Communications of the Association for Information Systems

Volume 20 Article 40

11-13-2007

Country-Level Determinants of E-Government Maturity

Harminder Singh
Michigan State University, singh@bus.msu.edu

Amit Das
Nanyang Technological University

Damien Joseph
Nanyang Technological University

Recommended Citation
Singh, Harminder; Das, Amit; and Joseph, Damien (2007) "Country-Level Determinants of E-Government Maturity," *Communications of the Association for Information Systems*: Vol. 20 , Article 40.
DOI: 10.17705/1CAIS.02040
Available at: https://aisel.aisnet.org/cais/vol20/iss1/40

Communications of the Association for Information Systems

COUNTRY-LEVEL DETERMINANTS OF E-GOVERNMENT MATURITY

Harminder Singh
Michigan State University
singh@bus.msu.edu

Amit Das
Damien Joseph
Nanyang Technological University

ABSTRACT

This paper presents a model of the drivers of e-government maturity. We differentiate "maturity" from "readiness" on the basis that the former refers to demonstrated behavior, while the latter provides an idea of a country's potential to achieve e-government, and argue that maturity is a more accurate measure of a country's realized progress. We investigate the prevalence of affluent countries in many e-government rankings using a model where the relationship between GDP and e-government maturity is mediated by ICT infrastructure, human capital, and governance. Using data from authoritative sources, we find that most of the positive influence of GDP on e-government maturity occurs through ICT infrastructure. More mature e-government, however, does not necessarily reflect better governance; in fact our data show a weak but significant *negative* relationship between e-government maturity and the quality of governance. We suggest plausible explanations for these findings and how the future evolution of e-government might change the observed relationships.

Keywords: e-government maturity, ICT infrastructure, human capital index, governance

I. INTRODUCTION

In recent years, governments have followed corporations in the use of the Internet to connect to their "clientele" - in this case, the citizenry. A mass of evidence, from anecdotes to systematic data, exists to illustrate the rise of e-government, as this phenomenon has been named by observers [Gronlund and Horan 2004]. A recent survey by Lee, Tan, and Trimi [2005] documents the state of e-government practices in different parts of the world, drawing parallels between private-sector e-business initiatives and the use of the Internet by government agencies for operational efficiency, inter-agency coordination, and online interactions with private business and the wider citizenry. Just as the adoption of e-commerce varies widely across countries [Zhu, Xu, and Kraemer 2006], we also find considerable variations in e-government maturity across countries and geographical regions.

The resources needed to monitor developments in e-government in almost 200 countries across the globe have led to cross-country measurement being dominated by consulting firms with global presence (such as Accenture), multilateral organizations such as the United Nations Department of Economic and Social Affairs (UN/DESA), and a few research centers such as the Center for Public Policy at Brown University. These diverse organizations have defined and measured e-

government independently and differently; this paper draws data from multiple sources while acknowledging their differences.

A common thread through these different attempts at measuring e-government efforts (see the Accenture, UN/DESA, and West rankings following in Table 1) is the preponderance of affluent (high GDP per capita) nations in the upper echelons, though some stories exist of creative projects being undertaken in less affluent countries, such as Mongolia's online consultation facility and the Kothmale Community Radio Internet Project in Sri Lanka [UN/DESA 2003a]. This association between GDP and e-government has not gone unnoticed. For example, Lee et al [2005] assert that "developed countries are leading the global phenomenon of e-government."

Table 1. Top Performers in E-Government

Accenture [2005]	**UN/DESA [2005]**	**West [2005]**
1. Canada	1. United States	1. Taiwan
2. United States	2. Denmark	2. Singapore
3. Denmark	3. Sweden	3. United States
4. Singapore	4. United Kingdom	4. Hong Kong
5. Australia	5. South Korea	5. China
6. France	6. Australia	6. Canada
7. Japan	7. Singapore	7. Germany
8. Norway	8. Canada	8. Australia
9. Finland	9. Finland	9. Ireland
10. Netherlands	10. Norway	10. Vatican
11. Sweden	11. Germany	11. United Kingdom
12. United Kingdom	12. Netherlands	12. Bahamas

In this paper, we try to understand why e-government has progressed further in more affluent nations. At one level, it can be argued that e-government demands discretionary investment in information and communication technology (ICT) that poorer nations simply cannot afford to make. While this is certainly a candidate explanation, it is also possible that the growth of e-government depends on other mediating factors such as human capital (especially literacy and education) and the quality of governance (freedom, fairness, and administrative effectiveness). If these factors matter, GDP alone might not be conclusive: countries with similar levels of per-capita GDP might develop e-government to different degrees. For example, a strong link between human capital and e-government maturity would emphasize the role of an active and informed citizenry in *demanding* e-government initiatives, while such a link between the quality of governance and e-government maturity would provide support for the notion that e-government is part of a broader trend toward *better* (i.e. more effective and transparent) government.

Disentangling the observed association between GDP and e-government maturity is thus a step towards better understanding of the e-government phenomenon, from a theoretical as well as practical policy perspective. Knowledge about which drivers of e-government maturity provide the most leverage can guide the allocation of resources directed to e-government, enabling developing nations to identify, prioritize, and act upon the "choke-points" that limit their progress toward e-government.

We emphasize the role of ICT infrastructure and governance in providing the *supply* of e-government, while human capital serves to stimulate the *demand* for e-government in a country. Including both supply and demand factors in our model enables us to estimate the relative contributions of these factors toward achieving maturity in e-government.

II. DEFINING E-GOVERNMENT MATURITY

As governments around the world have become aware of the potential inherent in Internet technologies to simplify, streamline and control the costs of their operations, many of them have introduced national e-government plans detailing their proposed initiatives and the benefits that will accrue from these plans. Examples include Singapore's E-Government Action Plan II, Hong Kong's Digital 21 Strategy, Germany's Deutschland Online and Australia's "Better Services, Better Government" strategy. In the light of this upsurge in activity, various business consulting firms, inter-governmental organizations and academic researchers have examined and assessed the progress of national and state governments in this domain.

Grönlund's [2004] exhaustive review of 170 papers reveals the diversity of e-government research in content as well as methods. Much e-government research has been qualitative in nature, consisting of detailed *case studies* of successful e-government projects, valuable to those who undertake similar initiatives. For example, Devadoss, Pan and Huang [2002] analyze the development of a government e-procurement application using a model based on structuration theory, and develop a classification of factors involved in e-government initiatives. Ke and Wei [2004] trace the development of a single ministry's e-government efforts to highlight how the critical success factors evolved as the ministry went through different stages of reform. Similarly, Golden, Hughes, and Scott [2003] follow the Irish government's "evolutionary path" in e-government, and using the lens of business process transformation, list learning points for other governments.

Such descriptive studies, however, do *not* attempt to assess the comparative success of different governments in realizing the potential of e-government. To that end, an alternative series of research projects, more quantitative in focus, has developed and used various criteria to measure the *performance* of governments. These range from technical indicators (such as the number of Internet connections in a country, or whether the use of digital signatures is established or not) to usage measures (such as how often residents transact with their governments over the Internet, or the number of hits on government Web sites). Some studies also assess how intensively Internet technology is used in a government's internal operations, by looking at aspects such as the percentage of government Web sites that offer at least one online service to citizens [West 2000], the ease of accomplishing a standard task online (by counting the number of departments that need to be visited or the number of forms to be submitted), or the satisfaction of visitors to a government Web site [Steyaert 2004].

Different studies use different measures of e-government activity. Some of this variety reflects different (and evolving) conceptualizations of what e-government *is*. These include:

- the use of the Internet and other digital devices by the public sector to deliver services and information [West 2005];
- the provision by governments of information about their services, as well as the ability to conduct government transactions, via the Internet [Accenture 2004];

- the use of information and communications technology (ICT) to transform a government's internal and external relationships, while maintaining its functions and its responsibility to remain useful, legitimate, transparent and accountable [UN/DESA 2003a]; and
- the use of ICT, particularly the Internet, as a tool to achieve better government [OECD 2003].

Cross-country comparisons of e-government are often undertaken by multilateral organizations or consulting firms. There are at least three reasons why their work is valuable. First, few academics have the global multi-country footprint that such studies require. In contrast, global organizations such as multilateral bodies and consulting firms have offices in most countries and can collect data with relative ease. Second, these global benchmarking reports are updated regularly (usually annually), creating valuable historical data sets. Finally, e-government being an applied field of research, new ideas originate in fields of practice as often as they do in academia. An example is Accenture's now-famous "publish-interact-transact" framework to describe the progress of e-government Web sites.

Flowing out of the varying emphases of the different types of studies are the divergent performance measures crafted to assess "successful" e-government. In this paper, we focus on the *maturity* of e-government in a country, defining it as the extent to which a government has established an online presence [West 2005]. The online presence of governments can be assessed using the features implemented in e-government Web sites. These features include online publications, online databases, the use of audio and video, support for non-native languages or foreign language translation, free (as opposed to paid) access, commercial advertising (a "negative" feature), disability access, a privacy policy, security features, the presence and breadth of online services, support for digital signatures and credit card payments, an e-mail address for questions / concerns, comment forms, provision of automatic email updates, Web site personalization, and access from non-PC devices such as personal digital assistants (PDA) [West 2006].

When we refer to "e-government maturity," we imply a continuum of developmental stages, with some having progressed further than others [West 2006]. This includes:

- the deployment of more advanced features on their Web sites (such as digital signatures, online payments mechanisms and access for the disabled); as well as
- enabling citizens to carry out a larger portion of their interactions with their governments online, be it to change their address when they move, register to vote, or apply for grants for new businesses.

Governments whose Web sites incorporate advanced functionality as well as provide more coverage for more services are considered to be leaders among their peers [Chen 2002]. At the minimum, Chen [2002] suggests, governments should use Web sites as informational devices where information is created and presented to citizens. At the highest level of electronic government, Chen argues that "there is an opportunity for the transformation of practices and services delivered from the government agencies to their constituents. E-voting and e-politics are examples of e-government applications that may significantly alter the conduct of democratic voting and political processes" [Chen 2002, p 224]. We recognize that these initiatives enable not only better service to citizens, but often also demand efficiency and cross-functional integration in the internal operations of government agencies, without which many services cannot be delivered online.

Academic research on e-government has frequently conceptualized maturity using an evolutionary approach [e.g. Layne and Lee 2001; Chen 2002; Moon 2002; Davison, Wagner, and Ma 2005; West 2005; Andersen and Henriksen 2006]. Three main stages are usually identified. First, e-government Web sites start off by publishing information on procedures, and then evolve to offer increasingly complex transactions over time. Next, interaction with the citizenry becomes richer as time passes. Beginning with simple information dissemination or publication,

governments often proceed to engage the governed in two-way discussions on policies and to gather feedback electronically. Such engagement improves support and services to citizens, promotes innovation from citizens and government, and provides the foundation for government reforms [Chen 2002; Hodgkinson 2002]. Finally, government services organized along agency lines are reorganized and integrated to fit a more citizen-centric orientation. Such reorganization might allow a business to apply for all of its licenses (e.g. health, customs, import, export) on a single portal, rather than having to visit the separate Web sites of multiple agencies. This move away from individual silos to shared databases represents a shift in e-government focus from designing the front-end customers' experience to the integration of back-office databases and support services on a standardized infrastructure [Hodgkinson 2002].

West's [2006] measure of e-government maturity captures the first of these three stages very well: the transition from publishing to transactions. Quite a few of West's criteria: databases, security features, and support for digital signatures and credit card payments bear directly on this capability to deliver online services. West's measure also captures some elements of the second stage (interaction with the citizenry): providing an e-mail channel for communications, soliciting comments and feedback, and personalizing Web sites to individual preferences. Indicators of third stage e-government – cross-agency integration – do not feature prominently in West's current measure.

Given the wide variation among countries, transaction capability and citizen interaction appear to be, at this point in time, a relatively level playing field on which e-government can be compared across countries. It is true that some of the advanced nations in America and Europe have moved further into the second and even third stages – electronic democracy and government reform / integration – but the vast majority of countries are still grappling with service delivery and citizen interaction. Of course, having completed most of the work of the first and second stages, advanced nations score well on West's measure and are not penalized.

While our conceptualization of e-government maturity reflects *demonstrated behavior*; there exist other measures that assess the *potential* of a country to carry achieve e-government. A well-known example is the UN's E-Government Readiness Index, which is made up of a Web measure index, a telecommunication infrastructure index, and a human capital index [UN/DESA 2005]. Other measures of e-government potential include the Economist Intelligence Unit's E-Readiness Ranking [EIU 2006] of the e-business environment of countries, and the World Economic Forum's Networked Readiness Index [WEF, 2007]. These latter indices indicate the *capacity* of a country to engage in e-government programs, but do not explicitly address its success in implementing them.[1]

III. DETERMINANTS OF E-GOVERNMENT MATURITY

The objective of this research is to identify the factors that enable countries to attain differing levels of e-government maturity. Noting the preponderance of affluent countries (defined as having high GDP per capita) among the top ranks of e-government, we seek to identify mechanisms through which affluence (higher GDP per capita) might translate into e-government maturity.

To examine what factors might be relevant under each of these categories, we examined prior studies on the diffusion of ICT and the Internet [e.g. Robison and Crenshaw 2001; Caselli and Coleman 2001; Beilock and Dimitrova 2003; Pohjola 2003; Chinn and Fairlie 2006]. The variables examined in these studies include income, human capital (especially, the level of educational

[1] Accenture (2005) also measures e-government maturity using a mixture of qualitative and quantitative methods, but covers only 21 countries. In comparison, the UN/DESA (2005) report on e-government readiness covered 191 countries, but did not examine e-government maturity, the construct of our interest.

attainment), telephone density, industrial development, regulatory / legal quality, political openness and civil liberties, indices of property rights, and openness to imports from OECD countries. For instance, a recent study [Srivastava and Teo 2006] found that ICT infrastructure, human capital, and macro-economic indicators are statistically significant predictors of the UN's e-government potential measure.

It is helpful to distinguish between factors that facilitate the supply of e-government and those that stimulate the demand for e-government in a country. The numerous factors identified in the above search were classified into three main constructs for this study: physical ICT infrastructure, human capital and the quality of governance. Of these, ICT infrastructure and governance provide the supply of e-government, while human capital serves to stimulate the demand for e-government in a country.

The maturity of e-government in a country can be reasonably expected to depend on the state of the ICT infrastructure, because such infrastructure limits the proportion of the citizenry that can be served by e-government services. Countries with higher per-capita GDP are in a better position to afford pervasive, high-quality physical ICT infrastructure. With enhanced levels of ICT access, citizens are more likely to conduct their affairs online. When this happens, governments find it easier to move more of their transactions to the Internet and away from face-to-face counters, facilitating the transfer of their resources away from traditional channels of interaction with their citizens. Over time, this change in the composition of interactions helps to realize the hoped-for savings, setting up a sort of virtuous cycle (positive feedback) that justifies further investment in e-government.

Furthermore, the quality of the infrastructure also constrains the nature of the applications that can be deployed for e-government. The bandwidth available to household Internet users limits the use of rich media (sound and video clips) on e-government Web sites. Without reliable connections, transaction capability, if built at all, is unlikely to be used. An example of transaction capability is electronic payments, since cost recovery (if not profit) is a priority for most public service managers. Achieving high quality in a country-wide ICT infrastructure is clearly investment-intensive, and this is likely to be one reason why more affluent countries have an advantage in e-government. In terms of our research model, we expect the ICT infrastructure of a country to mediate the relation between GDP and e-government maturity.

The development of e-government in a country is also likely to depend upon the level of human capital – specifically, the literacy and education level of the population.[2] Literacy here refers to the percentage of adult citizens who can read and write with understanding, while education refers to the proportion of the school-going age population that is enrolled in primary, secondary or tertiary educational institutions. E-government services, to the extent that they use mainly text-based communication, assume a high level of literacy. Jaeger [2003] summarizes a number of earlier studies that show the link between education and Internet use. Better educated citizens not only take up online e-government services when they are offered, but exhort more government agencies to go online. Observers have remarked that the spread of e-commerce has led a significant portion of people to expect similar levels and types of services from their governments [IBM, undated]. This segment of the population comprises the better educated and higher-earning citizens of a country, since they are the ones more likely to be online. West [2004] confirms that users of e-government Web sites tend to be young males with high education and income.

Once again, the development of literacy and education in a country demands adequate investment in education, so we postulate a positive relation between per-capita GDP and human capital, and a similar relation between human capital and e-government maturity. Human capital,

[2] Moon et al (2005) identify the full Human Development Index as a "push" factor for e-government. We use only the literacy and education components of the HDI in our measure, as they (rather than health and life expectancy) are more directly related to e-government.

we argue, is thus another pathway (in addition to the ICT infrastructure described above) through which affluent countries achieve leadership in e-government.

Given that e-government is essentially the embedding of digital technology in the thoroughly social process of governing a country, we expect that the e-government maturity of a nation would depend on how it is governed [West 2005]. Our third and final candidate for mediating the relation between per-capita GDP and e-government maturity is the quality of governance. E-government can deliver services to citizens who might otherwise find it difficult or inconvenient to access them. Additionally, e-government also provides a way for the government to engage citizens (for consultation, feedback, or dialogue) who might have earlier shied away from participation due to concerns about public visibility. This potential of e-government to serve citizens better and include them into the process of administration and policy-making is more likely to be realized in nations with stable governments that enact and enforce quality laws in the public interest. Furthermore, since e-government increases the visibility of policies and procedures [Michael and Bates 2005], governments striving for greater credibility, transparency and accountability to their citizens are more likely to undertake e-government initiatives.

E-government also presumes a strong, efficient state ex-ante [Ciborra and Navarra 2004]: the presence of government instability, pervasive corruption, arbitrary rule, a voiceless citizenry, and an ineffective government mandate make it unlikely for e-government to progress beyond basic information publishing (mainly propaganda). Such factors provide an unfavorable environment for active and useful participation by citizens in the running of a government, since fundamental ground rules, such as whether government policies will be carried out as laid down, whether official sources of information are accurate and unbiased, and whether long-term plans should be taken seriously, are not firmly established. The possibility that e-government might render administration and political decision-making more transparent [Watson and Mundy 2001] suggests that institutions favoring poor governance might actually resist the growth of e-government.

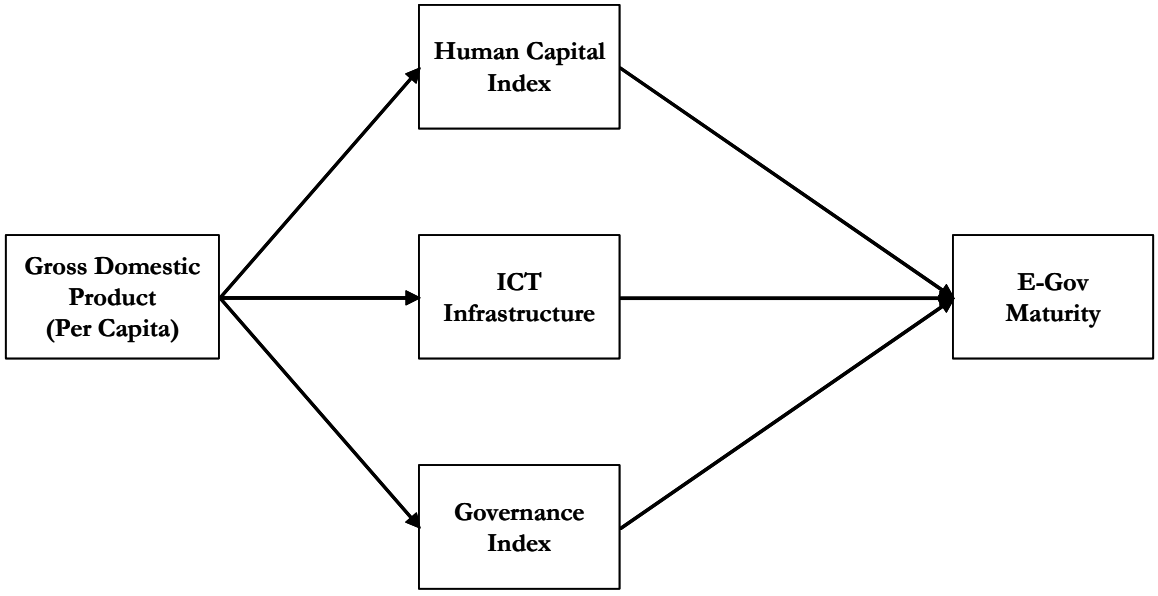


Figure 1. Research Model of E-Government Maturity

Good governance (stability, accountability, freedom from corruption) is also often associated with affluent countries. With rising prosperity, citizens become aware that engaging in corrupt practices or disobeying the rule of law endangers their overall well-being. At the same time, governments understand that high-quality regulations and a stable, consultative political regime

are the best options for maintaining affluence. Independent research by McNeal et al. [2003] confirms that increasing professionalization and closer links with businesses make legislators more likely to adopt e-government. This third mediator between per-capita GDP and e-government maturity, the quality of governance, completes our theoretical model.[3]

To sum up, we hypothesize that higher GDP per capita is associated with greater maturity of e-government, and that this association operates through three distinct pathways: technological infrastructure, human capital and quality of governance. The development of each of these factors presupposes a high level of GDP (three hypotheses), while each factor, in turn, can enhance e-government maturity (three more hypotheses).

MEASUREMENT

Our measure of e-government maturity is obtained from West [2006]. Given our interpretation of e-government maturity as demonstrated behaviors rather than just potential, West's measure is the most thorough quantitative report that matches our requirements.

West and his associates examined 1,782 government Web sites from 198 nations during the summer of 2006. Included among them were the sites of the executive, legislative, and judicial branches of government, and sites of cabinet offices and key agencies serving important functions, such as health, taxation, education, interior, economic development, administration, tourism, transportation, military, and business regulation. Web sites for sub-national units and local/regional/municipal government units were not included in their study.

Based on a comprehensive examination of the characteristics of government Web sites, West and his colleagues at Brown University scored countries on a maximum of 100 points. These characteristics include online publications, online databases, the use of audio and video, support for non-native languages or foreign language translation, free access (as opposed to paid access, a "negative" feature), commercial advertising (another negative feature), access for the disabled, privacy policy, security features, the presence and breadth of online services, support for digital signatures and credit card payments, an e-mail address for questions / concerns, comment forms, provision of automatic e-mail updates, Web site personalization, and access from non-PC devices such as personal digital assistants (PDA) [West 2006]. Non-English Web sites were translated by foreign language readers.

In terms of our independent variables, the per-capita PPP adjusted GDP figures (at current prices) are drawn from the International Monetary Fund's World Economic Outlook database – April 2007 edition [IMF 2007].

The quality of physical ICT infrastructure is a weighted index (we named it "*TECH*") between zero and 1 based on six underlying indices: PCs/1000 persons, Internet users/1000 persons, telephone lines/1000 persons, online population, mobile phones/1000 persons, and TVs/1000 persons. The measure was adopted from the *Global E-Government Readiness Report 2005* published by the United Nations Department of Economic and Social Affairs [UN/DESA 2005], who constructed the index using 2005 data from the International Telecommunication Union (ITU) and the UN Statistics Division, supplemented by the World Bank. Reflecting the mix of technologies currently utilized by most e-government applications, the ICT infrastructure index is computed as

Infrastructure Index = 1/5 (PC index) + 1/5 (Internet user index)

+ 1/5 (Telephone line index) + 1/5 (On-line population index)

[3] We ruled out a direct relation between human capital and governance (in addition to the shared antecedent, GDP), because such links have little basis in the literature (Acemoglu et al. 2005).

+ 1/10 (Mobile user index) + 1/10 (TV index).

The data for the Human Capital Index (we named it "*HCI*") were derived from the same UN/DESA [2005] report as *TECH* above and relies on the UN Development Report's "education index." This is a combination of the adult literacy rate (defined as the percentage of people above age 15 who can read and write with understanding a short statement on their everyday life) and the combined gross enrolment ratio of primary, secondary and tertiary schools in a country. The latter refers to the percentage of school-age population enrolled in any educational institution, and contributes one-third of the final *HCI* measure, with the remaining two-thirds coming from the adult literacy rate. The *HCI* Index ranges from zero to 1.

For our final independent variable, the quality of governance (we named this one "*GOVINDEX*"), we used the governance indicators developed by Kaufmann, Kraay, and Mastruzzi [2005]. These indicators are aggregated from more than two hundred variables, collected from 25 separate data sources created by 18 different organizations, such as Freedom House, the Economist Intelligence Unit and the U.S. State Department. Kaufmann et al define governance broadly as the traditions and institutions by which authority in a country is exercised, and, based on this, cluster the indicators into six components using an unobserved components model. The dimensions of governance they arrive at are: Voice and Accountability, Political Stability, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption. Across all countries, *GOVINDEX* is normally distributed with a mean of zero and a standard deviation of one. Virtually all scores fall between -2.5 and +2.5, with higher scores corresponding to better governance.[4]

DATA ANALYSIS

Given the links from GDP to TECH, HCI, and GOVINDEX, and those from the three variables to e-government maturity, we selected the method of path analysis. Path analysis is a generalization of the popular multiple regression technique, and is appropriate when each construct in a model is measured by a single indicator (latent variables would call for full-blown structural equation modeling, SEM). As with SEM, path analysis attempts to decompose the associations among constructs into component paths, in such a way that the matrix of correlations between model constructs as implied by the path model matches the original correlation matrix as closely as possible.

We use partial least squares (PLS) regression to assess the fit of our data to the theoretical model shown in Figure 1 [Chin 1998; Hulland 1999]. Compared to other ways of estimating path models, the partial least squares approach places fewer demands on sample size and residual distributions [Barclay, Higgins, and Thompson 1995; Gefen, Straub, and Boudreau 2000]. In this sense, our estimation technique is relatively robust to violations of multivariate normality and other demanding assumptions.

We removed 14 countries from our sample due to missing values on one or more variables. The remaining 178 countries in the dataset were examined for outliers and for violations of assumptions of multivariate analysis[5]. We standardized all of our variables to reduce the multi-collinearity. This helped us to keep the maximum condition index and variance inflation factors of the variables in the model at 13 and 7 respectively, well below the acceptable threshold values of 30 and 10 respectively [Hair et al. 1995]. Finally, the Durbin-Watson test for first-order

[4] The details on these sources and how they have been assigned are available at www.worldbank.org/wbi/governance.

[5] Given the steep rise in the e-government maturity rating for South Korea in 2006, we estimated our model with and without this country. We got the same results both times, confirming that South Korea is NOT an "influential observation" in our data set.

autocorrelation in the residuals confirms that there is no autocorrelation at all (Durbin-Watson test statistic d = 2.00).

We used the PLS-Graph 3.0 [Chin 2001] software to conduct partial least squares estimation of our path model. The path coefficients obtained can be interpreted exactly like standardized regression coefficients (β). Assessing the statistical significance of the path coefficients (i.e. whether they depart significantly from zero) requires an estimate of the standard error for each coefficient. These standard errors are computed using a jackknife procedure with sampling size of one [Barclay, et al. 1995] – withholding one case at a time and calculating the error between its observed value and that predicted by the model estimated using all other cases. Once the standard error estimates are available, assessing the statistical significance of the path coefficients is a routine lookup of the *t* distribution. The predictive power of a structural model is evaluated in terms of the variance explained in the dependent construct. These values are interpreted in the same manner as the R^2 obtained from regression analysis [Barclay, et al. 1995].

RESULTS

The bivariate correlations among our five variables – GDP, *HCI*, *TECH*, *GOVINDEX*, and e-government maturity – are presented in Table 2.

Table 2. Descriptive Statistics and Correlations*

Constructs	Mean	SD	1	2	3	4
1. E-Government Maturity	27.52	7.04	1.000			
2. Human Capital Index	0.75	0.22	0.495	1.000		
3. ICT infrastructure	0.18	0.21	0.656	0.586	1.000	
4. Governance Index	-0.06	0.90	0.457	0.514	0.844	1.000
5. Gross Domestic Product ($ Per Capita)	11,074.57	11,659.37	0.595	0.542	0.865	0.745

N=178. * All correlations are significant at p<0.001

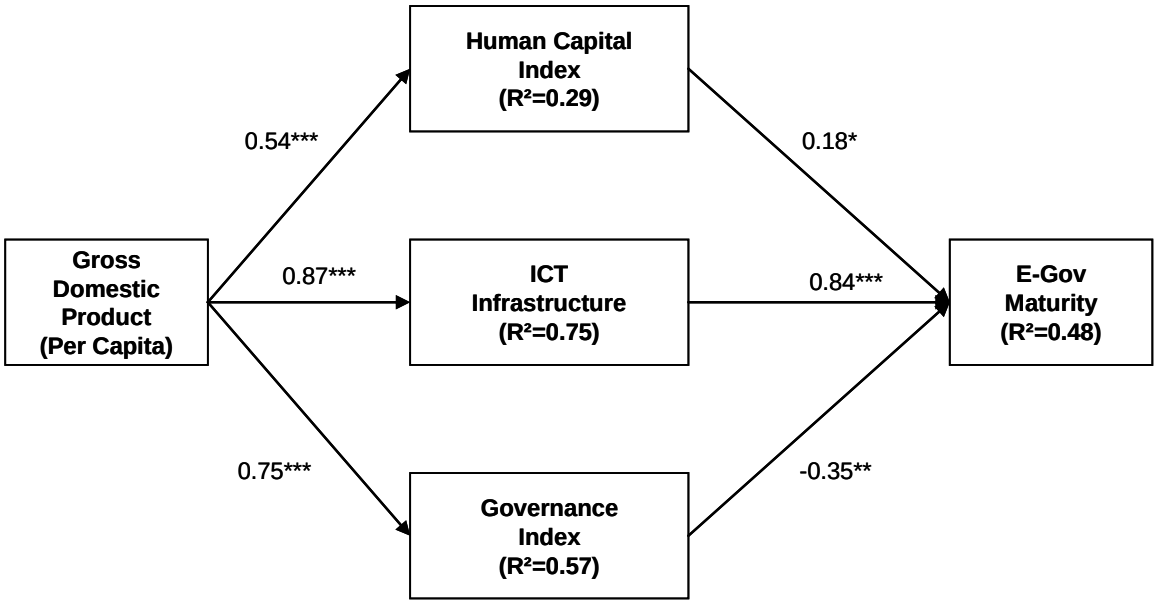
PATH MODEL

As shown in Figure 2 following, about half (48 percent) of the variation in e-government maturity among countries is explained by ICT infrastructure, human capital index, and governance index. In turn, variations in GDP explain 29 percent of the variance in human capital index, 75 percent of the variance in ICT infrastructure, and 57 percent of the variance in the governance index.

We also examine the size, sign and statistical significance of the path coefficients between the constructs. Figure 2 also shows the coefficients and their statistical significance.

As hypothesized, per-capita GDP is significantly and positively associated with the human capital index (β=0.542; t=7.572, p<0.001), ICT infrastructure (β=0.865; t=17.236, p<0.001) and governance index (β=0.754; t=13.838, p<0.001). In turn, the human capital index (β=0.178; t=2.009, p<0.05) and ICT infrastructure (β=0.844; t=4.514, p<0.001) are significantly, and positively, associated with e-government maturity. In contrast, the governance index is significantly, and *negatively* associated with e-government maturity (β=-0.347; t=2.539, p<0.01).

In summary, we find mixed support for our theorized model. Specifically, we find strong support for the mediating role of ICT infrastructure, but no evidence that good governance is needed to achieve e-government maturity. Human capital provides a relatively weaker positive link between GDP and e-government maturity. The implications of these results are discussed in the next section.



* p<0.05; ** p<0.01; *** p<0.001.

Figure 2. Path Model of the Antecedents of E-Government Maturity

IV. CONCLUSIONS

Statistical analysis suggests that the main pathway through which per-capita GDP enhances e-government maturity is ICT infrastructure (*TECH*). Our data support the notion that the better infrastructure of affluent nations puts them at an advantage with respect to maturity of e-government. Human capital is positively associated with per-capita GDP (as expected), but the strength of this pathway is relatively low. Interestingly, the link between governance and e-government maturity is negative, showing that there is no necessary connection between good governance and e-government maturity.

One possible explanation behind the observed pattern of results (the significance of ICT infrastructure, and the negative relation with governance) is that e-government is currently constrained by the newness of information technology. Leading-edge technology costs money, and confers benefits to those who can afford it. As the technologies used to implement e-government become more commonplace and affordable, the primary mediating role of ICT infrastructure may be weakened and the other mediators might gain in influence.

As e-government matures further and the citizens' role progresses from passive consumption of service to active consultation and involvement in policy-making, we think the link from human capital to e-government maturity will gain in strength. The variation in human capital across countries might then lead to corresponding variations in e-government maturity. It is interesting that human capital depends only weakly on GDP (R^2=0.29), suggesting that even low-GDP countries might have opportunities to improve their human capital index.

The focus on citizens as consumers is also a primary suspect for the negative relationship between the quality of governance and e-government maturity as measured by West (2006). E-government that focuses primarily on service delivery does not make serious demands on the participation of its citizens, as long as they are willing to consume e-services. Though we should not make too much of the negative relation between governance and e-government maturity on the basis of a single study, it is tempting to speculate that accountability limits the latitude

available to governments in spending public money on e-government projects that might only benefit a segment of the tax-paying population.

Chadwick and May [2003] lament that the "managerial" model of e-government has pushed out the "consultative" and "participatory" alternatives: our results provide some support for their gloomy prognosis. It is worth noting that consultative and participatory intent is not easily realized; Jaeger [2006] shows that the ability of U.S. and UK e-government sites to foster democratic dialogue has been, at best, limited, promoting more polarization than participation. At this time, the dream of democratization through e-government appears largely unfulfilled.

LIMITATIONS

The limitations of this study are rooted mainly in the measurement of e-government maturity. Although the proliferation of measures in the early 2000s appears to have stabilized somewhat, there is still a lack of consensus on what constitutes a defensible measure that can be used to fairly assess the e-government efforts of countries. Three issues deserve particular mention.

First, given the relative ambiguity of goals in public organizations, public sector managers use diverse measures to evaluate similar concepts, and their actions often depend on their choice of measures [Nicholson-Crotty, Theobald, and Nicholson-Crotty 2006]. Given that e-government, as an exercise in public administration, encompasses at least three distinct goals – service delivery, citizen involvement, and government reform/integration – it is possible that different countries consciously set their priorities differently. For example, if a country decides to invest more in back-office integration, or in a national campaign to educate citizens on the value of e-government, it might have less to spend on other items that might have boosted their West index. The investigation of such decision processes requires the use of qualitative techniques such as in-depth interviews with decision-makers, probing them particularly on how and why they made particular trade-offs.

The second issue related to measurement is that usage and usability might not be the only indicators to assess e-government quality. For example, a key outcome that many governments are keen to achieve is trust [Tolbert and Mossberger 2006]. Since trust in government can be divided into process-based and institution-based trust, both (especially the latter) depend critically on a government's track record well beyond the e-government domain. Measurement of e-government might need to be embedded in the broader context of citizen-government relations.

The final problem with measuring e-government is that it is difficult to relate improvements in e-government to corresponding improvements in the lives of citizens of a country. Citizens are a heterogeneous lot: some of them might (legitimately) hold perceptions and expectations different from the government [Yang and Holzer 2006]. Governments themselves are not monolithic either; different agencies display different attitudes and competencies in embracing e-government. Depending on which agencies citizens are exposed to, their assessment of e-government efforts might differ significantly. Thus measuring actual improvements in citizens' lives requires evaluation skills at different levels and is fraught with many of the traditional challenges facing public sector managers.

FUTURE DIRECTIONS

To summarize, we find that, circa 2006, it is still possible to attain maturity in e-government (in the sense of functionality and scope) through technical sophistication and some degree of human capital, without corresponding advances in the area of governance. We hope that this will change in the future, as citizen participation and government reform / integration become the foci of the e-government agenda. As Flak and Rose [2005] note, the ultimate success of e-government depends on the satisfaction of multiple stakeholders beyond merely government agencies and technology providers. As e-government grows to include government reform as a key goal in addition to service delivery and citizen participation, and measures are developed to reflect all

three goals, we plan to reevaluate our model: perhaps human capital and governance will play a bigger role the e-government maturity of nations.

We also hope to extend our cross-sectional study to a longitudinal (panel) design, thanks to the data being systematically accumulated by researchers of e-government and economic development. Already, relatively complete data (on GDP, human capital, ICT infrastructure, and governance) for most countries are available for a five-year period; we hope to use this data to examine issues of temporal precedence (leads/lags between independent and dependent variables), as well as the evolution of e-government as a function of the levels and trends in the independent variables.

Editor's Note: This article was received on July 3, 2006. It was with the authors six months for one revision.

REFERENCES

Editor's Note: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the paper on the Web, can gain direct access to these linked references. Readers are warned, however, that:

1. These links existed as of the date of publication but are not guaranteed to be working thereafter.

2. The contents of Web pages may change over time. Where version information is provided in the References, different versions may not contain the information or the conclusions referenced.

3. The author(s) of the Web pages, not AIS, is (are) responsible for the accuracy of their content.

4. The author(s) of this article, not AIS, is (are) responsible for the accuracy of the URL and version information.

Accenture Consulting. (2004). "eGovernment Leadership: High Performance, Maximum Value." *The Government Executive Series*, May 2004, http://www.accenture.com/NR/rdonlyres/D7206199-C3D4-4CB4-A7D8-846C94287890/0/gove_egov_value.pdf (Accessed October 5, 2007)

Accenture Consulting. (2005). "Leadership in Customer Service: New Expectations, New Experiences." *The Government Executive Series*, April 2005, http://www.accenture.com/NR/rdonlyres/F45CE4C8-9330-4450-BB4A-AF4E265C88D4/0/leadership_cust.pdf (Accessed October 5, 2007)

Acemoglu D., S. Johnson, J. A. Robinson, and P. Yared. (2005). "From Education to Democracy?" *American Economic Review*, 95(2), pp. 44-49.

Andersen, K. V. and H. Z. Henriksen. (2006). "E-Government Maturity Models: Extension of the Layne and Lee Model," *Government Information Quarterly*, 23(2): pp. 236-248.

Barclay, D., C. Higgins, and R. Thompson. (1995). "The Partial Least Squares (PLS) Approach to Causal Modeling, Personal Computer Adoption and Use as An Illustration," *Technology Studies*, 2(2), pp. 285-309.

Beilock, R. and D. V. Dimitrova. (2003). "An Exploratory Model of Inter-Country Internet Diffusion," *Telecommunications Policy,* 27(3-4): pp. 237-252.

Caselli, F. and W. J. Coleman. (2001). "Cross-Country Technology Diffusion: The Case of Computers," Cambridge, MA, National Bureau of Economic Research.

Chadwick, A. and C. May. (2003). "Interactions between States and Citizens in the Age of the Internet: 'e-Government' in the United States, Britain and the European Union," *Governance: An International Journal of Policy, Administration and Institutions*, 16(2), pp. 271-300.

Chen, H. (2002). "Digital Government: Technologies and Practices," *Decision Support Systems*, 34(3):pp. 223-227.

Chin, W. (2001). "PLS-Graph 3.0," Soft Modeling Inc.

Chin, W. (1998). "Issues and Opinion on Structural Equation Modeling," *MIS Quarterly*, 22(1), pp. 7-16.

Chinn, M. D. and R. W. Fairlie. (2006). "ICT Use in the Developing World: An Analysis of Differences in Computer and Internet Penetration," NET Institute Working Paper No. 06-03. http://ssrn.com/abstract=936474. January 12, 2006

Ciborra, C. and D. Navarra. (2003). "Good Governance and Development Aid: Risks and Challenges of E-Government in Jordan," Paper presented at the IFIP WG 8.2 - WG 9.4 Conference, Athens, Greece.

Davison, R. M., C. Wagner, and L. C. K. Ma. (2005). "From Government to eGovernment: A Transition Model," *Information Technology & People*, 18(3), pp. 280-299.

Devadoss, P. R., S. L. Pan, and J. C. Huang. (2002). "Structurational Analysis of e-Government Initiatives: a Case Study of SCO," *Decision Support Systems,* 34, pp. 253-269.

Economist Intelligence Unit (EIU) and IBM Institute for Business Value. (2006). *The 2006 E-Readiness Rankings*. London: Economist Intelligence Unit, http://www.eiu.com/site_info.asp?info_name=eiu_2006_e_readiness_rankings&rf=0 (Accessed October 5, 2007).

Flak, L. S. and J. Rose. (2005). "Stakeholder Governance: Adapting stakeholder theory to e-Government," *Communications of the Association for Information Systems*, 16, pp. 642-664.

Gefen, D., D. Straub, and M.-C. Boudreau. (2000). "Structural Equation Modeling and Regression: Guidelines for Research Practice," *Communications of the Association for Information Systems*, 4, pp. 1-77.

Golden, W., M. Hughes, and M. Scott. (2003). "The Role of Process Evolution in Achieving Citizen-Centered E-Government," Paper presented at the Ninth Americas Conference on Information Systems, Tampa, Florida.

Grönlund, A. (2004). "State of the Art in E-Gov Research: A Survey," in R. Traunmüller (ed.) *Proceedings of EGOV 2004,* Lecture Notes in Computer Science, Vol. 3183, Berlin: Springer-Verlag, pp. 178 - 185

Grönlund, A. and T. A. Horan. (2004). "Introducing e-Gov: History, Definitions, and Issues," *Communications of the Association for Information Systems,* 15, pp. 713 -729.

Hair, J. F., Jr., R. E. Anderson, R. L. Tatham, and W. C. Black. (1995). *Multivariate Data Analysis with Readings, 4th ed.* Englewood Cliffs, NJ: Prentice Hall.

Hodgkinson, S. (2002). "Managing an eGovernment Transformation Program," Presentation at the 'Working Towards Whole-of-Government Online' Conference, Canberra, Australia.

Hulland, J. (1999). "Use of Partial Least Squares (PLS) In Strategic Management Research: A Review of Four Recent Studies," *Strategic Management Journal*, 20, pp. 195-204.

IBM Global Services (no date). "Laying the Foundation for More Effective Government: How IT Infrastructure Plays a Transformational Role in Improving Service, Effectiveness and

Efficiency," http://www-935.ibm.com/services/au/igs/pdf/g510-3840-laying-foundation-effective-government.pdf ; April 08, 2007.

International Monetary Fund. (2007). "World Economic and Financial Surveys," World Economic Outlook Database, April 2007 Edition. http://www.imf.org/external/pubs/ft/weo/2007/01/data/index.aspx ; April 20, 2007.

Jaeger, P. T. (2003). "The Endless Wire: E-Government as Global Phenomenon," *Government Information Quarterly*, 20 (2003), pp. 323–331.

Jaeger, P. T. (2006). "Deliberative Democracy and the Conceptual Foundations of Electronic Government," *Government Information Quarterly*, 22, pp. 702–719.

Kaufmann, D., A. Kraay, and M. Mastruzzi. (2006). "Governance Matters V: Governance Indicators for 1996–2005," (September 2006). Available at SSRN: http://ssrn.com/abstract=929549.

Ke, W. and K. K. Wei. (2004). "Successful E-Government in Singapore," *Communications of the ACM,* 47(6), pp. 95-99.

Lee, S. M., X. Tan, and S. Trimi. (2005). "Current Practices of Leading e-Government Countries," *Communications of the ACM,* 48(10), pp. 99-104.

McNeal, R. S., C. J. Tolbert, K. Mossberger, and L. J. Dotterweich. (2003). "Innovating in Digital Government in the American States," *Social Science Quarterly*, 84(1), pp. 52-70.

Michael, B. and M. Bates. (2003). "Assessing International Fiscal and Monetary Transparency: The Role of Standards, Knowledge Management and Project Design," *International Journal of Public Administration*, 6(2).

Moon, M. J. (2002). "The Evolution of E-Government among Municipalities: Rhetoric or Reality?" *Public Administration Review*, 62(4), 424–433.

Moon, M. J., E. W. Welch, and W. Wong. (2005). "What Drives Global E-Governance: An Exploratory Study at the Macro Level," Proceedings of the 38th Hawaii International Conference on System Sciences, pp. 1-10.

Nicholson-Crotty, S., N. A. Theobald, and J. Nicholson-Crotty. (2006). "Disparate Measures: Public Managers and Performance-Measurement Strategies," *Public Administration Review*, 66 (1), pp. 101–113.

Organisation for Economic Cooperation and Development (OECD). (2003). *The e-Government Imperative: 2003*. Paris, France: OECD, http://webdomino1.oecd.org/COMNET/PUM/egovproweb.nsf/viewHtml/index/$FILE/E-Government%20Imperative%20Final().pdf (Accessed October 5, 2007).

Pohjola, M. (2003). "The Adoption and Diffusion of ICT across Countries: Patterns and Determinants," Chapter 4 in D. C. Jones (Ed.) *The New Economy Handbook*, Elsevier Science and Technology Books, Amsterdam, Netherlands.

Robison, K. K. and E. M. Crenshaw. (2001). "Post-Industrial Transformations and Cyber-Space: A Cross-National Analysis of Internet Development," Columbus, OH, The Ohio State University.

Srivastava, S. and T. S. H. Teo. (2006). "Antecedents of E-Government Development and E-Participation: A Global Perspective,". Paper presented at the 66th Academy of Management Meeting, Atlanta, Georgia.

Steyaert, J. C. (2004). "Measuring the Performance of Electronic Government Services," *Information and Management*, 41, pp. 369-375.

Tolbert, C. J. and K. Mossberger. (2006) "The Effects of E-Government on Trust and Confidence in Government," *Public Administration Review*, 66 (3), pp. 354–369.

United Nations Department of Economic and Social Affairs (UN/DESA). (2003a). "E-Government at the Crossroads," *World Public Sector Report 2003*

United Nations Department of Economic and Social Affairs (UN/DESA). (2003b). *UN Global eGovernment Survey 2003*. New York: United Nations, http://unpan1.un.org/intradoc/groups/public/documents/un/unpan016066.pdf (Accessed October 5, 2007).

United Nations Department of Economic and Social Affairs (UN/DESA). (2005). *Global e-Government Readiness Report 2005: From E-Government to E-Inclusion.* New York: United Nations.

Watson, R. T. and B. Mundy. (2001). "A Strategic Perspective of Electronic Democracy," *Communications of the ACM*, 44(1), pp. 27-30.

West, D. M. (2000). "Assessing E-Government: The Internet, Democracy, and Service Delivery by State and Federal Governments," http://www.insidepolitics.org/egovtreport00.html; April 5, 2007

West, D. M. (2003). "Global E-Government, 2003," http://www.insidepolitics.org/egovt03int.pdf; August 17, 2004.

West, D. M. (2004). "E-Government and the Transformation of Service Delivery and Citizen Attitudes," *Public Administration Review*, 64(1), pp. 15-27.

West, D. M. (2005). *Digital Government*, Princeton University Press.

West D. M. (2006). "Global E-Government 2006," http://www.insidepolitics.org/egovt06int.pdf; April 5, 2007.

World Bank. (2006). *World Development Indicators 2006*. International Bank for Reconstruction and Development/The World Bank, Washington, D.C.

World Economic Forum (WEF). (2007). *Global Information Technology Report 2006-2007*.

World Markets Research Centre. (2001). *Global E-Government Survey 2001.*

Yang, K. and M. Holzer. (2006). "The Performance-Trust Link: Implications for Performance Measurement," *Public Administration Review,* 66 (1), pp. 114–126.

Zhu, K., S. Xu, and K. L. Kraemer. (2006). "The Global Diffusion and Convergence of E-Commerce," in Kraemer K. L., J. Dedrick, N. Melville and K. Zhu, (eds) *Global E-Commerce: Impacts of National Environments and Policy*, Cambridge University Press (in press).

ABOUT THE AUTHORS

Harminder Singh is a doctoral student in Information Technology Management at Michigan State University. His research interests are the improvement of process models, firm-specific determinants of IT investment, and e-government development. He has presented his research at the International Conference on Information Systems, the Academy of Management Annual Meetings, and the Mid-West Association for Information Systems Conference. He recently won the *Best Interactive Paper* award, Organizational Communication & Information Systems Division (OCIS), at the 2007 Academy of Management Meeting.

Amit Das is an associate professor of Information Technology at the Nanyang Technological University in Singapore. He is currently interested in information security and privacy issues, especially as they relate to e-government. He has published his research in journals including *Management Science*, and presented papers to conferences such as the International Conference on Information Systems and the Academy of Management Annual Meetings.

Damien Joseph is a lecturer with the Nanyang Business School with research interests in the management of information systems (IS) professionals. His research papers have been presented in international conferences including the International Conference on Information Systems, SIGMIS-CPR, and the Academy of Management Annual Meetings.

Communications of the Association for Information Systems

ISSN: 1529-3181