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Factors Impacting E-Government Development

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Abstract

E-government is a way for governments to use new technologies such as the Internet to provide citizens with more convenient access to government information and services, to improve the quality of services, and to provide greater opportunities for citizens to participate in democratic institutions and processes. This research investigates factors impacting e-government development. Based on the growth theory and human capital theory from the economics literature, we hypothesize that information and computer technology, and human development are two factors impacting e-government development. The hypotheses were empirically tested using secondary data from the United Nations and the United Nations Development Programme. The results support the two hypotheses. Further analysis was also carried out to compare countries with low, medium, and high human development levels.

Keywords: E-government development, Web presence, growth theory, human capital theory

Introduction

With the advancement of communication (including both wired and wireless) as well as computer technologies in recent years, e-government has attracted increasing interest from both researchers and practitioners. E-government presents a way for governments to utilize all kinds of information and communication technologies, to facilitate the daily administration of government, and to provide better services to citizens and businesses, as well as other government agents. The evolvement of e-government provides extensive opportunities for citizens to participate in democratic institutions and political processes.

There are four major areas of e-government development: government-to-customer (G2C), government-to-business (G2B), government-to-government (G2G), and government-to-employee (G2E). Figure 1 clarifies the objectives and activities (possible projects or functionalities) of each of the four areas.

Among these four areas, G2C and G2E involve interaction and cooperation between government and individuals, while G2B and G2G address the interaction between government and organizations. Moreover, G2C and G2B represent the external interaction and collaboration between government and outside institutions, while G2E and G2G involve the internal interaction and cooperation between government and government employees, as well as between governments at different levels and at different locations. Figure 2 features the overall framework of the e-government.

With successful implementation, e-government has the potential to make valuable and highly effective connections between government and citizens (G2C), businesses (G2B), employees (G2E), and other governments (G2G).

However, the concept of e-government and research on e-government are still in their infancies. Little published research has been conducted on the determinants of e-government development from a cross-national perspective. Most of the existing research examines e-governments of a specific region, such as municipalities of the United States (Holzer and Melistski 2003; Kaylor 2001; Public Sphere Information Group 2002;), states within the United States itself (McNeal et. al. 2003), or specific countries such

	Individual	Organization
External	**G2C** Objective: (1) To provide satisfactory service to citizens in order to improve the government-citizen relationship Activities: (1) Information access such as benefits, policy, loans, and educational materials (2) Individual business transactions such as social service, grants/loans, taxes	**G2B** Objectives: (1) To provide better service to businesses (e.g., eliminating redundant data collection) (2) To reduce the purchasing cost of government by using e-business technology Activities: (1) Providing a single portal and an integrated database (2) Entering the e-market to gain cost efficient benefits
Internal	**G2E** Objective: (1) To improve efficiency and effectiveness of government administration Activities: (1) Reorganizing internal operations and adopting the best commercial practices (2) Providing services to government employees such as training, payroll, travel, and reimbursement	**G2G** Objective: (1) To enhance cooperation and collaboration between governments of different levels and at various locations Activities: (1) Sharing or integrating federal, state, and local government databases, as well as integrating separate systems (2) Enhancing collaboration and cooperation such as grants, law enforcement, public safety, and emergency management

Figure 1. E-Government Portfolios

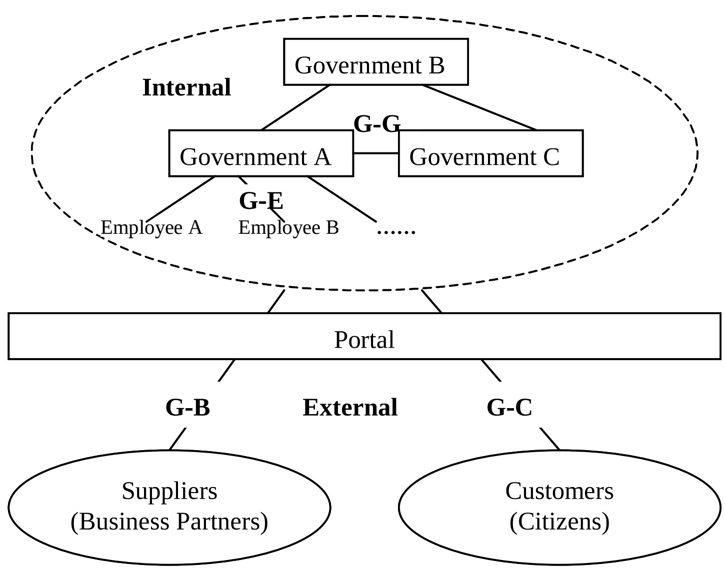

Figure 2. E-Government Framework

as Scotland, Africa, and Australia (Heeks 2002; Li 2003; Teicher and Dow 2002). Using secondary data from the United Nations (2003) and the United Nations Development Programme (2003), this paper investigates factors impacting e-government evolvement.

The rest of the paper is organized as follows: The next section provides a literature review on the e-government stage model, which serves as a basis for e-government development measurement. Growth theory and human capital theory, which serve as the theoretical foundation for this research, are discussed and the research questions and hypotheses are also presented. The research methodology is described and the research results are presented. The results and future research directions are discussed. The last section concludes the paper and highlights the contribution of this research.

Literature Review

Stage models are important as they depict the stages of development. Figure 3 illustrates the UN's five-stage model. The UN's model covers the stages a government may experience during the e-government evolvement. Moreover, this model was utilized as a guideline to evaluate e-government development by examining the presence or absence of online services in each stage. In this research, the data is based on the UN's five-stage model.

As the figure shows, there is a "jump" or "leap" between each of the stages. The primary purpose of the first three stages is to automate and digitalize the processes, while the objective of the last two stages aims at transforming government services, reorganizing the internal operational processes, and reconceptualizing the way citizens participate in decision making and policy formulation.

Several e-government stage models have also been proposed by other researchers (e.g., Hiller and Bélanger 2001; Layne and Lee 2001; Moon 2002) and institutions (e.g., Gartner Group [see Baum and Di Maio 2000]; Deloitte and Touche [2001]). Table 1 compares these different stage models in e-government.

As can be seen from Table 1, these models are slightly different. The joint UN–ASPA (2001) five-stage model focuses on the measurement of content and types of service available online. Deloitte's six-stage model is based on the customer service perspective, which emphasizes customer-centricity and defines the process as an evolution of the relationship between both the government and the citizen. However, besides enhancing customer service, e-governments should also reorganize the internal operations so as to improve the efficiency and effectiveness of government administration. Unfortunately, these are ignored in the Deloitte's model.

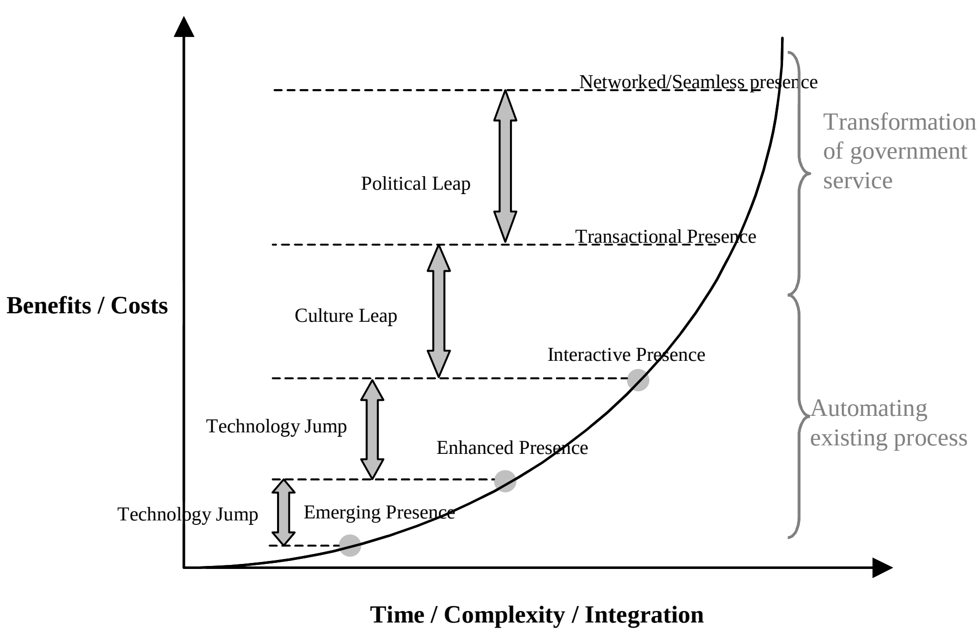

Figure 3. A Five-Stage Model of E-Government Implementation

Table 1. Comparison of E-Government Stage Models

Model	Stages	Strengths and weaknesses
The joint UN–ASPA (2001) and Hiller and Bélanger's (2001) five-stage model	• Emerging Web presence • Enhanced Web presence • Interactive Web presence • Transactional Web presence • Seamless or fully integrated Web presence	(1) Both front-end Web portal and back-end office development are important to e-government development (2) Regard Web presence as an indicator of e-government development
Deloitte's six-stage model (2001)	• Information publishing/ dissemination • Official two-way transaction • Multipurpose portals • Portal personalization • Clustering of common services • Full integration and enterprise transaction	(1) Essentially a customer-centric model (2) Ignore the reengineering of government internal operations (3) Ignore the potential benefits of political changes (4) Some of the stages can be combined
Layne and Lee's (2001) four-stage model	• Catalogue • Transaction • Vertical integration • Horizontal integration	(1) Ignore the potential benefits of political changes
Moon's (2002) five-stage model	• Simple information dissemination • Two-way communication • Service and financial transaction • Vertical and horizontal integration • Political participation	(1) Good but not concise enough (2) Political participation used in the model does not seem to adequately capture the "true" meaning of that stage
Gartner's four-stage model (Baum and Di Maio2000)	• Web presence • Interaction • Transaction • Transformation	(1) Concise and easy to follow (2) Ignore the potential benefits of political changes

Both Layne and Lee's (2001) four-stage model and Moon's (2002) five-stage model have been developed based on a general and integrated perspective which combines technical, organizational, and managerial feasibility. The main difference between these two models is the political participation phase. The model proposed by Layne and Lee does not consider political participation, whereas the model by Moon highlights the political participation stage as the ultimate objective of e-government development.

Gartner's four-stage model is straightforward and concise. However, akin to the model proposed by Layne and Lee, Gartner's four-stage model misses out on the political participation component and does not address the possible changes in the way decisions are made in government.

These five models address e-government development from different perspectives. The UN's five-stage model was used in this study since the data from the United Nations was collected based on the model.

Theoretical Foundation

Growth Theory

Growth theory is an economic theory investigating reasons for growth and development. Since Adam Smith, the theory has been developed for 200 years. Growth theory can be differentiated into classical growth theory, neoclassical growth theory, and new growth theory. The classical growth theory regards the increase in labor productivity as the main reason for growth, while the new growth theory extends the reasons to technological progress and creativity (Lucas 1988; Romer 1986, 1990). The new growth theory believes that technology is an endogenous rather than an exogenous variable (as believed in neoclassical growth theory). There are three key elements required for growth: increase in human capital, increase in research and development, and formulation of pro-growth trade policies. The new growth theory supports a knowledge-based economy, and recognizes the importance of information and computer technology.

Based on the new growth theory, we argue that information and computer technology (ICT) plays an essential role in growth and development of e-government. E-government needs to utilize all kinds of information and computer technology in order to deliver government information and service to the public. Warkentin *et al.* (2002) stressed that e-government is characterized by extensive use of information and computer technology. Information and computer technology, therefore, plays an important role in stimulating the advancement of e-government development from one stage to the next. Bellamy and Talor (1998) and Heeks (1999) also highlighted that information and computer technology has played an increasingly important role in public administration. Therefore, we hypothesize that a country's ICT level has a positive effect on its e-government development status.

Human Capital Theory

Besides the technology factor, social factors also play important roles in e-government development. It has long been recognized that humans are an important component of the wealth of a nation. Schultz (1959, 1961) and Lewis (1955) in their human capital theory (HCT) had emphasized the critical role of "human capital" (such as education, health, and fertility) in growth and development of both the individual and society. They argued that these factors were pre-requisites for growth.

In essence, the human capital theory is an economic theory stressing that education, knowledge, health, and skills are forms of capital—human capital. The investment in human capital generates returns in the future. The development of the human capital theory extends from individuals (i.e., personal investment in human capital, say, education and training) to organizations and nations. Economists (e.g., Schultz 1961) argued that human capital might be one of the critical reasons that explains the differences in growth (e.g., income and productivity) between human beings as well as nations. HCT attempts to explain not only individuals' but also nations' behavior involving human capital—for example, the differential level of growth across countries rising from differences in human capital investment (Flamholtz and Lacey 1981).

Based on human capital theory, we argue that human capital (including education, health, and income) is one of the important determinants of e-government development. According to Burn and Robins (2003), IT leverage, learning capability, and knowledge capability are potential factors affecting e-government development. From the e-government stage models discussed in the previous section, it is clear that to achieve the cultural and political leaps in the UN's five-stage model (i.e., from the interactive stage to the transactional stage, and from the transactional to the seamless stage), social factors are essential to spur the development. Mooney and Lee (1995) also identified governmental and societal resources as important factors in government policy innovation.

Governmental and societal resources can be simply measured by economics indexes such as GDP/GNI per capita. An extended model includes education and knowledge level as measures of government development environment (McNeal et al. 2003). A better measurement of human capital is the human development index (HDI). According to The United Nations Development Programme (2003) report, the human development index aims to evaluate a country's achievement in human development. The index includes three aspects: GDP per capita, knowledge level, and life expectancy.

Research Model and Hypotheses

Based on the theoretical analysis, we hypothesize that both technology and social factors play important roles in determining e-government development status. Therefore, ICT and HDI are regarded as two factors impacting e-government development.

> ***Hypothesis 1****:* *The higher the level of information and computer technology, the higher the level of e-government development.*
>
> ***Hypothesis 2****:* *The higher the level of human development, the higher the level of e-government development.*

The research model and hypotheses are depicted in Figure 4.

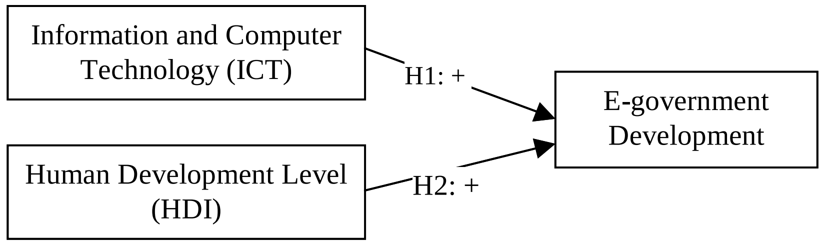

Figure 4. Research Model

Research Methodology

Data Collection

The data used in this study is secondary data obtained from a few sources. Some researchers (e.g., Jarvenpaa 1990) have pointed out that secondary data present a variety of untapped opportunities in information systems research. The data are extracted from two reports—E-Government Reports 2003 (United Nations 2003) and the Human Development Report 2003 (United Nations Development Programme 2003). The former is a comprehensive report based on the UN global e-government survey of 2003, which is the most extensive world survey on e-government to date. The latter addresses human development goals and provides valuable data such as HDI, income level, and country classification.

The United Nations report covers 191 UN members, while the United Nations Development Programme report covers 173 countries. Since we needed the data from both resources, we had to find the set of countries that were covered in both reports. Data from 160 countries was available for this research.

Measurement

The major categories of data used in this study include the Web measure index (HMI), technology infrastructure index (HII), and human development index (HDI).

The Web measure index (HMI) is an indicator of e-government development provided by the United Nations report. HMI is a quantitative index that measures the generic capability of governments in employing e-government to inform, interact, transact, and network.

The UN's five-stage model (i.e., emerging presence, enhanced presence, interactive presence, transactional presence, and networked presence as shown in Figure 3) was the conceptual basis for the data collection. Countries were coded based on whether they provided the required service or information characterized by a given stage.

The coding procedure utilized a questionnaire requiring researchers to assign a binary number to the index according to the presence or absence of the information or service available. The questionnaire has been revised and improved from previous years of UN research. It integrates multiple perspectives of e-government Web presence introduced in Figure 1 (i.e., G2B, G2C, G2E, and G2G).

National portal or the official homepage of a government was chosen in the survey. The survey limited itself to a predetermined set of five additional Web sites. These government Web sites consist of people-centric departments or ministries, including health, education, social welfare, labor, and finance. The same questions were directed to the selected government departments across the world. Therefore, the same or similar functional Web sites were selected and assessed for these countries.

HMI was chosen in this study as an indicator of the e-government development of a specific country. There are a few reasons for its selection. First, the measurement is based on the UN's five-stage model (as shown in Figure 3), which depicts the generic e-fovernment development across nations. Furthermore, accessing services provided by official government Web sites is a direct and succinct way to measure the e-government development situation of a specific country. Second, the measurement is an extension and improvement of the previous year's (i.e., United Nations 2002) assessment. It has been revised by a group of researchers through feedback from earlier use. The instrument is relatively mature and reliable. Third, HMI provided by the UN is an authentic and comprehensive index for the whole world. It is difficult for individual researchers or institutes to conduct such a comprehensive and costly survey. The secondary data from the UN makes this research possible.

The technology infrastructure index (HII) was also introduced in the United Nations report. It is a composite and weighted index of six indices based upon ICT-related indicators. The six components include PCs/1,000 persons; Internet users/1,000 persons; Telephone lines/1,000 persons; online population/1,000 persons; mobile phones/1,000 persons; and TVs/1,000 persons (see Appendix A). HII is used as a comprehensive indicator of ICT development.

The human development index (HDI) is extracted from the United Nations Development Programme report. HDI is a composite indicator of a country's achievement in human development. The three primary components in this index are GDP per capita, knowledge, and longevity (i.e., life expectancy). HDI is used in this study as an indicator of human development of a specific country.

Appendix A provides further definitions of the indices used in this study.

Statistical Analyses

The objective of this research is to investigate factors impacting e-government development. The research model and hypotheses were presented in the previous section. To investigate the research questions, a regression model was tested and a follow-up analysis was conducted to provide further support for the research findings.

Results and Discussion

A series of assumptions of multiple regression were tested to determine the feasibility of the analysis. A follow-up group comparison test was conducted after the regression analysis.

Multiple Regression Assumptions

Multiple regression relies upon certain assumptions. Some of them are robust to violation (e.g., normal distribution of errors), and others can be achieved through proper design of a study (e.g., independence of observations). In the following, those assumptions that are less robust to violation are discussed. Specifically, we will focus on the assumptions of normality, linearity, homoscedasticity, and collinearity.

Normality

Regression assumes that variables have normal distribution. Normality can be achieved through descriptive statistics (such as skewness and kurtosis) and certain statistical tests (such as Kolmogorov-Smirnov test). Since the reliability of normality tests is sometimes questioned, we used descriptive statistics to check the normality of the variables in our model.

Table 2. Descriptive Statistics of Variables

	Mean	Standard Deviation	Skewness		Kurtosis	
			Statistic	Std. error	Statistic	Std. error
Web Presence (WebPrese)	0.29356	0.22047	0.764	0.192	-0.176	0.381
Technology Infra-structure Index (TII)	0.19678	0.22467	1.338	0.192	0.668	0.381
Human Capital Index (HCI)	0.71061	0.17052	-0.666	0.192	-0.476	0.381

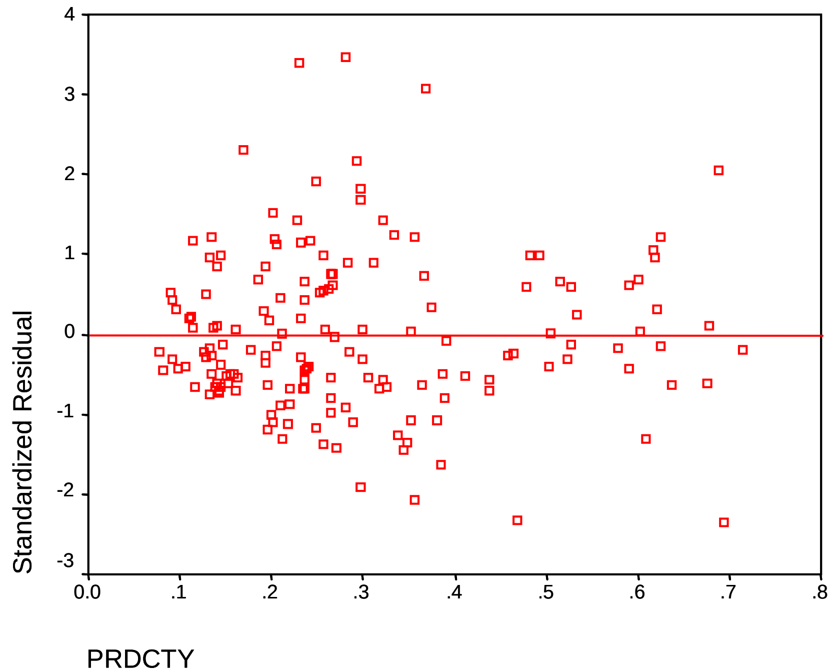

Figure 5. Residual Plot (Standardized Residuals against Predicted y–Web presence)

Several rules-of-thumbs have been used to access the normality by skewness and kurtosis. A strict rule-of-thumb is to use "1" as the cut-off value (which means that the absolute values of both skewness and kurtosis should be less than 1). Except for the skewness of TII, all the values satisfy the rules. Although the skewness of TII is greater than 1 (i.e., 1.338), it is not highly skewed (i.e., it is less than 2). Therefore, there is no serious violation of normality for the three variables.

Linearity

The linear relationship between dependent variables and independent variables is another assumption of the standard multiple regression model. If the linearity assumption is violated, the results of the regression analysis will underestimate the true relationship. This underestimation carries two risks: First, an increased chance of a Type II error for that independent variables, and second, in the case of multiple regression, an increased risk of Type I errors (overestimation) for other independent variables that share variance with that independent variable.

This assumption can be checked by the residual plot (Cohen and Cohen 1983; Pedhazur 1997). The standardized residuals are first plotted against the predicted y. If the points scatter randomly about the line of the mean of residuals, it suggests a linear relationship. Figure 5 shows a scatter plot of predicted y against residuals.

No significant trend was observed from the scatter plot. The residual points are distributed randomly around the line of mean. However, some possible outliers could be observed from the plot. Deleting the outliers one by one, we did not find significant difference in the results. Therefore, the outliers have little effect on the results. In short, the residual plot suggests no violation of linearity.

Homoscedasticity

Homoscedasticity is defined as the variance of errors being the same across all levels of the independent variable (Pedhazur 1997). When the variance of errors differs at different values of the independent variable, heteroscedasticity is indicated. Slight heteroscedasticity may have little effect on significance tests (Berry and Feldman 1985; Tabachnick and Fidell 1996). However, serious heteroscedasticity may lead to distortion of findings and increase the possibility of a Type I error.

Homoscedasticity can also be checked using residual plots. As can be seen in Figure 5, the residual points are randomly scattered around the mean, which indicates no violation of homoscedasticity.

Collinearity

Collinearity refers to the intercorrelation among independent variables. The high correlation among independent variables may lead to deviation of the estimation of regression statistics (Pedhazur 1997). Tolerance (or variance inflation factor the reciprocal of tolerance) was used to check for the collinearity of two independent variables. As a rule of thumb, if tolerance is less than .20, a problem with multicollinearity is indicated. In this case, SPSS shows the value of tolerance as 0.453 (variable inflation factor equals to 2.209), which indicates no serious violation.

In summary, we did not find serious violation of assumptions.

Hypotheses Test

After verifying the assumptions of multiple regression, the hypotheses tests were conducted. The Web measure index, an indicator of e-government development used in the United Nations report, is employed as the dependent variable. Two predictors, technology infrastructure index as an indicator of information and computer technology, and human development index as an indicator of human development, are employed as the two independent variables in the model.

The statistic test shows a significant result for the whole model ($p < .0001$). ICT and HDI together explain 53 percent ($R^2 = .526$) of the variance of e-government development.

To further examine the effects of two independent variables, we checked the coefficients table (as shown in Table 3). Both of the coefficients are positive and are statistically significant at 0.05 level, which indicate a positive relationship between two independent variables and dependent variable respectively. The results support the research hypotheses.

The statistical analysis suggests, first, the regression model is statistically significant, which means that both independent variables—ICT and HDI—affect the e-government development of a country. Second, each of the independent variables (i.e., ICT and HDI) plays a significant role, and ICT accounts for a relatively larger part ($Beta_{ICT} > Beta_{HDI}$). Third, the significant positive coefficients for both ICT and HDI indicate a positive effect on e-government development, which supports our two hypotheses.

The result of the test supports the hypotheses that the higher the level of ICT and HDI, the more advanced the e-government development stage of a country.

Further Analysis

To further validate the result of the hypothesis test, we use HDI as a categorical variable to examine the group differences between countries with e-government development. The United Nations Development Programme classifies countries into three groups—low, medium, and high human development—according to their HDI index (as shown in Table 4).

For this analysis, the sample consists of 173 countries covered in The United Nations Development Programme (2003).

Table 3. Coefficients of the Two Independent Variables

	Coefficients[a]				
	Unstandardized Coefficients		**Standardized Coefficients**		
Model	**B**	**Std. Error**	**Beta**	**t**	**Sig.**
1 (Constant)	4.286E-03	.065	.569	.066	.948
ICTIDX	.558	.080	.195	6.966	.000
HDI	.253	.016		2.392	.018

[a]Dependent variable: WEBPRESE

Table 4. Classifications of Countries

Categorical variables	Groups	Number of Countries (Total of 173 countries)
Human development index	Low human development (HDI < 0.5)	39
	Medium human development (0.5 < HDI < 0.8)	82
	High human development (HDI > 0.8)	52

Table 5. Rank Differences between Groups of Countries in Different HDI Groups (Kruskal-Wallis Test)

	Ranks		
	HID	**N**	**Mean Rank**
WEBPRESE	Low HDI	39	56.38
	Medium HDI	82	76.10
	High HDI	52	127.14
	Total	173	

Because of the unequal sample size, as well as the possibility of non-normal distribution, nonparametric statistical technique (e.g., Kruskal-Wallis test) was utilized.

The statistic result shows significant difference of e-government development between countries on HDI ($\chi^2 = 51.895$, $p < 0.001$). Rank differences between groups are illustrated in Table 5.

To further understand the differences, a planned *post hoc* test was conducted. In the test, confidence intervals were first checked to provide a straightforward observation. Planned *post hoc* tests were then conducted to test the differences illustrated by the confidence intervals.

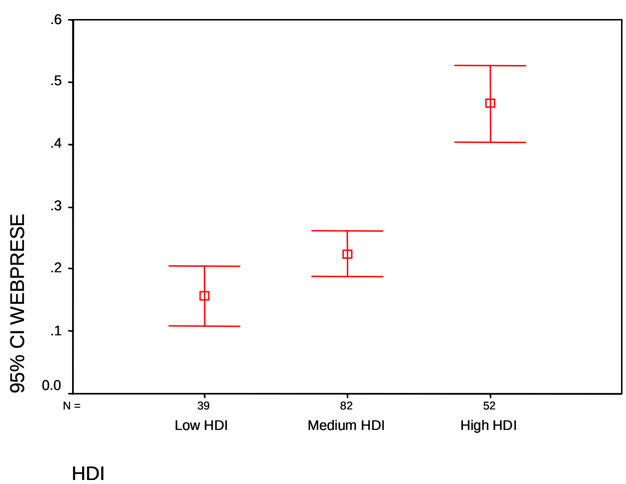

Figure 6. Confidence Interval Chart for HDI

Table 6. *Post Hoc* Tests for HDI

Comparison	M-W U[1]	Sig.[2, 3]
Low HDI–Medium HDI	1178	0.019
Medium HDI–High HDI	817.5	< .0001**
Low HDI–High HDI	241	< .0001**

Notes:

1. M-W U refers to the score of Mann-Whitney test.
2. ** = p < .001.
3. Bonferoni α is used to control Type I error.

Table 6 presents the planned *post hoc* test for each pair. Figure 6 shows the confidence interval. The height of each bar indicates the variance of the variable (i.e., Web measure index in this case), and the middle point of each bar represents the mean of that variable in different groups. The tests show statistically significant differences between low HDI and high HDI, and medium HDI and high HDI.

However, there is no significant difference between low HDI and medium HDI. The p-value for the comparison of low HDI and medium HDI equals to 0.019. Using either a Bonferoni a or Holm's α to control for Type I error, the critical value is 0.05/3=0.017, which is less than the resulting p-value. This means that there is no significant difference between the two groups and the null hypothesis was not rejected.

Although there is no significant difference between medium and low HDI countries, the results of comparison tests suggest a more advanced e-government development for those countries with high HDIs than countries with medium and low HDIs. This finding indicates that HDI is an important factor to distinguish countries with e-government development. The result also supports the regression model's finding that HDI impacts e-government development.

Discussion

This research investigates factors that impact the development of e-governments. The result of the regression analysis supports the hypotheses that both the technology factor (i.e., ICT in this case) and the social factor (i.e., HDI in this case) affect e-government development. The higher the level of information technology and human development, the more advanced is the e-government development.

A comparison test was conducted between groups of countries with e-government development based on different HDI levels. The result shows that e-government development for countries with high HDI is significantly different from countries with medium and low HDIs. The comparison test supports the finding that HDI is an important factor to differentiate countries with e-government development.

There are some potential limitations to this study. First, the data used in this study is secondary data from different resources. Due to the nature of secondary data, it is difficult to assess the reliability and validity of the data. For example, since we do not have the exact instrument used to measure Web presence, it is difficult to determine whether the instrument is reliable and valid, and whether Web presence is a good representation of e-government development. However, as the data collection was prepared and conducted by the United Nations, we believe that the data collection was done properly and scientifically. Second, the data is not a perfect fit for multiple regression. For example, there are a few potential outliers in the data set. However, our testing shows that there is no serious violation of assumptions of multiple regression.

There are other factors affecting e-government development. Future research should investigate factors such as culture, government policies, and leadership. Also, developing and validating instruments to measure e-government development is an important area that warrants research. Delving in-depth to focus on certain aspects or factors of e-government development via qualitative research methods (such as case studies or grounded theories) will contribute much to the field of e-government development. For example, there is a lack of theories in this area and the grounded theory approach may be needed.

Contributions and Conclusions

The research investigates the impact of two factors—information and computer technology, and human development level—on e-government development. Using secondary data from the United Nations, we ran regression analyses and the results show that both factors have a significant impact on e-government development There is a paucity of research investigating the determinants of e-government development from a global perspective. This paper contributes to the literature by providing empirical evidence of factors impacting e-government development. For academic researchers, this research identifies two important factors that impact e-government development. The examination of HDI through comparison tests provides us a more in-depth understanding of the differences in e-government development between groups of countries. For practitioners, the research findings suggest that improvement in technology is not the only factor in e-government development. Social factors such as knowledge and economic conditions are also important.

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Appendix A. Definition of the Indices

Web Measure Index (WMI)

The Web measure index aims to evaluate the service and facilities provided by government Web sites. The index is purely quantitative and based on the presence or absence of specific online services or facilities available. Since Web presence directly reflects e-service provided to the public, Web measure index is a straightforward assessment indicating progress of e-government development of that country.

Technology Infrastructure Index (TII)

The telecommunication infrastructure index aims to measure information and computer technology development across countries. It is a composite, weighted average index of six primary indices based on basic ICT-related infrastructure indicators: PCs/1,000 persons; Internet users/1,000 persons; telephone lines/1,000 persons; online population/1,000 persons; mobile phones/1,000 persons; and TVs/1,000 persons.

Human Development Index (HDI)

The human development index measures a country's achievements in three aspects of human development: longevity, knowledge, and a decent standard of living. Longevity (life expectancy index) is measured by life expectancy at birth; knowledge (human capital index) is measured by a combination of the adult literacy rate and the combined gross primary, secondary, and tertiary enrolment ratio; and standard of living is measured by GDP per capita.

Life Expectancy Index (LEI)

Life expectancy at birth is the number of years a newborn infant would live if prevailing patterns of age-specific mortality rates at the time of birth were to stay the same throughout the child’s life.

Human Capital Index (HCI)

The data for the human capital index relies on the United Nations Development Programme education index, which is a composite of the adult literacy rate and the combined primary, secondary, and tertiary gross enrollment ratio with two thirds of the weight given to adult literacy and one third to gross enrollment ratio.

Gross Domestic Product (GDP) per Capita

GDP is one of the essential indices to evaluate the economic development of one country. The sum of value added by all resident producers in the economy plus any product taxes (less subsidies) not included in the valuation of output. It is calculated without making deductions for depreciation of fabricated capital assets or for depletion and degradation of natural resources. Value added is the net output of an industry after adding up all outputs and subtracting intermediate inputs.

GDP per capita is calculated by GDP (US$) divided by midyear population.