K. (2006). "E" the People: Do U.S. Municipal Government Web Sites Support Public Involvement? *Public Administration Review*, *66*(3), 341–353.
Siau, K., & Long, Y. (2009). Factors Impacting E-Government Development. *Journal of Computer Information Systems*, *50*(1), 98–107. https://doi.org/10.1080/08874417.2009.11645367
Singh, H., Das, A., & Joseph, D. (2007). Country-Level Determinants of E-Government Maturity. *Communications of the Association for Information Systems*, *20*, 632–648. https://doi.org/10.17705/1CAIS.02040
Stier, S. (2015). Political Determinants of e-Government Performance Revisited: Comparing Democracies and Autocracies. *Government Information Quarterly*, *32*(3), 270–278. https://doi.org/https://doi.org/10.1016/j.giq.2015.05.004
Susha, I., & Grönlund, Å. (2012). eParticipation Research: Systematizing the Field. *Government Information Quarterly*, *29*(3), 373–382. https://doi.org/10.1016/j.giq.2011.11.005
Sylvester, D. E., & McGlynn, A. J. (2010). The Digital Divide, Political Participation, and Place. *Social Science Computer Review*, *28*(1), 64–74.
United Nations. (2018). *E-Government Survey 2018: Gearing E-Government to support transformation towards sustainable and resilient societies*. *New York*. https://doi.org/e-ISBN: 978-92-1-055353-7
Verba, S., Schlozman, K. L., & Brady, H. (1995). *Voice and equality: Civic voluntarism in American politics*. Cambridge: Cambridge University Press.
Vicente, M. R., & Novo, A. (2014). An Empirical Analysis of e-Participation. The Role of Social Networks and e-Government over Citizens' Online Engagement. *Government Information Quarterly*, *31*(3), 379–387. https://doi.org/10.1016/j.giq.2013.12.006

Wirtz, B. W., Daiser, P., & Binkowska, B. (2018). E-participation: A Strategic Framework. *International Journal of Public Administration*, *41*(1), 1–12. https://doi.org/10.1080/01900692.2016.1242620

Zhang, H., Xu, X., & Xiao, J. (2014). Diffusion of e-Government: A Literature Review and Directions for Future Directions. *Government Information Quarterly*, *31*(4), 631–636. https://doi.org/10.1016/j.giq.2013.10.013

Zheng, Y., & Schachter, H. L. (2017). Explaining Citizens' E-Participation Use: the Role of Perceived Advantages. Public Organization Review, *17*(3), 409–428.

Zolotov, M. N., Oliveira, T., & Casteleyn, S. (2018). E-Participation Adoption Models Research in the last 17 Years: A Weight and Meta-analytical Review. *Computers in Human Behavior*, *81*, 350–365. https://doi.org/10.1016/j.chb.2017.12.031

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