

E-GOVERNMENT READINESS, BUSINESS ENVIRONMENT AND ENTREPRENEURSHIP – THE EFFECT DEPENDS ON THE INCOME LEVEL OF THE COUNTRY?

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ABSTRACT

E-government refers to the delivery of government information and services online through the Internet or other digital means (West, 2004), and well-implemented e-government platforms can help to improve the business environment and the creation of new businesses. The present article has as its main goal to measure the impact of change of the index of e-readiness of e-Government (and its sub-indices) on ease of doing business, in the new business rate and the perception of corruption in countries of high, medium and low income, in order to test whether the effects depend on the income level. The study used a panel data (repeated measures), with four points (years 2008, 2010, 2012 and 2014), with three periods of change (2008/2010, 2010/2012 and 2012/2014), with data the following databases: Doing Business Report of the World Bank, the United Nations Survey on e-Government, Corruption Perception Index of Transparency International and World Bank's Survey on Entrepreneurship. Data were analyzed using Mixed Linear Models procedures with fixed and random effects. The findings indicate that different models should be employed to understand e-government impact depending on the income level of the countries, since they have a very diverse technological and service delivery capacity and different population profiles when compared on digital and Internet use, and even cultural traits. Thus, the findings support the hypothesis that the effects are diverse and depend on the income level. Indications for future research are discussed.

KEYWORDS

Electronic Government; Corruption; Entrepreneurship; Income level; Doing Business

1. INTRODUCTION

The new technologies and the broader information access, and more specifically the government service delivery and the extension of its impacts long been debated (West, 2004). However, there is a near consensus that e-government is a suitable platform for improved delivery of many categories of public services, mostly based on online transactions, and the broad dissemination of the operation of government. Studies have found that there is statistically significant relationship between trust and use of a local government website, as well as other positive assessments of governments. In addition, e-government can increase process-based trust by improving interactions with citizens and perceptions of responsiveness (Tolbert & Mossberger, 2006).

The services provided by e-government platforms can be very useful to the citizens, who can request governmental services at any time, and most often without the typical delay of traditional services provided by local, state and federal governments (Morgesson & Mithas, 2009). Services delivered in an electronic format are also good for businesses, since internet-based services allow faster processes to start a company, to obtain building permits, to hiring people, to import and export goods, and many other procedures essential for all companies, whether they deal with the government or not. According to Peters, Janssen, & van Engers (2004) businesses now have the expectation that the governments will reduce the administrative burden for businesses. Governments in turn, may accomplish this objective by creating a public administration that is smart, service oriented, through the establishment of an operational e-government presence.

A smarter public administration that is service oriented is an important incentive for the creation of companies and for keeping their operations. A diminishing or optimized way to deal with obligations can improve the rate of business creation in a given country, and in turn, advance other economic indicators related to the business environment. The essential idea is that the improvement in e-government applications, e.g, the establishment of governmental websites, portals, social networks, video channels and other forms of interaction, improves the business environment, as measured by the dimensions of the Doing Business Report (Almeida & Zoauin, 2014).

Many studies aimed to measure and understand the difference between dissimilar levels of access to information technologies, or Internet, in countries, organizations and even individuals. The difference between the units of analysis has been called the digital divide. Preliminary findings have pointed out that there is difference between countries, due mainly to their income level. According to the literature, wealthier countries, organizations and individuals have better position on the “digital divided world”, and thus, efforts should be undertaken to level the digital access worldwide to ensure the same levels of sophistication and benefits of e-government (Riggins & Dewan, 2005).

In addition, the level advancement in the implementation of e-government projects is very diverse between countries, and in general, the lower income countries have significantly lower levels of success in the creation of e-government applications. The poorer country usually rely on a much more limited infrastructure, have a population less educated and proficient in IT tools, and therefore a significantly weaker participation through e-participation processes and the use of digital services.

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Therefore, it is essential to understand the impact of e-government initiatives in different contexts and their respective impact on improving the business environment, in the creation of companies and reduction of the perception of corruption in the countries. This is the objective of the present work, which is structured in five sections. In the following section, we will briefly present a review of the literature on the electronic government, and its impact on the business environment and in reducing corruption, plus a succinct analysis of the differences between worldwide e-government initiatives. The third section discusses the methodologies and methods used, while the fourth section presents data analysis. The fifth section presents the final considerations and conclusions.

2. LITERATURE REVIEW

According to West (2004), e-government refers to the delivery of government information and services online through the Internet or other digital means. West (2004) still points out that service delivery on the internet are by nature nonhierarchical, nonlinear, two-way, and always available, while the traditional structures have as their characteristics to be hierarchical, linear, and one-way. Being nonhierarchical the e-government services based on the internet allows the citizens to search for information at their own convenience, not only in government's business hours.

The e-government allows both citizens and bureaucrats to send and receive information, thus being an effective way to improve service delivery and responsiveness to citizens. The interactive nature of Internet technology, plus its ability to speed up and improve communications, has the potential to make governments work better. Consequently, the application of the new technologies eliminate the issue of geographical distance, enhance communication, allow citizens to be aware of diverse viewpoints, and encourage deliberation of public matters (West, 2004).

The use of the internet as a new platform can governments, altering the capacity and changing the defining features of traditional bureaucracies, with the potential "to substantially redistribute power, functional responsibilities, and control within and across federal agencies and between the public and private sectors" (Fountain 1999 *apud* West, 2004). More importantly, the integrated work of people in different agencies in cross-agency portals, which have services and information, can be a source of considerable change in how the public sector functions (West, 2004).

More generally, the research about e-Government is growing, but not yet in a mature stage. The total number of papers has increased considerably in the last 10 years or so, but the first articles related to the topic just appeared in the 1990's, and it did not become a mainstream topic until the beginnings of 2000's (Almeida et al., 2014). Still, the creation and expansion of an e-government platform has been the objective of the most Governments for a series of reasons, and a series of governmental led initiative are blossoming worldwide.

One of the most mentioned reason for the creation of a e-government implementation strategy is that it allows transparency in public acts on information about income and expenses, in addition to providing a greater amount of available services, increasing the efficiency and responsiveness of Government (Brunetti & Weder, 2003; West, 2004; Mahalik, 2014). Margetts (2006) indicates that a wide adoption of e-government initiatives increases the chance that the e-government projects can bring economic and social benefits for its citizens.

West (2014) sustains that it is impossible to know whether a particular technological innovation will produce large-scale or small-scale change until years have passed, it makes sense for researchers to focus on the nature and direction of new practices in the short-run. Thus, it is important to study short-term change, since it offers clues about longer-term changes and gives policy makers benchmarks for evaluating how close they are to achieving particular goals and outcomes (West, 2004). Therefore, a series of articles seeking empirical evidence to verify the strength of the impact of e-government on a great selection of variables have been developed over the last years. For instance, Andersen's (2009) study used a panel data with 149 countries, with two data points (two years) to compare the improvement in e-government and their effects on control of corruption (more specifically in the perception of corruption).

Another study conducted by Tolbert, & Mossberger (2006) indicated that visiting a federal, state, or local government website statistically increases the perceived responsiveness of government. In the same study, the authors found that citizens using websites for any level of government were more likely to say that the Internet has improved their interaction with government at that level. In addition, simulations performed have indicated that the effect of local e-government use has a dramatic effect on perceptions of local government responsiveness. The deployment of e-government services also contributes to the creation of an electronic State, which is also minimum, transparent, responsive and accountable (Margetts, 2006).

However, the degree of success in e-Government implementations has always been different among countries. Therefore, the concept of e-readiness was created to provide a unified framework to evaluate the magnitude of this digital disparity between the countries during the 1990's (Hanafizadeh et al., 2009).

Hanafizadeh et al. (2009) proposed a model of measuring the concept of e-readiness, based on the convergence of various e-readiness assessments (e-government readiness index) consists of the following dimensions: infrastructure and access; access to and use of ICT by households and individuals; e-business; e-education; e-Government and indicators allowing comparisons and measurement of the level of ICT development. In addition, as an initiative to measure the progress of adoption of e-government solutions in different countries, the United Nations (UN) has created an index known as e-government readiness index (e-readiness) consisting of the indices of human capital, infrastructure, online services (formerly Web Measure) and e-participation index (UN 2014).

The human capital index is a composite of the adult literacy rate and the combined gross enrollment rate of primary, secondary and tertiary levels (UN 2014). The infrastructure index consists of five primary indices relating to the ability of a country's infrastructure, especially indicators that relate to the ability to provide e-government services. The Web index Measurements (called online services index in later editions) was based on a five-stage model of Andersen & Henriksen (2006), which in turn was based on previous levels of sophistication of the online presence framework of the United Nations.

The e-participation index aims to measure the transition from a passive to an active role of e-Government. The model includes three components: e-participation (access to information on demand), e-consultancy (people involved in discussions and contributions on public policies and services) and e-decision (empowerment of people for co-design of public policy and services) (UN, 2014).

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West (2004) proposes other taxonomy of e-government transformation stages. This proposed model is more directed to measure the extent of change promoted by e-government. According to the author there are four general stages of e-government development that distinguish the level of sophistication of government agencies in their way to transformation: (1) the billboard stage; (2) the partial service-delivery stage; (3) the portal stage, with fully executable and integrated service delivery; and (4) interactive democracy with public outreach and accountability enhancing features.

Governmental officials responsible for e-government projects have greatly publicized technology's potential to transform the public sector by bringing citizens closer to government. Even though the technology to facilitate greater responsiveness is readily available, many government sites have not taken full advantage of the available possibilities (Riggins & Dewan, 2005). Most developed nations have made greater progress in this area, especially countries in Europe, USA, South Korea and Japan, leaving most of the world behind (World Bank, 2014; Almeida & Zouain, 2014).

Riggins and Dewan (2005) explain that large organizations are more likely to adopt innovations and advanced ICT solutions than smaller organizations, and that may happen to countries, when compared by size and wealth, since a country's spending on ICT usually highly correlated with the respective level of development. Heeks (2006) indicates that the implementation of e-government initiatives in developing countries requires a customization between the technology and the specific contexts of these countries, which further hinders the adoption of a model of e-Government in these countries.

Additionally, the e-government initiatives depend on the use of a more complex ICT infrastructure (Stanforth, 2006) that is strongly associated with the income level of a country, higher-income countries tend to have a much more developed infrastructure and tend to invest more in e-government applications.

This occurs since the implementation of e-government is far from being dependent only on political will, and the issue of how to pay for e-government infrastructure remains a pressing challenge, even more for smaller or poorer countries. Even though the costs of hardware and software have decreased over the last years, many governments still cannot afford to make the implementation and expansion of e-government one of the major budgetary priorities (West, 2004). Thus, the level of development of e-government initiatives varies around the world, due to the substantial investment required to the creation and improvement of IT infrastructure, as well to create and maintain e-services for citizens (Ebrahim & Irani, 2005).

In addition, the higher income countries usually have a set of institutional factors that make them easier for doing business than lower income countries, reflected in better indicators in the dimensions of Doing Business (DB). On the other hand, corruption tends to be higher in poorer countries and without stronger public institutions (Transparency International, 2013). For operational and analytical purposes, the main criterion for the classification of economies by income by the World Bank is the gross national product (GNP) per capita. As there are changes in the GNP per capita value over time, the composition of country income groups can change depending on the edition of World development indicators calculation.

For the present study, the classification was based on GNP per capita in the most recent year with data are available (the year of 2013 was used in this study), and the countries remain in the same category for all years. Low-income economies (low income) are those with a per capita GNP of \$ 1035 or less in 2012. The classified as middle-income economies are those with a per capita GNP of more than 1035 dollars, but less than \$ 12,616. Within the range of middle-income countries, the middle-income countries of the lower stratum (lower middle)

and the middle-income countries of the upper stratum (upper middle), separated by a difference in the per capita GNP of \$ 4,085. According to the World Bank classification, the high-income economies (high income) are those with a per capita GNP of \$ 12,616 or more (World Bank, 2014).

The Doing Business report provides a quantitative measure of regulations for starting a business, dealing with construction permits, employing workers, registering property, getting credit, protecting investors, paying taxes, trading across borders, fulfillment of contracts and closing a business-how to apply to small and medium-sized national companies (World Bank, 2014). The indicators are composed of a combination of the number of procedures time needed to perform some crucial tasks of business how to register a business, closing, export and import, the income tax rate, access to credit, labor costs and many other indicators (World Bank, 2014). Also from the World Bank, the Entrepreneurship Survey measures the entrepreneurial activity in more than 100 countries in the period 2000-2014. The database includes cross-country data, time series on the number of enterprises in total and recently registered, collected directly from the Registrar of companies in the respective countries.

Finally, one of the most widely used instrument for measuring corruption in a country is the index of perception of Corruption (Corruption Perception Index -CPI), published since 1995 by Transparency International, ordering the countries of the world according to "the degree to which corruption is perceived to exist among public officials and politicians". The corruption perception index (CPI) measures the level of perception of public sector corruption in 180 countries and territories around the world (Transparency International, 2010). The countries which have highest perception of corruption have a near-zero indicator, while the smallest perception has near index 10.

3. METHODOLOGY

The data for this study was obtained for four non-consecutive years (2008, 2010, 2012 and 2014). The databases present on this study were: Doing Business Report issued by the World Bank (World Bank, 2014), United Nations research on e-government (UN e-Government Survey) (UN, 2014), Entrepreneurship Survey also from the World Bank, in addition to database Corruption Perception Index published by Transparency International. The choice of period of analysis was due to the availability of data for selected datasets. The data was imported and processed in the Microsoft Excel 2010 software.

The study employs a data analysis method known as panel data. A panel means that a variable for the same subject is available at different times. Hsiao (2003) indicates that the panel data have become increasingly popular due to a greater availability of data in this format, and because panel data is more capable to respond to the substantial questions than a set of indicators measured at a single point in time, which is usually found in most research in social sciences: cross-section data.

Still, the study may also be classified as a correlational study, since it was conducted to determine the relationship between variables (MARCZYK et al, 2005).The statistical analyses were performed with the software: SPSS version 23.0, and the significance level employed for all statistical tests was 0.05. The main research question article were defined as follows:

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- *The improvement of the e-government readiness is associated with improvement of the ranking of a country ranking in Doing Business dimensions?*
- *The improvement of the e-government readiness is associated with the rate of creation of new businesses (TEA)?*
- *Does this eventual relationship depends on the income level of the country?*

To test the hypothesis that the impact of e-government in the dependent variables is not the same among countries with different income levels, countries have been congregated into three categories based on the World Bank classification. The first group, “low income” contains the low-income countries and lower middle income, the second group “middle income” was composed by middle and upper middle income countries, while the third group “high income”, have exclusively countries classified by the World Bank as high income (World Bank, 2014).

During the regressions, this categorization serves as a dummy variable to create interaction terms between the variables, dividing the groups of country according to their income level. Therefore, instead of having a single slope for all countries, there is a coefficient for each country group, when used as a term of interaction, being thus possible to identify the impact of each variable, by income group, in only an equation or model for the dependent variable. It is important to note that to establish causality between variables in non-experimental designs is not possible, but the approach of this article using panel data deals with this limitation, and permit stronger assumption of causality. In addition, the use of the quantification of variable change between the years instead of use of the actual values, improves the likeliness of the presence of the theorized effects. The variables that employ the change of values instead of the actual value (of a single year) are marked with the symbol Δ (delta) to facilitate understanding.

4. ANALYSIS

After the consolidation of databases, errors and test data consistency and visual inspection, a total of 15 observations were classified as outliers, mostly due to missing data on some years or very big variations between positions in some of the rankings. The countries/year pairs removed were Bangladesh (two years), while Ecuador, Ghana, Grenada, Kiribati, Marshall Islands, Micronesia, Montenegro, Palau, Slovak Republic, St. Lucia, Uganda, Vanuatu, Zambia had one year removed from the sample.

After the removal of the outliers, the shape of the distribution of the data was tested by One Sample Kolmogorov-Smirnov test. The null hypothesis of this procedure establishes that the distribution is normal, and values of p greater than 0.05 indicate that the data has an approximately normal distribution, and therefore appropriate to go perform tests and procedures that require the normality to provide adequate results (Hair et al., 2010).

The results indicated that no variable tested had a normal distribution (Z statistic varying 0.050 to 0.199-p-values of $p < 0.00 < p = 0.004$). Although the visual graph analysis for the PP plot indicated that for most variables, the deviation relative to a normal distribution was not large. In the sequence, we tested the distribution of the main variables and compared the countries according to their income level. The results are in table 1:

Table 1. Descriptive Statistics by income level – all years considered

Variable	Country Income level								
	Low and Lower income			Upper Middle income			High income		
	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
Rank Doing Business	41.00	191.00	138.98	27.00	151.00	84.56	1.00	168.00	32.33
E gov ranking	11.00	187.00	129.69	12.00	181.00	84.16	1.00	170.00	41.92
Egov Index	.09	.60	.31	.27	.73	.48	.23	.95	.70
Human Capital Index	.11	.96	.59	.49	.98	.81	.53	1.00	.90
E Participation Index	.00	.80	.15	.00	.95	.24	.00	1.00	.48
Online service index	.01	.69	.24	.01	.84	.38	.03	1.00	.62
InfraStructure Index	.01	.43	.10	.01	.62	.27	.04	.94	.57
Corruption Perception	1.10	6.50	2.86	1.30	7.10	3.61	1.70	9.46	6.64
Total early stage entrepreneurship	7.00	52.10	22.00	4.00	36.00	14.44	2.40	24.30	7.79

The descriptive statistics presented in table 1 allow you to compare different groups with the income group of countries (low income, middle income and high income), and indicate that higher income countries feature better indicators in all the variables studied, except for entrepreneurship, indicating a linear relationship between the income and the remaining indicators.

However, to verify the statistical significance of these differences, a comparison of averages, using the procedure analysis of variance – ANOVA (Analysis of Variance), having as independent variable the variable of belonging to the group and as dependent variables the other variables of the study. All comparisons were statistically significant, with p-value <0.001. In addition, the post-hoc procedure of Tukey HSD to compare the differences between the possible pairs for each of the variables and check which of the groups of countries separated by income feature difference in average values. 54 comparisons were carried out (9 variables x 6 possible combinations of the 3 groups, taken 2 to 2). All comparisons showed significant difference with p-value of all comparisons $p < 0.001$.

Besides the differences between variables within countries, a spearman correlation test was performed between four variables divided by country income level: yearly change in ease of e-government level (e.g 2008-2010), change in e-government ranking, change in corruption perception index and change in the rate of entrepreneurship, measured by the TEA variable. The use of Spearman's correlation coefficient was necessary to compute the relationship between the variables since when the relationship between two variables is not normal bi-variate or when one is measured at a ordinal level the Pearson coefficient may not be the best estimative of the correlation of the variables (Miles & Shevlin, 2001). The results are presented in Table 2:

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Table 2. Spearman Correlations between main variables of the study

Income Group	Variable	ΔEase of Doing Business Rank	ΔE gov ranking	ΔCorruption Perception Index	ΔTotal early-stage Entrep. Activity (TEA)
Low and Lower income	ΔEase of Doing Business Rank	1.000	-.090	-.107	.200
	ΔE gov ranking	-.090	1.000	-.113	.014
	Δ Corruption Perception Index	-.107	-.113	1.000	-.386*
	ΔTotal e. s. Entrep. Activity (TEA)	.200	.014	-.386*	1.000
Upper middle income	ΔEase of Doing Business Rank	1.000	-.029	-.078	.201
	ΔE gov ranking	-.029	1.000	-.050	-.265*
	Δ Corruption Perception Index	-.078	-.050	1.000	.122
	ΔTotal e. s. Entrep. Activity (TEA)	.201	-.265*	.122	1.000
Higher Income	ΔEase of Doing Business Rank	1.000	.034	.102	.074
	ΔE gov ranking	.034	1.000	-.064	.047
	Δ Corruption Perception Index	.102	-.064	1.000	.175
	ΔTotal e. s. Entrep. Activity (TEA)	.074	.047	.175	1.000

*. Significant correlation at 0,05 level (both-sided)

The correlation analysis indicate a difference between income levels in the relationship between the variables. However, for all the countries considered, just two correlations were statistically significant. For lower income countries, the change in corruption perception index were related to the entrepreneurial activity, indicating that a decrease in perception of corruption was related to improved business creation rate. The middle and upper middle-income countries had a significative correlation between the change in TEA and change in e-government ranking. The negative correlation indicate that improvement in e-government ranking (lower number) was related with an increase in total early entrepreneurship rate. For high-income countries, no statistically significant relation was found.

The next step was to perform a regression of variables against two main dependent variables of the study: entrepreneurship and the ranking of the ease of doing business (Easy of Doing Business ranking-EoDB). From this point the present variables analyses in terms of variation and not absolute values. These variables are preceded by the symbol delta (Δ).

The first model, in order to explain the change in the rate of new businesses, we used as independent variables the changes in indices of e-readiness of e-Government, and its sub-indices and also the change in the perception of corruption (Corruption Perception Index -CPI), for all groups (high income, average income, and low income). The second model had as its aim to explain the variation in the classification of the country the EoDB, using the sub-indices of e-readiness of the Government and change the perception of corruption (CPI) for all groups.

We used a similar procedure to the stepwise, where predictors were included one at a time, the models were compared using the criteria usually employees of Akaike Information Criterion (AIC) to select between the generated models. Lowest AIC indicates models that best fit the data.

To verify the relationship between the change of variables and dimensions of e-government and Doing Business, we employ a linear mixed effects model (MIXED) implemented in the SPSS software. For a more comprehensive review of the application of

such models, we suggest that readers consult the works of McCulloch and Searle (2000), and Verbeke and Molenberghs (2000).

Briefly, in a linear mixed effects model the responses of a subject are the linear sum of fixed and random effects. If a given effect affects the population average, is a fixed effect, if an effect is associated with a sampling process it is called the subject effect and is considered a random effect. In addition, in a mixed effects model the random effects contribute only to the covariance structure of the data, that is, they do not change the coefficients.

The use of mixed models presents a clear advantage over ANOVA methods on actual data modeling, since when you ignore variations present the random effects can produce estimates of standard error incorrect or get fake positive tests (SPSS, 2013). In this study, SPSS version 23 and PROC MIXED procedure (SPSS, 2013) were used to perform an analysis of the relationship between the change in rates of e-Government and the change of the EoDB and TEA using a linear mixed effects model. The fixed effects were changes in sub-indices of e-readiness (infrastructure, e-participation, online services and human capital indices) and income group (high, medium, and low). For random effects, we had the intercepts of the subject (countries), keeping fixed inclinations by factors (or interactions). Visual inspection of the errors did not indicate deviations of linearity or normality. The first model had as dependent variable Δ Doing Business ranking (Δ EoDB), and the indexes that make up the e-readiness as predictors along with the group variable. The results are available in Table 3:

Table 3. Estimates for Fixed Effects- Δ EoDB Ranking dependent variable (Model 1)

Δ Ease of Doing Business Ranking Parameter	Estimate	Standard Error	GL	t	sig. p.	95% confidence interval	
						Lower Limit	Upper Limit
[GROUP = L.I.]	0.449	0.549	282.249	0.818	0.41	-0.631	1.53
[GROUP = M.I.]	1.886	0.656	282.825	2.877	0.00	0.596	3.177
[GROUP = H.I.]	2.918	0.609	247.188	4.792	0.00	1.719	4.117
Δ HumCapInd	-102.797	6.657	389.315	-15.44	0.00	-115.885	-89.708
Δ EPartInd	-21.537	2.049	399.153	-10.51	0.00	-25.564	-17.509
Δ OnServInd	-43.342	2.968	464.434	-14.6	0.00	-49.173	-37.51
Δ InfraInd	-55.378	5.749	439.299	-9.632	0.00	-66.677	-44.078

a. Dependent Variable: Δ Ranking Ease of Doing Business

Group = L.I – Low income, GROUP = M.I= Middle income, GROUP H.I = High Income

The model obtained indicated to be in low income groups does not bring a significant impact on the ranking of EoDB (estimate for Group 1 parameter is statistically equal to 0 ($b = 0.449$, p value = 0.0414), while for the medium and high income countries, the parameters indicate a worse performance in Doing Business dimensions. For example, belong to the Group 3 (high income) meant a loss of almost three positions in the ranking, keeping all other factors constant.

The improvement of the human capital index had the strongest effect on the EoDB ranking variable ($t = -15.441$). For example, according to the model, if a country in Group 1 (low income) had an increase in Human Capital index 0.10 10 positions in the current rankings improve. For comparison, the same country should improve the index and 0.45, -participation in the online index service by roughly 0.25, and infrastructure by 0.20 to achieve the same improvement of 10 positions. All these indices can range from 0 to 1 (UN .2014).

The comparative fit index model was $AIC = 3476.53$. As the variable of belonging to the Group of income had a significant effect, an effect of interaction was tested between the

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variable of belonging to the Group of income and the predictors in a new model, which obtained a higher setting, with AIC = 3410.6. The main advantage of the second model is the calculation of a different regression coefficient for each group and variable, making it possible to verify how the impact is different for every combination of variable and group. The results are in table 4:

Table 4. Estimates for Fixed Effects-dependent variable Δ EoDB Ranking (Model 2)

Parameter	Estimate	Standard Error	GL	T	sig.	95% confidence interval	
						Bottom Limit	Top Limit
Intercept	1.008	0.392	208.324	2.574	.011	0.236	1.781
[GROUP = L.I] * Δ HumCapInd	-79.476	6.704	340.742	-11.855	.000	-92.663	-66.290
[GROUP = M.I] * Δ HumCapInd	-96.014	10.208	267.411	-9.406	.000	-116.113	-75.916
[GROUP = H.I] * Δ HumCapInd	-119.148	14.531	248.560	-8.200	.000	-147.767	-90.529
[GROUP = L.I] * Δ EpartInd	-14.605	3.023	249.251	-4.831	.000	-20.560	-8.650
[GROUP = M.I] * Δ EpartInd	-18.227	3.588	265.252	-5.080	.000	-25.292	-11.162
[GROUP = H.I] * Δ EpartInd	-12.670	3.039	273.034	-4.170	.000	-18.652	-6.688
[GROUP = L.I] * Δ OnServInd	-70.525	4.326	320.815	-16.302	.000	-79.036	-62.014
[GROUP = M.I] * Δ OnServInd	-78.860	5.174	317.444	-15.242	.000	-89.040	-68.681
[GROUP = H.I] * Δ OnServInd	-32.052	4.472	271.329	-7.168	.000	-40.855	-23.249
[GROUP = L.I] * Δ InfraInd	-84.766	10.634	233.972	-7.971	.000	-105.718	-63.815
[GROUP = M.I] * Δ InfraInd	-74.199	8.769	364.623	-8.462	.000	-91.443	-56.955
[GROUP = H.I] * Δ InfraInd	-60.268	6.601	245.187	-9.131	.000	-73.269	-47.267

a. dependent variable: Δ EoDB Rank.

Group = L.I – Low income, GROUP = M.I= Middle income, GROUP H.I= High Income

The results of the model shown in table 3 indicate differences in all the coefficients between the three groups. All the coefficients were negative, indicating an improvement in any variable represents an improvement in ranking (ranking is a type of variable of type the smaller the better). The effects on the improvement of human capital in EoDB seemed higher in the highest income group. The change of e-participation has had more impact on middle-income countries. In connection with the online services, the improvement was greater in middle-income countries and low income, and, finally, the infrastructure change has had a greater impact on the EoDB for countries with lower income, followed by the middle-income countries and less of an impact for the high-income countries.

In the next model the main variable of the study regressed against the total early-stage entrepreneurial activity (TEA), which represents the percentage of the population about to start a business or activity that has companies with up to 3.5 years of foundation (new business).

The first model proposed included as predictors Δ human capital index, Δ e-participation, Δ online services index, Δ infrastructure index, Δ EoDB Ranking, Δ CPI, and identification of the variable income group. The model results indicate that only variables Δ infrastructure and Δ EoDB Ranking were significant predictors of variation of TEA. A series of incremental changes were performed with the objective of building a simpler model, and improve the statistics. The final model used only two variables as predictors (the effects of interaction were not significant in this model). The most comprehensive model obtained AIC = 1026.869 while

the simplest model had AIC = 1021.310, indicating that the simpler model is preferable. The parameters of the selected model are displayed in Table 5:

Table 5. Estimates for Fixed Effects-dependent variable Δ TEA

Parameter	Estimate	Standard Error	GL	t	sig.	95% confidence interval	
						Lower Limit	Upper Limit
Intercept	-.242313	.314004	187.619	-.772	.441	-.861745	.377118
Δ InfraInd	8.206201	2.965321	175.632	2.767	.006	2.353953	14.058449
Δ eod_rank	.060464	.018367	171.254	3.292	.001	.024210	.096718

a. Dependent Variable: Δ Total early-stage Entrepreneurial Activity (TEA)

The intercept of the model was not statistically different from zero ($p = 0.441$), but was retained in the model, since its removal would mean that, if a country had no change in the ranking of Doing Business or infrastructure dimensions wouldn't change TEA (so it would be equal to zero). However, we assume that many other factors can affect the TEA. This model also indicated that the two independent variables were significant predictors of improvement in TEA. Both have positive coefficients, indicating that the improvement of any variable is associated with an increase in TEA.

5. CONCLUSIONS

The results of this study support the general perception and previous studies about the big difference in the level of sophistication of e-Government in relation to the income of the countries. All variables studied presented significant differences with independent variable belongs to one of the income groups (low, medium and high).

The data indicate that countries with lower income have less availability of online services, less advanced infrastructure, electronic participation reduced, smaller development of human capital and a higher perception of corruption, as have been already pointed out in the United Nations e-government Surveys during the years analyzed. The only positive indicator for the lower income countries was a rate of early-stage entrepreneurship (TEA) higher than the other two groups. The higher income countries present therefore the best indexes on all these indicators, and only present the indicator TEA as the worst of the three groups. While the middle-income countries, remained in middle term in all the dependent variables, including TEA.

The analysis also indicated that the improvements in the variables of e-readiness of e-Government and its contents have statistical power to explain the change of positions of a particular country in the ranking EoDB and TEA. There were important differences between groups and variables, indicating a very interesting dynamics, which have practical implications. Online services and improvements in human capital were independent variables that had the greatest impact on the EoDB, when considering all countries as a group. According to the model, human capital is the most effective way to improve the business environment of a country, regardless of the income level; the online service was the second best predictor.

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However, we have to note that this study reached its goal to demonstrate that it is important to consider this relationship taking into account the level of income of the countries. We were able to achieve this when considering the effects of the interactions between the variable group and the other predictors available in model two. For low-income countries, the infrastructure was the predictor with the greatest impact in improving to Doing Business rankings; the improvement in participation had a very limited impact in comparison with the others, and can be partially explained by the effective lower level of participation in those countries. For middle-income countries, the trend was different, due to different dynamics and characteristics.

The most important predictor was the change in the human capital index, followed by the change in the index of online services and the change in the index of infrastructure. Once more, the improvement in the e-participation had the lowest impact. Finally, for the high-income countries, the enhancement of human capital was definitely the most powerful predictor for the improvement of the EoDB rankings, followed by infrastructure index, then the index of online service, while the e-participation had the lowest impact.

In relation to the model prepared to explain the changes in the rate of entrepreneurship, not all variables were statistically significant. The representative of the country's income level was a significant predictor, which means that the effects are practically the same in all three groups. The only change in the human capital index and ranking EoDB were significant predictors for changes in total entrepreneurial activity (TEA) stage. As variables are of different magnitudes and natures, the comparison of the effects is more difficult than the comparison among the indexes, though a statistic *t* biggest suggests that improving the EoDB ranking has deeper impact on TEA. The lower power of the model to explain TEA was anticipated, since e-government plays only a minor role in the definition of new business creation. Although new and small business greatly benefit from a good e-government platform, it is not the main driver of the entrepreneurial decision to create a new business, which are influenced by a myriad of factors and personal decisions.

The results of this study suggest that the division of countries by income level to understand the impact of e-Government is very relevant, even mandatory. In addition, further research should seek to understand how and by what causes the impact of e-government services differs according to the levels of sophistication of e-government applications and the income levels of countries, and other factors that may explain why the e-government implementations have different impacts during the years. The total early entrepreneurial rate was not very affected by the changes in e-government rankings or indicators. That does not mean that the variable is not important, but instead, that other external variables play a larger role in determining the decision of start a business. In relation to the result on the perception of corruption, future studies should seek to establish relationships between the e-government initiatives and a diminished perception of corruption.

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