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Facilitators for e-Government Development: An Application of the Technology-Organization-Environment Framework

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ABSTRACT

There are relatively few empirical studies that analyze e-Government development from a global perspective. Using secondary data from 115 countries and the Technology-Organization-Environment (TOE) as the guiding theoretical lens, we examine the facilitators for e-Government development. Our research highlights the importance of national *technological* and *organizational* (human capital) contexts for e-Government development. Our results also show that national *environment* (institutional and macro-economic) is not a significant facilitator for e-Government development. Further post hoc analysis reveals the anomalous significant relationship of public institutions with e-Government development in the negative direction. Through this research, we make some important contributions and implications for researchers, practitioners and policy makers.

Keywords

e-Government, TOE, technology, organization, environment, secondary, development, PLS

INTRODUCTION

The role, definition and understanding of e-Government has been evolving in the literature over time. Early researchers conceptualized e-Government more as a technological initiative to use information and communication technologies (ICTs) and the Internet for delivering government services more efficiently (Koh and Prybutok, 2003). Gradually, the focus shifted from a mere improvement in operational efficiency to an opportunity for system reform and government process reengineering (Moon, 2002; Grant and Chau, 2005). In the present day context, e-Government can be defined as the use of ICTs and the Internet to enhance the access to, and delivery of all facets of government services and operations for the benefit of citizens, businesses, employees and other stakeholders.

Research on e-Government has highlighted the multifarious benefits it offers for citizens, businesses and governments. The impact of new technologies in the government sector has not only helped in improving service delivery (West, 2004; Moynihan, 2004; Von Haldenwang, 2004) and increasing democratization (West, 2004; Von Haldenwang, 2004), but has also helped in reducing corruption and increasing government transparency (Von Haldenwang, 2004; Cho and Choi, 2004). Though researchers have realized the positive impacts of e-Government, relatively few studies have investigated the facilitators for e-Government development.

A further review of the literature on e-Government reveals that most of research on e-Government are conceptual in nature (Layne and Lee, 2001; Von Haldenwang, 2004; Kunstelj and Vintar, 2004), case studies of e-Government implementation within particular countries (Moynihan, 2004; Koh et al., 2005; Li, 2003; Heeks, 2002; Srivastava and Teo, 2005; Bannister and Walsh, 2002; Cho and Choi, 2004; Poon and Huang, 2002) and comparative case studies across countries (Lee et al., 2005; Grant and Chau, 2005). Empirical studies on e-Government are relatively few and most of them are limited to analyzing a particular e-Government implementation within a country (Norris and Moon, 2005; Moon, 2002; Reddick, 2004; West, 2004; Ho, 2002). Cross country empirical studies are even fewer. To our knowledge there is no large scale empirical study, involving more than a hundred countries, which aims to understand e-Government development.

To fill these research gaps, using the Technology-Organization-Environment (TOE) framework (Tornatzky and Fleischer, 1990) as the guiding theoretical lens, we analyze the contexts facilitating e-Government development. The TOE framework, which has emerged as a useful theoretical lens for understanding technology adoption, has been mostly used in the context of business firms. Moreover, most TOE studies have used primary survey data. In our study, using secondary data from multiple

sources, we apply the TOE framework in a cross country scenario for understanding the facilitators of e-Government development. In doing so, we extend the applicability of the TOE framework to analyze cross country secondary data.
The rest of the paper is organized as follows. *First*, using the TOE framework as the guiding theory we explicate the contexts necessary for e-Government development to formulate our research model and hypotheses. *Next*, using data from 115 countries, we test the hypotheses so formulated. *Finally*, we end the discussion with a set of conclusions and contributions of this study.

THEORY AND HYPOTHESES

Technology-Organization-Environment (TOE) Framework

The Technology-Organization-Environment (TOE) framework developed by Tornatzky and Fleischer (1990) states that the decision to adopt a technological innovation by a firm is based not only on the technology, but is also dependent on the organizational and environmental contexts. Technological context describes the relevant technologies available to the firm. Organizational context describes some of the organizational characteristics and resources like the quality of its human resource, amount of slack resources, etc. The environmental context consists of the environmental characteristics in which the firm conducts its business. These three contextual factors influence a firm's decision to adopt an innovation, which eventually impacts the firm performance. We extend this theoretical argument to the proliferation of technological innovations at a national level. E-government development is enabled by technological facilitation (Layne and Lee, 2001) and requires a host of enablers which help its adoption and usage (Srivastava and Teo, 2004).

Past IS studies have used the TOE framework in different settings, for example, adoption of complex innovations (Swanson, 1995; Kuan and Chau, 2001), electronic data interchange (Iacovou et al., 1995), e-business value (Zhu et al., 2004), etc. Empirical studies using the TOE framework have found consistent support for the association of all or some of the contextual factors with technology adoption and consequently performance. Most of the studies using TOE framework have focused on technology adoption. Though the TOE framework has been used in various contexts, to our knowledge it has not been used to analyze e-Government development. Moreover most studies applying the TOE framework have used primary survey data. In contrast to this, we use secondary data for our analysis. The use of secondary data enables us to examine the determinants of e-Government development on a global scale, whereas the primary data collection is less feasible as it would entail enormous resources to collect data from 115 countries.

Technological Context

E-Government development is the extent to which the interactive features of the World Wide Web are used to conduct the business of the government (West, 2004; UN Report, 2004; Kunstelj and Vintar, 2004). The presence of a well developed national ICT infrastructure and an overall conducive technological environment appears to be critical for the development of e-Government. In the absence of a sound technological infrastructure, e-Government development will only remain an unrealized dream (Srivastava and Teo, 2004; Von Haldenwang, 2004; Koh,, et al. 2005). Technological development is thus imperative for e-Government development. This leads to the following hypothesis:

Hypothesis 1: The technological development in a country is positively associated with its e-Government development.

Organizational Context

Past studies using the TOE framework have used various organizational factors for the organizational context. These factors included resources (tangible and intangible) which the firm has, like firm size, global reach i.e. market resources, financial resources, human resources etc., (Zhu et al., 2004). Studies on e-Government have stressed the need of national resources for e-Government development. Among these resources citizens' knowledge appears to be a vital resource. Bogaert, Martens and Cauwenbergh (1994) have highlighted that in addition to physical resources, human resource is imperative for organizational development. A sound national human capital has been identified as a major enabler for e-Government as well (Srivastava and Teo, 2004; Von Haldenwang, 2004). Educated and trained citizens are in a better position not only to use but also to be involved in the implementation of e-Government projects by providing useful feedback and suggestions. This leads us to our next hypothesis:

Hypothesis 2: The level of human capital in a country is positively associated with its e-Government development.

Environmental Context

In TOE studies, the impact of various environmental factors on the adoption of technology has been examined (Zhu et al., 2004). Past studies on e-Government have highlighted the importance of environmental factors like 'public institutions' and 'national macroeconomic condition'. Moon (2002) found that the two institutional factors of size and type of government contribute to the adoption of e-Government among municipalities. Norris and Moon (2005) found that e-Government adoption and sophistication were correlated with certain institutional factors. In a similar vein, McNeal et al. (2003) concluded that legislative professionalism and professional networks are associated with extensive use of e-Government. Von Haldenwang (2004) mentioned the importance of having sound institutional base for the development of e-Government. In his discussion on e-Government development, he also mentions that advanced countries with sound macro-economic indicators are more likely to implement and use e-Government. Similarly, West (2004) mentions the importance of 'institutional arrangements' in ensuring e-Government development. Thus the institutional and macro-economic environments appear to have a direct influence on e-Government development.

Hypothesis 3: The state of environment in a country is positively associated with its e-Government development.

The research model for this study is depicted in Figure 1.

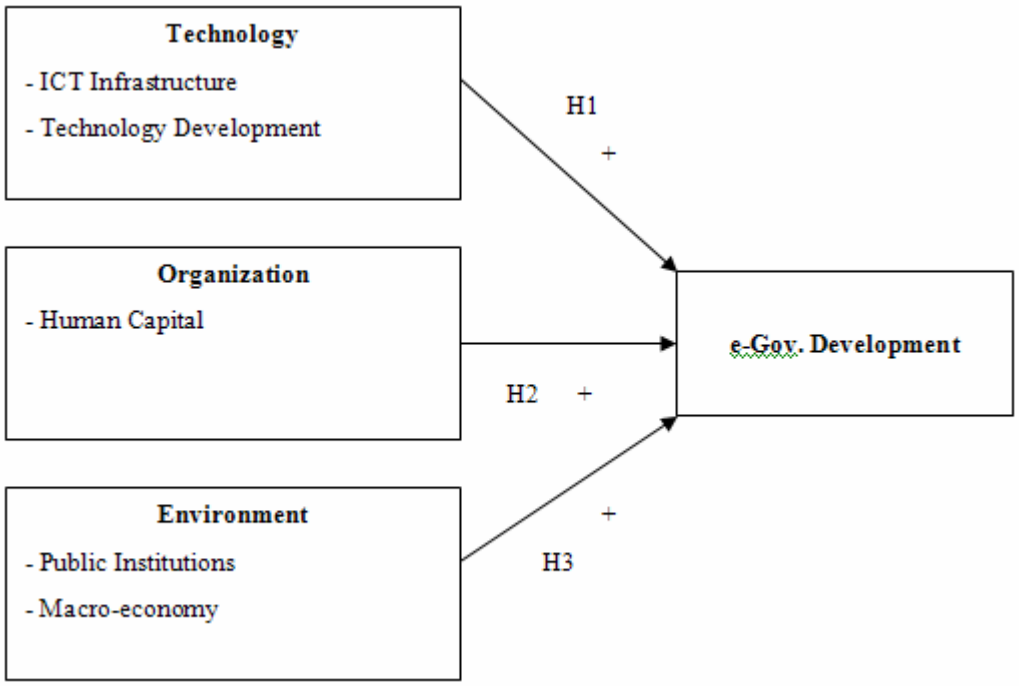

Figure 1. Research Model for e-Government Development based on the TOE Framework

METHOD

Data

For a meaningful testing of hypotheses in this research, we require data from a large number of countries aggregated at the national level. For this purpose, we extracted relevant data from multiple secondary data sources. Secondary data research has the unique advantage of replicability and offers an opportunity to offer generalizable results from a large cross section of the population. In this study, we use two major data sources: the United Nations Global e-Government Readiness Report (UN

Report, 2004) and the World Economic Forum Global Competitiveness Report (WEF, 2005). The data from the UN e-Government readiness report cover 191 countries and data from the Global Competitiveness Report cover 117 countries. As the variables used in this study were taken from both these reports, it was essential to consider data only for those countries that were available in both reports. After analyzing for the common data points across the two reports, we had data from 115 countries for analysis.

Constructs, Variables and Measures

As depicted in our research model (Figure 1), there are four constructs in this study: technology, human capital (organization), environment and e-Government development. We give a brief description of the constructs and measures employed in this study.

Technology

Technology construct is composed of two indicators: the Technology Index[1] from the global competitiveness report and the Telecommunication Infrastructure Index[2] from the UN e-Government readiness report 2004. The Technology Index from the global competitiveness report (WEF, 2005) uses a mix of hard data as well as survey of executives and indicates the state of technological development of the country. The Telecommunication Infrastructure Index is a composite weighted average index of six primary indices based on basic infrastructural indicators, which define a country's ICT infrastructure capacity. These are: PC's/1000 persons; internet users/1000 persons; telephone lines/1000 persons; online population/1000 persons; mobile phones/1000 persons; and TV's/1000 persons (UN Report, 2004). The two indicators capture the level of technological development in a country; hence we have modeled them as reflective indictors for the technology construct.

Organization (Human Capital)

The construct of *human capital* is taken from the UN e-Government readiness report 2004 as the Human Capital Index. The data for the Human Capital Index relies on the UNDP 'education index' which is a composite of the adult literacy rate and the combined primary, secondary and tertiary gross enrolment ratio with two third weight given to adult literacy and one third to gross enrolment ratio (UN Report, 2004).

Environment

The construct of *environment* has two indicators taken from the Global Competitiveness Report 2005. Institutional environment is indicated by the Public Institutions Index[3]. This index is formulated on the two dimensions of public institutions: the execution of contracts and law and the state of corruption in the country. The macro-economic environment is indicated by the Macro-Economic Environment Index[4], which uses a mix of hard data as well as survey of executives and indicates the state of macro-economic condition of the country. It consists of three major components: macro-economic stability, institutional investor country credit rating and government waste variable (WEF 2005). Since the two indicators capture two different aspects of the environment variable: the public institutions environment and the macro-economic environment, we have modeled them as formative indicators for the environment construct.

E-Government Development

The construct of *e-Government development* is indicated by the Web Measure Index from the UN e-Government readiness report 2004. The Web Measure Index is based upon a five-stage model, ascending in nature, and building upon the previous level of sophistication, of a country's online presence. For countries which have established an online presence, the model

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[1]Technology index for core innovators = 1/2 innovation subindex + 1/2 ICT subindex
Technology index for non-core innovators = 1/8 innovation subindex + 3/8 technology transfer subindex + 1/2 ICT subindex

[2] Data for UN Member States were taken primarily from the UN International Telecommunication Union (ITU) and the UN Statistics Division, supplemented by the World Bank. The data across countries was standardized by constructing six separate indices for the indicators.

[3] The public institutions index = ½ contracts and law sub index + ½ corruption sub index.

[4] Macro-economic environment index = ½ macro-economic environment stability sub-index + ¼ country credit rating + ¼ government waste

defines stages of e-readiness according to a scale of progressively sophisticated citizen services (UN Report, 2004). Countries are coded in consonance with what they provide online and the stage of e-Government evolution they are presently in. The five stages of e-Government on which the country websites were coded were based on the UN's five stage e-government evolution model[5] in which the stages are: emerging presence, enhanced presence, interactive presence, transactional presence and networked presence. The Web Measure Index is an indicator of the sophistication and development of the e-Government websites of that particular country. Since all the above indices are well established measures for the constructs they are measuring, they are directly used for our data analysis and hypotheses testing.

DATA ANALYSIS, RESULTS AND DISCUSSION

For our analysis we employed Partial Least Squares (PLS) as it allows for constructs to be modeled as either formative or reflective indicators as was the case in our analysis (Chin, 1998). Also PLS imposes minimal demands in terms of sample size to validate a model compared to alternative structural equation modeling techniques. Many information systems (IS) studies have found it to be an effective method of analysis (Teo et al., 2003; Bock et al., 2005).

Measurement Model

Following the recommendations of researchers like Anderson and Gerbing (1988) and Hair et al. (1998), we conducted a two-stage analytical procedure. In the first stage, the confirmatory factor analysis was conducted to assess the measurement model and then the structural relationships were examined. We used three kinds of validity to validate our model: content validity, convergent validity and discriminant validity. Content validity was ensured by having measurement items based on extant literature. For examining the convergent validity, we assessed the composite reliability and the average variance extracted from the measures as shown in Table 1 (Hair et al., 1998; Chin, 1998).

Measures	Items	Composite Reliability	Average Variance Extracted
Technology	2	0.982	0.964
Environment	2	0.963	0.929

* For variables of Organization (Human Capital) and e-Government development we did not report the composite reliability as they have a single indicator each.

Table 1. Results of Confirmatory Factor Analysis*

From the table, we find that the values for composite reliability are above the conservative value of 0.7 for a reliable construct as recommended by Chin (1998). Also the average variances extracted are above 0.5, which is the recommended cut off value by Fornell and Larcker (1981).

We examined the discriminant validity by looking at the square root of the average variance extracted as shown in Table 2 (Bock et al., 2005; Fornell and Larcker, 1981). The square root of the average variance extracted for each construct is greater than the levels of correlations involving the construct, which indicates discriminant validity.

	Technology	Organization	Environment	e-Gov. Dev.
Technology	0.981			
Organization	0.569	1.000		
Environment	0.890	0.471	0.964	
e-Gov. Dev.	0.798	0.558	0.670	1.000

*The shaded numbers in the diagonal row are square roots of average variance extracted

Table 2. Correlation between Constructs*

[5] The full description of the model is available at http://www.unpan.org/egovernment3.asp .

From Table 2, we observe that one of the correlations between the independent variables of technology and environment is above 0.8; hence we checked for multicollinearity among the variables. The variance inflation factor (VIF) for all the constructs range between 1.595 and 5.068, which are below the value of 10 for multicollinearity problems (Allison, 1999; Belsley et al., 1980). Hence we conclude that there is no significant problem of multicollinearity among the independent variables in our study.

Structural Model

We tested the proposed hypotheses using PLS. The results of analysis are depicted in Figure 2.

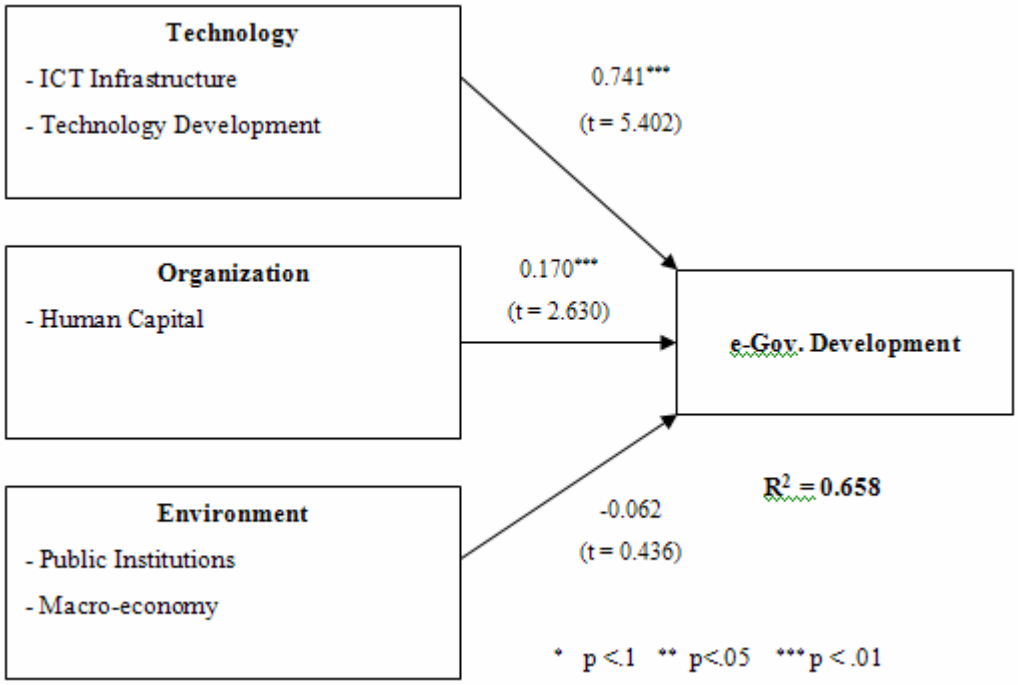

Figure 2. Results of PLS Analysis

From the results, we see that hypothesis 1 which states that there is a positive association between technological development and e-Government development in a nation received strong support ($p<0.01$). Hypothesis 2 which states that human capital is positively associated with the e-Government development also received strong support ($p<0.01$). The third hypothesis which specifies an association between the environment and e-Government development is not supported. The model explains a significant amount of variance (65.8%) in the e-Government development. In general, the results indicate that technology and organization factors play a greater role in facilitating e-Government development than environmental factors. This result is consistent with the previous research in other areas like, Internet adoption (Teo, Tan and Buk, 1997) and strategic use of IT (King and Teo, 1994) which also found technology and organization factors to be more important. However, past research on e-Government has generally found that environmental factors are also important.

Post hoc Analysis

The results from our research do not support hypothesis 3. This finding in the case of e-Government is not in consonance with the past research, which exhibited a positive association of environment with e-Government development. Though none of the past studies investigated the relationship of public institutions or macro-economic environment with e-Government from a cross-country perspective, the results from various studies found consistent association of institutions and macro-economy with e-Government (Moon, 2002; Norris and Moon, 2005; McNeal et al., 2003; Von Haldenwang, 2004; West,

2004). This fact motivated us to further investigate the association of environment with e-Government development in greater detail.

In our initial analysis we had considered environment as a single formative construct consisting of institutional and macro-economic environments. In our post hoc analysis, we split the environment variable into two separate variables of public institutions and macro-economy. The rest of the model remained the same as in the previous analysis. By splitting environment into two separate variables, we aim to have a deeper analysis of the two environmental factors of public institutions and macro-economy. In our post hoc analysis, we found that our measurement model still fulfilled the criteria for content, construct and discriminant validity. The only change was in the correlation among the independent variables as shown in Table 4.

	Technology	**Organization**	**Public Institutions**	**Macro-economy**
Technology				
Human Capital	0.589			
Public Institutions	0.896	0.544		
Macro-economy	0.834	0.548	0.876	
e-Gov. Dev.	0.796	0.648	0.688	0.676

Table 4. Correlation between Constructs: Post hoc Analysis

Since some of the correlations between the independent variables were higher than 0.8, we again tested the variance inflation factor (VIF) for possible problems of multicollinearity. The VIF for all the variables ranged from 1.595 to 5.653, which is below the limit of 10 for multicollinearity problems (Allison, 1999; Belsley et al., 1980). Hence we conclude that there is no significant problem of multicollinearity among the independent variables in our post-hoc analysis. We tested the model for post hoc analysis using PLS in a similar way. The results of the analysis are given in Figure 3.
From the results, we see that this model explains a greater variance (68.9%). Technological development ($p<0.01$) and human capital ($p<0.05$) still remain significantly positively associated with e-Government development. Among the environment variables, public institutions are significantly related to e-Government development but in the negative direction ($p<0.05$).

The relationship between macro-economic environment and e-Government development is not significant.
The negative association of public institutions with e-Government development is an even more interesting result than suggested by the analysis in the previous section which indicated no association between environment and e-Government development. This result suggests that better public institutions may in fact lead to lesser e-Government development. One possible reason for this surprising result is that countries having well established public institutions tend to have a lot of faith in their established systems. This might impart them a sense of satisfaction with the current state of affairs, thereby making their systems rigid as there is less willingness to change to e-Government or make efforts for e-participation. This routine rigidity may help explain the inverse relationship of public institutions with e-participation (Gilbert, 2005).

CONTRIBUTIONS AND CONCLUSIONS

Understanding the facilitators of e-Government development is vital for the effective implementation and administration of e-Government plans (UN Report, 2004; Von Haldenwang, 2004). The dependent variable in our study: e-Government development represents the *capability* of the countries' e-Government websites in terms of their functionality with reference to the five stages of e-Government evolution: emerging presence, enhanced presence, interactive presence, transactional presence and networked presence. Facilitators for this important aspect of e-Government have not been studied in detail in the past literature.

The main limitation of this study is that we use secondary data from different sources. Consequently, we analyze data only from those countries which were present in our secondary data sources, for example, we could not include countries like Hong Kong and Taiwan in our analysis as data for these countries were not available in the UN report. Taking into

consideration the fact that we have large scale data from 115 countries, omitting some of the countries may not make a substantial difference in the results.

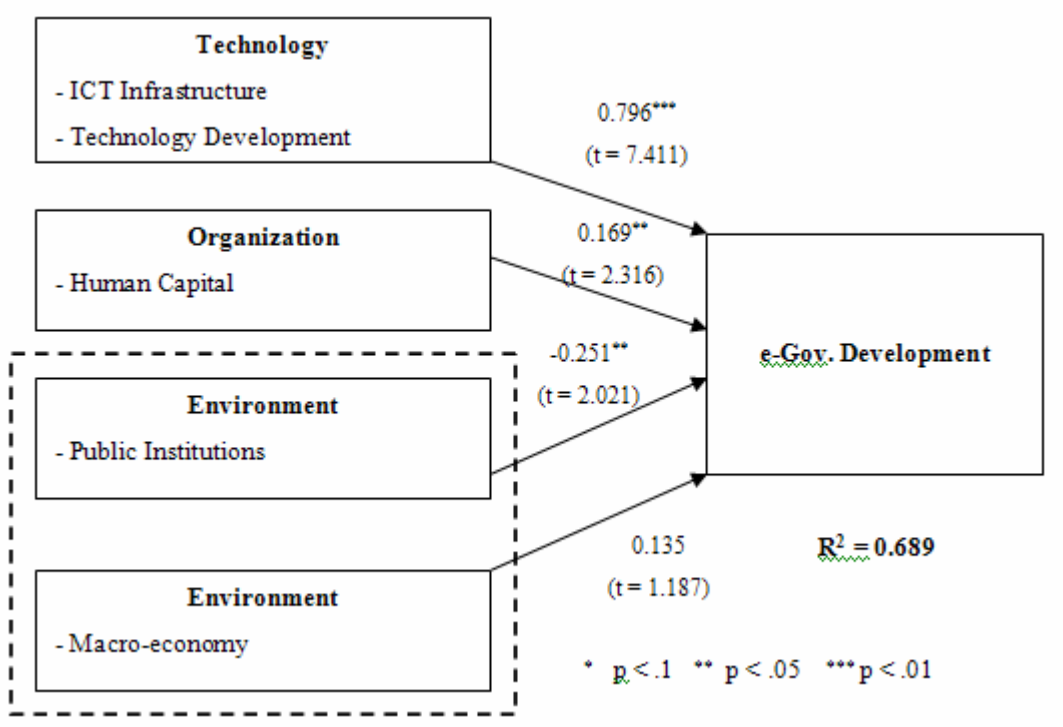

Figure 3. Results of PLS Analysis: Post hoc Analysis

Through this research, we make some important contributions for academics as well as practitioners and policy makers. *First*, most studies on e-Government are either conceptual or case studies. There is a dearth of empirical studies on e-Government (Norris and Moon, 2005). Moreover there are relatively few studies on e-Government which address issues from a global perspective. Further, very few studies on e-Government use secondary data for their analysis. Our empirical study which uses secondary data to analyze e-Government development from a cross-country perspective involving 115 countries fills these gaps in the e-Government literature and makes an important contribution for e-Government research. Future research can make use of other sources of secondary data for better understanding of e-Government from a cross country perspective.

Second, another contribution on the methodological front for the e-Government literature is the use of PLS. This study is one of the first e-Government studies which uses PLS for analyses. Future studies on e-Government, especially with smaller sample sizes can use PLS as it has lesser restrictions of sample size, compared to SEM techniques.

Third, this is the first study that uses the TOE framework in the cross-country perspective for analyzing the development of e-Government at the national level. TOE, which has served as a useful theoretical framework for understanding the adoption and performance of technological innovations and information systems (IS) in the organizational context, is applied and tested in a global context. Moreover past studies using the TOE framework have mostly used primary survey data. In contrast to this we use secondary data for our analysis as it enables us to analyze data from 115 countries.

Fourth, our study suggests that Technological Development and Human Capital are important prerequisites for e-Government development. Our research also shows relatively little or no relationship of environment (institutional and macro-economic) with e-Government development. This finding in a cross country setting is different from the past studies which have shown the importance of institutions and environment for e-Government development in specific countries (Norris and Moon, 2005; McNeal et al., 2003; Von Haldenwang, 2004; West, 2004).

Fifth, post hoc analysis of the relationship of the constituents of the environment variable with e-Government development provides interesting counter-intuitive results. Our analysis reveals that though the relationship between macro-economic environment and e-Government development is not significant, the relationship of public institutions with e-Government development is significant in the negative direction. As already explained, this anomaly may be due to routine rigidity which is due to well established and successful public institutions (Gilbert, 2005). Any change in terms of e-Government interaction may not be so easy to implement in such a situation.

There are very few studies on e-Government which use rich sources of secondary data for cross country studies. Our study is a case in point and exhorts future researchers to use other cross country secondary data sources to make inferences about e-Government from a global perspective. Another aspect that is brought out in our study is the anomalous role of environment (public institutions and macro-economic) on e-Government development. Though we have offered one possible explanation for this anomaly, future research can investigate the role of environment on e-Government in greater detail.

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