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The Relationship Between Information and Communication Technologies and Country Governance: An Exploratory Study

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Abstract:

In this exploratory study we investigate the relationship between information and communication technologies (ICTs) and country-level governance. We include in our framework the five factors of ICTs: access, quality, affordability, applications and institutional efficiency & sustainability. Governance indicators include voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption. Using secondary data on ICTs and governance indicators for countries from the World Bank, and controlling for the wealth effect, our main multivariate result indicates that ICTs—with the exception of the institutional efficiency and sustainability factor—have a positive relationship with governance indicators. ICTs therefore, have the potential to promote good governance. We also find that accessibility is the most important ICTs' factor to enhance governance. Our results are useful in shaping policy decisions involving the nature and extent of investment in ICT infrastructure at the country level.

Keywords: country governance, e-government, Information and Communication Technologies (ICTs)

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I. INTRODUCTION

Experts believe that good governance is a key determinant of a country's growth and its reduction of poverty. Interdisciplinary literature has been investigating the effects of good governance on a country's growth (e.g., economic growth, poverty reduction and sustainability) and identifying the enablers of good governance [Kaufmann and Kraay, 2008; Kaufmann, Kraay and Mastruzzi, 2007a; Kaufmann, Kraay and Mastruzzi, 2007b; Kaufmann, Kraay and Mastruzzi, 2008; Meso et al., 2006; Meso et al., in press; World Bank Institute, 2001; World Economic Forum, 2007; World Economic Forum, 2008]. According to several authors, underlying the conceptual frameworks and theories of good governance is one plausible group of enablers—ICTs [Alvarez and Hall, 2008; Georgescu, 2008; Katchanovski and LaPorte, 2005; Kumar and Vragov, 2009; Meso et al., 2006; Meso et al., in press; Singh et al., 2007; Srivastava and Teo, 2008]. But in spite of the apparent key role of ICTs, little empirical research has been done to determine whether and what types of ICTs do in fact influence a country's governance favorably. This becomes the thrust of this exploratory study.

While prior studies such as the ones cited above have addressed a range of research questions regarding the relationship between ICTs and governance, none have studied it in a comprehensive fashion. Nearly all pertinent studies are more micro in nature in that they are limited in scope to the role of technologies in enabling firm-level governance, such as financial reporting, disclosure, and transparency. These studies include:

- conference calls and disclosure [Bushee et al., 2003; Frankel et al., 1999]
- financial reporting via the Internet [Ashbaugh et al., 1999; Craven et al., 1999; Debreceny et al., 2002; Hodge et al., 2001; Xiao et al., 2004]
- websites for corporate governance disclosures and reporting [Ettredge et al., 2001; Ettredge et al., 2002a; Ettredge et al., 2002b; Jiang et al., 2009a; Jiang et al., 2009b]
- Internet for investor relations [Heldin, 1999]
- search-facilitating technology in financial reporting [Hodge et al., 2004]
- use of XBRL and XML in financial reporting [Baldwin et al., 2006; Debreceny and Gray, 2001]

Since ICTs have demonstrated positive relationship to firm level governance at the micro level, it can be argued by proxy that a similar relationship may exist at the macro level with country level governance.

We accept that good country governance is key to achieving growth and promoting social goals. In fact, a few studies have addressed the moderating role of governance in the impact of ICTs on socioeconomic development [Meso et al., 2006]. Even so, the effects of ICTs on governance itself have not been addressed. To justify the promotion of further investment in ICT infrastructure, the role of ICTs as key drivers of country governance needs to be empirically evaluated.

A second limitation of current studies in this area is that investigation has focused on a specific ICT variable, such as e-government [Marchionini et al., 2003; Singh et al., 2007; Srivastava and Teo, 2007a; Srivastava and Teo, 2008], disregarding the overall effect of ICTs. Further, e-government has been studied as a dependent variable [Singh et al., 2007]. These studies provide a thorough picture of a specific ICT and enrich our understanding of its role. Yet, to a country's government, this is not enough information since those leaders must consider allocating resources on different ICT dimensions. The challenge is compounded when leadership has limited resources, a reality in nearly all countries. To guide a government on how to use its financial resources wisely, a holistic picture of ICTs is necessary.

In a third way, current studies miss adding to country-level understanding of ICT impact: they examine the implementation of ICTs in "specific regions or countries" [Heeks, 2002; Holliday, 2002; McHenry and Borisov, 2006a; McHenry and Borisov, 2006b; Srivastava and Teo, 2005] but can say little about the implication of their findings to other countries. This is also consistent with the research methodologies employed in those studies, which are conceptual in nature [Gronlund and Horan, 2004; Grant and Chau, 2005; Layne and Lee, 2001; Srivastava and Teo,

2004; Warkentin et al., 2002] and case-study oriented [Chan and Pan, 2008; Irani et al., 2008; Phang et al., 2008]. Quantitative studies in this topic are relatively few [Srivastava and Teo 2008], and most are limited to analyzing a specific e-government implementation within a country [McHenry and Borisov, 2006b; Ho, 2002; Norris and Moon, 2005; Teo et al., 2008; Tung and Rieck, 2005]. The few cross-country quantitative empirical studies that exist employ small samples. Wong and Welch (2004), for example, used data from only fourteen countries. Even in the field of IT impact, there is scant research at national and cross-country levels [Melville et al., 2004].

Thus, there is a great need for large-scale, quantitative empirical studies exploring the relationship between ICTs and governance. Our review of the literature finds that no large-scale empirical study exists involving many countries and aiming to understand the relationship between ICTs and governance.

In summary, the limitations of current ICTs' literature compel us to extend the research to encompass an understanding of the overall relationship between ICTs and country governance using a large-scale sample. In particular, we recognize that the potential for ICTs to improve growth and reduce poverty in developing countries is of profound interest to policy makers (in governments, firms and institutional lenders). Macro-level empirical studies are beginning to appear in the literature [Meso et al., 2006; Meso et al., in press], but primarily in ICTs effects on development with governance as a moderating factor. A few have even analyzed the relationship between ICTs and governance in depth [Meso et al., 2006]. But the relationships between ICTs and country governance itself have not been addressed. We propose to investigate relationships between various ICTs and country-level governance indicators. Through this exploratory research, we hope to advance our understanding of the critical role ICTs can play in a country's governance. We analyze the relationships of various ICTs (factors) with country governance indicators so as to address two distinct but related research questions:

1. *Do ICT factors have a positive relationship to a country's governance, controlling for the "wealth effect"?*
2. *Which ICT factors have potential to improve governance?*

The rest of the article is organized as follows: We first provide background information with respect to governance and the potential of ICTs to enable effective governance. We then describe the conceptual framework of the relationship between ICTs and governance and develop the hypotheses. Third, we describe our methodology. Fourth, we discuss the results of our statistical analysis and implications. Finally, we discuss the scope and limitations of our work, provide conclusions and suggest future research directions.

II. RESEARCH BACKGROUND

Governance within a country is described "as the way public officials and public institutions acquire and exercise authority to provide public goods and services, including basic services, infrastructure, and a sound investment climate" [World Bank Institute, 2001: <http://www.worldbank.org/wbi/governance>; World Bank, 2007].

Governance Matters

A report by the World Economic Forum written by PricewaterhouseCoopers argues that a "global consensus has emerged in the last decade in favor of transparent, accountable institutions, fair decision making procedures, and democratic political and judicial systems, economic openness and a viable civil society—components of good governance" [World Economic Forum, 2007]. The World Bank has suggested "governance matters for economic development [World Bank, 2007]." The general consensus is that countries that run democratic and transparent governments and institutions have the capability to promote development and growth, increase the overall standard of living, and mitigate poverty. Operationally, good governance results in those countries receiving incentives and priority allocation of resources by international funding agencies [World Bank, 2007]. Since the 1970s, the World Bank has used evaluations of "government performance" in the allocation of "concessional resources." More recently, the evaluation criteria have been expanded to include a range of issues, among them accountability, corruption level, regulatory environment, economic policies, social and sustainability policies, as well as the success/failure of the public sector delivery of certain goods and transparency.

One could argue that these more sweeping criteria could push administrators, decision makers, policy developers and citizens to become more accountable for their actions. Reports in the popular news confirm the view that "informed" citizens demand more openness from their governments (e.g., e-democracy). For example, it is reported that governments in several countries, Japan and Turkey included, have been taken to task by their citizens for poor "disaster planning," the same citizens who would have been passive in earlier occurrences of natural disasters [World Economic Forum, 2007]. As Besancon [2003] argues, a well-governed country adheres to the rule of law, and safeguards political and civil freedom as well as the numerous other indicators of quality of life, including education, financial systems and health care.

Indeed, estimates of the development dividend of good governance suggest that a realistic one standard improvement in governance would raise incomes in the long run by two-to-threefold [Kaufmann and Kraay, 2002]. On average, improving control of corruption by only one standard deviation was associated with a jump in Growth Competitive Index for a country by almost thirty rank positions. Even after controlling for the income level of the country, improvement in corruption control produced a large jump in the competitiveness of a country—between fifteen and twenty rank positions [Kaufmann et al., 2007a].

The per capita income and the quality of governance were also strongly positively correlated across countries [Kaufmann and Kraay, 2002]. In a study of the six worldwide governance indicators (available for the 1996–2006 period) that allowed systematic assessment of the benefits of good governance in a large sample of countries, the data at first revealed a very high correlation between good governance and key development outcomes across countries. A very close link between various governance components and national income per capita was observed [Kaufmann et al., 2007a; Kaufmann et al., 2008]. Moreover, extensive research showed that foreign investment was lower in countries perceived to be corrupt, which further thwarted their chance to prosper. When countries improved governance and reduced corruption, they reaped a “development dividend” that, according to the World Bank Institute, included improved child mortality rates, higher per capita income, and greater literacy.

Impact of ICTs on Governance

Numerous studies at the firm level have described the potential of ICTs in the areas of corporate governance, disclosure, reporting, and transparency [Ashbaugh et al., 1999; Baldwin et al., 2006; Bushee et al., 2003; Craven et al., 1999; Debreceny and Gray, 2001; Debreceny et al., 2002; Ettredge et al., 2001; Ettredge et al., 2002a; Ettredge et al., 2002b; Frankel et al., 1999; Heldin, 1999; Hodge et al., 2001; Hodge et al., 2004; Jiang et al., 2009a; Jiang et al., 2009b; Xiao et al., 2004]. The arguments from these studies can be extrapolated to suggest that ICTs also have the potential to improve country-level governance.

First, ICT enhances social inclusion and promotes more effective, accountable democratic government [Guislain, et al., 2006; Lane, 2008]. Mobile phones have an especially dramatic impact in developing countries: substituting for scarce, fixed connections, increasing mobility, reducing transaction costs, broadening trade networks and facilitating searches for employment. With prepaid services and calling cards, even poor households benefit from increased telephone access. Alternatively, a single broadband Internet connection in a village can provide access for numerous institutional programs (such as e-government and computers in schools) and private users. These types of ICTs have the potential to make government and its services more transparent by providing easy access to information while at the same time enabling citizens to participate in activities indicative of democracy and good governance.

Second, ICTs are used increasingly to deliver public services and provide information about institutional performance. Official websites that provide relevant information and tools to enable citizen participation are good indicators of institutional transparency and accountability [Bellver and Kaufmann, 2005]. One study examined the voluntary practice of local authorities in New Zealand to provide financial reporting via the Internet. Six variables associated with voluntary disclosure were examined: political competition, size, leverage, municipal wealth, press visibility, and type of local authority. Results indicated that leverage, municipal wealth, press visibility, and type of council were among the disclosures [Laswad et al., 2005]. The decision to “go public” with such information was an act of reform by local and central governments which, in the early 1990s, were aligned—at least in terms of their financial reporting practices—with those of the private sector. It was perceived that the Internet provided an opportunity to examine voluntary disclosure in the public sector, and in particular, in the local government environment. Some local New Zealand authorities elected to voluntarily provide financial information on their websites. Clearly, the Internet is a fast and cost-effective mechanism for the dissemination of information to voters, and, therefore, may be an important medium for meeting the incremental monitoring obligations of political agents.

Third, institutional reforms and the growth in information networks, while appearing to benefit the world as a whole, may be particularly useful to poorest nations [Thompson Jr. and Garbacz, 2007]. Telecommunications networks promote global information exchange; put citizens in touch with one another, their media, and their government institutions; and provide valuable feedback where needed. Evidence suggests that the economic impact of expanding telecommunications infrastructure in regions such as sub-Saharan Africa is formidable, not to mention the positive returns from improved political stability and institutional economic reforms [Waverman et al., 2005].

Islam [2008] used empirical evidence to explore the link between the flow of information flow and governance, and developed a new indicator—the transparency index—to measure the frequency with which governments updated economic data made available to the public. Cross-country regression estimation showed that countries with better information flows were also governed better. While the effects of ICTs on governance are pervasive, we use e-government [Gronlund and Horan, 2004] to illustrate its potential.

Srivastava and Teo [2008] define e-government as “the use of information and communication technologies (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 the impact of e-government has delineated the numerous benefits it offers citizens, businesses, and governments [Srivastava and Teo, 2007a]. For example, e-government has not only helped in improving service delivery [Moynihan, 2004; West, 2004] and increasing democratization [West, 2004; Von Haldenwang, 2004], it has also helped in reducing corruption and increasing government transparency [Cho and Choi, 2004; Srivastava et al., 2007a; Srivastava et al., 2007b; Wong and Welch, 2004]. The results of another study by Srivastava and Teo [2008] showed a strong association between e-government development and national business competitiveness, and e-participation and national business competitiveness. A recent special issue of the *Journal of Strategic Information Systems* also looked at the various dimensions of e-government strategies [Hackney et al., 2008].

In the media, there are numerous anecdotes that also support the notion that ICTs are helping governance. *The Economist* reported in 2008 that the Internet is playing a role in awakening large segments of the British population, through blogs to the creation and distribution of online petitions [2008c]. In India, as part of its e-government initiative, several ICT projects are under way to, among other things, computerize passport files and digitize such paper-based records as farm statistics and household surveys. In the state of Gujarat, software is being implemented to link the state’s 483 police stations so people can file complaints online or check the status of cases from anywhere in the state. As part of a nationwide project to set up emergency 91-type hotlines across India, the state of Rajasthan is establishing a “dial 108” response center in the capital city of Jaipur [Sheth, 2008].

Also making the popular press were many examples of ICT use—particularly mobile and Web technologies—in democratic processes, indicators of good governance [*The Economist*, 2007]. For example, approximately 40 percent of all Americans received their campaign news from the Internet, according to the Pew Internet & American Life Project [*The Economist*, 2008a]. In the U.K., various forms of e-voting were tested during elections at the local level in May 2002. Although the results were mixed, the phenomenon promoted political participation. In Brazil, electronic poll-site voting was used to improve the transparency of the election process, and indeed the electronic registration of voters can help lower the barriers to voting. In another example, observers noted that mobile telephones played an important role in the presidential elections in Kenya in December 2002; they were used to monitor the election process and to publicize the results of vote counts. In a number of countries, public Internet access points (telecenters, kiosks, Internet cafes) are already being used as nodal points of civic organization and political debate [Von Haldenwang, 2004]. Again, in the 2008 U.S. presidential election, sophisticated Web 2.0 technologies—such as online social networking—were used by rival campaigns to motivate and mobilize supporters [Allison, 2008].

Another example from November 2007 reported that Tunisia blocked access to the popular video-sharing sites YouTube and Daily Motion, both of which carried material about Tunisian political prisoners. In response, Tunisian activists and their allies organized a digital sit-in, linking dozens of videos about civil liberties to the image of the presidential palace on Google Earth, thus turning a suppressed and regional human-rights story into a fashionable global campaign. But these events are superseded by what is happening now in Egypt, Libya and other countries in the Middle East. Armenian president Robert Kocharian ended his term in office in March 2008 with a media blackout that reportedly extended to Web logs, or blogs. Not surprisingly, the move prompted the creation of a huge number of blogs hosted on servers outside Armenia—all sharply critical of authorities [*The Economist*, 2008b]. In China, citizens have used the Web during national campaigns to monitor western news media and foreign companies, as was the case in 2008 after riots broke out in Tibet for biased reporting [Barboza, 2008]. Social networking sites, too, have seen their share of governance usefulness. In spring 2008, for instance, a protest against rising food prices and President Hosni Mubarak’s Egyptian government became a Facebook group with more than 75,000 members. The movement overlapped with a textile workers strike in Egypt [Cohen, 2008]. Launched online in early 2007, the Wikileaks website uses anonymous technology to disguise the source of leaked information. The site is run by a loosely-formed group of open-government and anti-secrecy advocates who want to allow people who live under oppressive regimes to anonymously leak documents that have been censored or are of ethical, political or diplomatic significance. The notion has taken off. Wikileaks.org has mirror sites in a number of countries, including Belgium, Sweden, and Australia. In 2007, Wikileaks revealed massive corruption in the Kenyan government [Marks, 2008].

Exposed to online postings that multiply before they can be censored, the public has come to expect more transparency and responsiveness from their governments. Before censors could block him, a Chinese blogger known as Mr. Zhou used his cell phone to post snippets to Twitter, a public instant-messaging feed, warning about the earthquake in Sichuan and the riot in Guizhou [Fowler and Ye, 2008]. In the March 2008 Zimbabwe election, 8,900 network volunteers of ZESN [Zimbabwe Elections Support Network] received official accreditation by the government to observe voting—using cell phones, text messaging, satellite phones and fax machines to report final vote counts to Harare from polling stations around the country [Childress, 2008]. In the recent election in

Bangladesh, it was reported that “the spread of mobile phones, many with cameras, produced an army of unofficial campaign monitors, alert to any violation” [*The Economist*, 2009].

These anecdotes and examples warrant further investigation into the empirical relationship between ICTs and governance. Using ICTs, countries in the developing world will have a chance to “leap frog” their way toward good governance. New information and communication channels can strengthen civil societies, even under authoritarian rule [Von Haldenwang, 2004].

III. CONCEPTUAL FRAMEWORK

Drawing broadly from the literature on corporate disclosure and transparency [Bushman and Smith, 2001; Bushman and Smith, 2003; Bushman et al., 2004] as well as the several macro studies on the effects of ICTs [Brynjolfsson, 1993; Brynjolfsson, 1994; Brynjolfsson, 1996; Brynjolfsson and Hitt, 1996; Brynjolfsson and Hitt, 2000; Brynjolfsson and Hitt, 2003; Brynjolfsson et al., 2002; Clarke, 2008; Hitt and Brynjolfsson, 1996; Jensen, 2007; Meso et al., 2006; Meso et al., in press; Oliner and Sichel, 2000] discussed in the prior section, we present a framework to characterize the relationships between ICTs and country governance as shown in Figure 1.

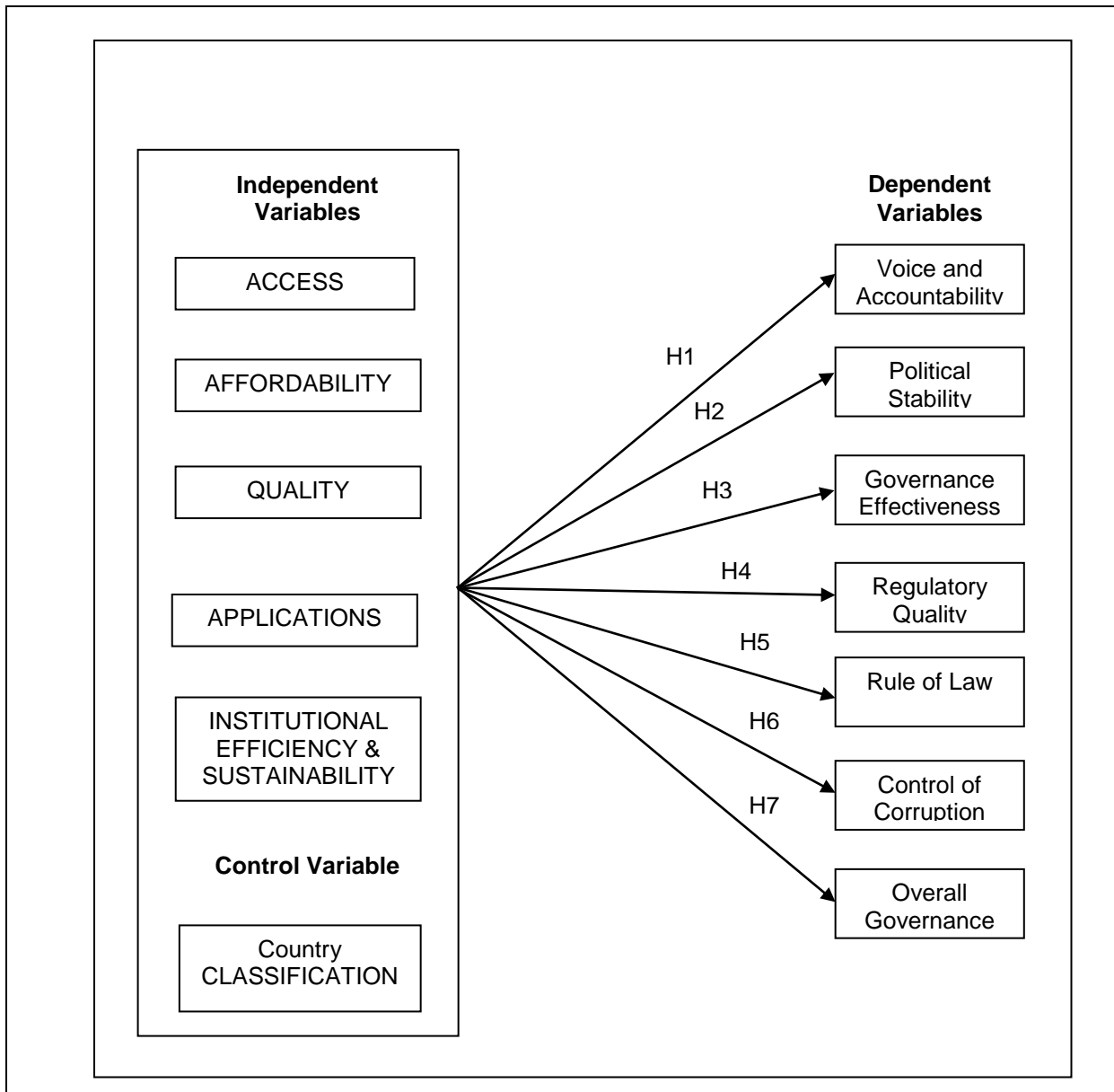


Figure 1. Relationship Between ICTs and Governance—A Conceptual Framework

Consequently, the following hypotheses are tested:

H1: Information and communication technologies (ICTs) are positively related to voice and accountability controlling the wealth effect.

H2: Information and communication technologies (ICTs) are positively related to stable political environment controlling the wealth effect.

H3: Information and communication technologies (ICTs) are positively related to efficient governance controlling the wealth effect.

H4: Information and communication technologies (ICTs) are positively related to high quality regulation controlling the wealth effect.

H5: Information and communication technologies (ICTs) are positively related to improved rule of law controlling the wealth effect.

H6: Information and communication technologies (ICTs) are positively related to better control of corruption controlling the wealth effect.

H7: Information and communication technologies (ICTs) are positively related to better overall governance controlling the wealth effect.

Given the purpose of this study is to look at the relationship between ICTs and governance indicators, ICTs become the key factors. Yet, it can be argued that a country's income level is a common factor to influence both ICTs and governance. That is, high-income-level countries have more resources and, therefore, can afford better governance, so wealth effect is fundamental to the possible relationship between ICTs and country governance. Accepting that this is a reasonable argument, we include a country's income level in our research framework and control the wealth effect when assessing the relationship between ICTs and governance. The results obtained this way will be more convincing in terms of the importance of ICTs.

To sum up, we classify the components in the framework into three categories: control variable (country-level income), independent variables (ICTs, which have five factors) and dependent variables (governance indicators). The control variable is represented by the World Bank's country classification scheme which uses gross national income [GNI] per capita. Based on its GNI per capita, each country is classified as low income, middle income, or high income [<http://go.worldbank.org/CWTURYIPS0>]. The next two subsections provide detailed definitions and measurements for governance indicators and ICTs' factors.

Governance Indicators

A governance indicator is a measure that underscores some aspect of a country's state of governance. Governance indicators are usually narrowed to measure more specific areas of governance, such as electoral systems, corruption, human rights, public service delivery, civil society, and gender equality [World Bank, 2007]. We use the well established governance indicators—Worldwide Governance Indicators [WGI]—as described in Kaufmann, Kraay and Mastruzzi [2007a], Kaufmann, Kraay and Mastruzzi, [2007b], Kaufmann, Kraay and Mastruzzi, [2008] and World Bank [2006] and applied recently in Meso, Datta and Mbarika, [2006] and Singh, Das and Joseph [2007]. WGI measure six dimensions of governance, defined below [<http://www.worldbank.org/wbi/governance>]: *voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption.*

Voice and Accountability (VA): measures the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association and a free media.

Political Stability and Absence of Violence (PS): measures the perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including domestic violence and terrorism.

Government Effectiveness (GE): measures the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.

Regulatory Quality (RQ): measures the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.

Rule of Law (RL): measures the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, the police and the courts, as well as the likelihood of crime and violence.

Control of Corruption (CC): measures the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as “capture” of the state by elites and private interests.

ICT Factors

With regards to ICTs, several attempts have been made in the past few years to measure the relative levels of ICT development in individual countries. These varied efforts have highlighted the significance of ICTs as key factors that contributed to a country’s economic and social transformation, and as a cohesive force for integrating a country into the global economy [Minges and Qiang, 2006; World Bank, 2006b].

The World Bank created an ICT Index, which is based primarily on internationally accepted variables for measuring ICT [World Bank, 2006b]. This index includes only ICT sector specific indicators based on the following premises. First, though the general economic context plays an important role in determining demand for ICT, one can find countries with broadly different levels of ICT development at any given income level. Including economic variables in the index would “pre-judge” a country’s ICT level according to its income level, and thus distort the World Bank ICT Index. Second, although sector structure—such as independent regulation, incumbent ownership, and the level of competition—has a significant impact on sector performance, there is no single sector structure that fits all countries. It would be difficult to attach a numerical value to rate this component.

The World Bank ICT Index provides a holistic view of ICTs by incorporating twenty-one ICT sector specific variables reflecting five factors of ICTs—access (AC), quality (QU), affordability (AF), application usage (AP) as well as efficiency and sustainability (ES). Instead of using a single ICT index, we consider the five factors of ICTs so as to provide concrete and further understanding of the relationships between ICTs and country governance. Table 1 summarizes the scope of each factor [World Bank, 2006b] and lists the component variables for each factor used in this study.

Table 1: Scopes and Variables for ICTs Factors (World Bank—ICT at a Glance)

ICT factors	Scope	Variables
Access	Variables that reflect the availability of ICTs, such as fixed and mobile telephones, computer, the Internet, and televisions	Telephone mainlines (per 1,000 people) International voice traffic (minutes per person) Mobile phone subscribers (per 1,000 people) Population covered by mobile telephony (%) Internet users (per 1,000 people) Personal computers (per 1,000 people) Households with television (%)
Quality	Variables that reflect how well networks perform by measuring telephone faults, and also measuring their bandwidth and international Internet capability	Telephone faults (per 100 mainlines) Broadband subscribers (per 1,000 people) International Internet bandwidth (bits per person)
Affordability	Variables that measure the price of ICT services and the capacity of citizens to pay for them	Price basket for residential fixed line (US\$ per month) Price basket for mobile (US\$ per month) Price basket for Internet (US\$ per month) Telephone average cost of call to US (US\$ per three minutes)
ICT applications	Variables that reflect the viability of the sector in terms of revenue generation and labor productivity	Information and communication technology expenditure (% of GDP) Secure Internet servers (per 1 million people) Schools connected to the Internet (%) E-government readiness index (scale 0-1)
Institutional efficiency and sustainability	Variables that measure the extent to which ICTs are used in different sectors of the economy, such as government and business	Telecommunications revenue (% GDP) Telecommunications investment (% of revenue) Telephone subscribers per employee

IV. METHODOLOGY

Data Sources

In order to estimate the relationship between ICTs and country governance, we gathered data from several World Bank databases for 2004, the year for which complete data was available (given the circumstance that countries submit data over a period of time). The country income data were obtained from the World Development Indicators database [WDI] and the countries were classified as high-, middle-, or low-income countries.

The data for the 21 ICT variables were extracted from The World Bank ICT At-a-Glance database. All the ICT variables were screened for skewness and kurtosis. Log transformation was performed for four variables with strong positive skewness. Then, all the ICT variables were standardized using their mean values and standard deviations. Following the World Bank ICT At-a-Glance database, these twenty-one ICT variables were classified into five key factors. As seen in Table 1, *Access* includes seven variables, *Quality* includes three variables, *Affordability* and *ICT Applications* include four variables each, and *Institutional Efficiency and Sustainability* includes three variables. One *Affordability* variable and one *ICT Applications* variable were deleted from further analysis due to a high proportion of missing values. Given World Bank ICT At-a-Glance report ensures the face validity of these factors, factor scores of each factor were calculated as the mean value of its corresponding variables as there is no theoretical argument for the unequal weights of those variables.

The governance data set was extracted from the Worldwide Governance Indicators: 1996–2006 database [<http://www.worldbank.org/wbi/governance/data.html>; <http://www.govindicators.org>]. This is an aggregated data set, combining data from approximately thirty-three separate data sources constructed by thirty different organizations, many of them based on opinion and expert surveys, such as Freedom House and the Global Competitiveness Report [Kaufmann and Kraay, 2008; Kaufmann et al., 1999; Van De Walle, 2006]. The indicators are based on several hundred individual variables measuring perceptions of governance. These individual measures of governance are assigned to categories capturing these six dimensions of governance. Scores are recalculated every two years [Kaufmann et al., 2005]. The dataset contains data for 212 countries and territories for the year 2004. As per Kaufmann et al., an unobserved components model was used to construct six aggregate governance indicators for the period.

The datasets of ICTs' factors and governance indicators were merged based on the unique identification information: country name (or code). The final dataset contained data for 200 countries.

Research Method

Hierarchical linear regression [HLR] was conducted to test each hypothesis in SPSS, the statistical software. HLR is a theory-driven testing technique that allows groups of variables to be introduced in the regression model sequentially. The order in which the predictor variables are entered is not a statistical decision, but based upon theoretical or logical assumptions on which the hypothesis is based. This is an important difference between HLR and stepwise regression where the software determines the order of entry of the variables.

Our hypotheses consider the impact of two groups of variables on country governance: wealth factor and ICT factors. Consequently, there are two steps for each hypothesis testing. In the first model (Model 1), a regression of governance indicators on country income level was performed. In the second model (Model 2), a regression of governance indicators on both country income level and the five ICT factors was performed. Because Model 1 is nested in Model 2, we can compare the change in R-square and the associated F statistics and p-values to assess whether the more complex model can significantly improve the goodness of fit of the model.

Since we explore the relationship of ICTs with governance, we have to include all the five factors of ICTs simultaneously in Model 2 because they capture the overall construct of ICTs. Entering them individually in Model 2 would cause model misspecification. In addition, the five factors may be correlated as they define one big construct; therefore, the impact of each factor has to be assessed in the presence of other dimensions. Doing it this way allows us to evaluate not only the overall impact of ICTs on governance but also which factor has a higher impact on governance. The answer to the first part helps to confirm the impact of ICTs on governance, if any. The answer to the second part provides further information and important implications in resource allocation strategy regarding ICTs investment.

V. RESULTS AND DISCUSSION

Table 2 summarizes the descriptive statistics of five ICTs factors and six governance indicators. An examination of the correlation matrix indicates that Accessibility, Quality, and ICT applications are closely related, while Institutional Efficiency and Sustainability and Affordability do not correlate with the others. All constituent factors are highly

correlated with the governance indicators except for Institutional Efficiency and Sustainability. As we mentioned before, the high correlation between ICTs factors and governance could be due to the common third factor—country's income level. In order to better understand the relationship between ICTs and governance, hierarchical linear regression analysis was performed.

Table 2: Descriptive Statistics and Correlations of ICT Factors and Governance Indicators

Factors and Indicators	Statistics		Correlations					
	Mean	St. Dev.	AC	QU	AF	AP	ES	VA
AC	-0.04	0.89	1					
QU	-0.04	0.86	.79 (**)	1				
AF	0.02	0.81	0.14	0.09	1			
AP	-0.19	0.83	.69 (**)	.63 (**)	0.11	1		
ES	-0.017	0.67	0.14	-0.04	-0.01	0.01	1	
VA	-0.04	1.01	.69 (**)	.59 (**)	.27 (**)	.63 (**)	.17 (*)	1
PS	-0.06	1	.65 (**)	.55 (**)	.26 (**)	.44 (**)	0.16	.70 (**)
GE	-0.01	1.01	.87 (**)	.76 (**)	0.14	.77 (**)	0.09	.76 (**)
RQ	-0.02	1.01	.86 (**)	.71 (**)	.16 (*)	.73 (**)	0.09	.80 (**)
RL	-0.04	1.01	.85 (**)	.75 (**)	.21 (**)	.69 (**)	0.09	.79 (**)
CC	-0.02	1.01	.85 (**)	.75 (**)	.23 (**)	.70 (**)	0.09	.76 (**)

Factors and Indicators	Statistics (cont)		Correlations (continued)					
	Mean	St. Dev.	PS	GE	RQ	RL	CC	
PS	-0.06	1	1					
GE	-0.01	1.01	.72 (**)	1				
RQ	-0.02	1.01	.72 (**)	.94 (**)	1			
RL	-0.04	1.01	.82 (**)	.94 (**)	.93 (**)	1		
CC	-0.02	1.01	.76 (**)	.95 (**)	.90 (**)	.96 (**)	1	

Note: ** Correlation is significant at the 0.01 level; * Correlation is significant at the 0.05 level.

AC—access, QU—quality, AF—affordability, AP—application usage, ES—institutional efficiency and sustainability, VA—voice and accountability, PS—political stability, GE—Governance Effectiveness, RQ—regulatory quality, RL—rule of law, CC—control of corruption

The regression results are reported in Table 3. The results show similar patterns in that country's income level was significant in Model 1 but turned to be insignificant in Model 2. In each set of hypothesis testing, we found that the change of *F* statistics is significant with $p < 0.001$ when ICT factors were added in the regression with the control variable. For instance, when testing Hypothesis 1, the results of Model 1 indicated that country's income level is highly associated with voice and accountability with coefficient 0.62. However, its impact became almost negligible in Model 2, whereas four factors of ICTs (i.e., access, affordability, application usage, and efficiency and sustainability) generated substantial impact on voice and accountability. Those ICT factors improved the coefficient of determination by 0.17, and the corresponding *F*-statistics change of 8.56 was significant with $p < 0.001$. This provides empirical evidence that ICTs' factors provide a substantial positive contribution to country governance on the top of income level. When we combined all the governance indicators into one (i.e., overall governance) and re-ran the analysis, similar results were obtained. We conclude, therefore, that the models, which contain ICT factors, improve the goodness fit substantially compared with the ones that only have country income level as the single predictor. All seven hypotheses being supported, we discuss at least three major findings:

First, the results show that ICT infrastructure is significant in explaining the variance of a country's governance. The results are similar to those found in the corporate governance literature and therefore contribute to the overall body of knowledge on disclosure, governance and transparency by extending the findings to the public sector and providing a macro level perspective (i.e., country level). As discussed previously, e-government is a good example of the application of ICTs to promote disclosure and transparency.

Second, a country's income level appears to have a substantial impact on governance indices by itself (Model 1). However, when combined with ICT factors, it is insignificant in explaining *voice and accountability (VA)*, *political stability (PS)*, *governance effectiveness (GE)*, *regulatory quality (RQ)*, and *control of corruption (CC)* and negligibly significant for *rule of law (RL)* (p value close to 0.05). As such, the results do not support the "wealth effect" argument, as much as they emphasize the dominant impact of ICT factors. The results, to a certain extent, reflect the same idea as the study by Singh, Das, and Joseph [2007] which found that most of the positive influence of GDP (as a proxy for wealth) on e-government maturity occurs through ICT infrastructure. Overall, the results underscore the importance of investing in ICT infrastructure and the potential benefits. Irrespective of which income level a country falls in, high ICT factor performance will result in better governance. The results are, therefore, very

encouraging for developing countries that in the past may have held ICT infrastructure in disregard as an accessory to rich countries. Indeed these poorer countries must invest in ICTs to improve governance and, ultimately, economic growth.

Third, it is interesting to note that although ICT infrastructure overall has a positive impact on a country's governance, not all ICTs are equally important. Indeed, "Access" turns out to be the only ICT factor that contributes to better country governance for each governance indicator, followed by "ICT Applications." "Institutional Efficiency and Sustainability," on the other hand, seems to have no impact on governance in most of the indicators. It is plausible that the variables in this factor deal with traditional telecommunication devices and infrastructure and perhaps have no bearing on today's world of mobile technologies and wireless devices, captured in the "Access" factor. The different impact of ICT factors offers strong investment implications for a country. Given limited resources for each nation (especially those developing countries), they should first promote the one area that could influence the governance status in all aspects (i.e., access). In short, if a country has a clear vision of which area of governance it wants to improve, our results spell out which ICT factor will provide the best chance for success.

Table 3: Hierarchical Regression Results

Explanatory variables	Dependent Indicators					
	Voice and accountability		Political stability		Governance effectiveness	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
GNI	0.62**	0.00	0.60**	0.05	0.79**	0.15
AC		0.38*		0.59**		0.38**
QU		0.09		0.14		0.16*
AF		0.19**		0.12		0.03
AP		0.27**		-0.16		0.30**
ES		0.13*		0.11		0.05
ΔR^2	0.38	0.17	0.36	0.13	0.63	0.19
ΔF	72.95	8.56	64.60	5.58	199.05	22.53
<i>Sig. of ΔF</i>	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Explanatory variables	Dependent Indicators (continued)							
	Regulatory quality		Rule of law		Control of corruption		Overall governance	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
GNI	0.79**	0.15	0.80**	0.19	0.80**	0.09	0.79**	0.13
AC		0.54**		0.47**		0.62**		0.50**
QU		0.07		0.17*		0.16*		0.15*
AF		0.05		0.06		0.13**		0.10*
AP		0.16*		0.11		0.04		0.15*
ES		0.05		0.04		0.08		0.08
ΔR^2	0.63	0.14	0.64	0.13	0.63	0.17	0.63	0.16
ΔF	194.58	13.51	204.38	13.02	200.26	18.35	199.31	16.55
<i>Sig. of ΔF</i>	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Note: The table reports the standardized regression coefficients. Regression coefficients significant at $p < 0.05$ are marked by *, significant at $p < 0.01$ are marked by **. GNI—gross national income (control variable in Model 2).

VI. CONCLUSIONS, LIMITATIONS AND FUTURE RESEARCH

This study empirically confirmed the positive impact of ICT factors on a country's governance level beyond the wealth effect. Our cross-country regressions document that governance indicators are higher (better) in countries with better ICT infrastructure. In contrast, the impact of a country's income level loses its significance vis-a-vis governance when ICT factors are considered. These results provide clear policy implications for countries to improve governance level, and they are particularly encouraging to developing countries where financial resources are in short supply. In addition, our results indicate that improvement of ICT infrastructure be a priority. ICT accessibility has a substantial impact on all governance indicators. Where resources are limited, a country may focus its spending on those areas that improve accessibility. If a country would like to improve a specific dimension of governance, the study also suggests the corresponding ICTs on which it can focus.

Scope and Limitations

Our study is not without limitations. We acknowledge that our work is a snapshot in time, and it is exploratory in nature. As the databases are updated and complete data is available for additional years, longitudinal studies involving time-series can be undertaken for more robust generalizability. In addition, other intervening variables, such as country characteristics, may have an effect. Furthermore, our data is secondary data acquired from the World Bank data sets. The explanatory ICT variables and the dependent governance indicators are aggregated from multiple models and sources. We expect that future research into the effects of ICTs (and technology in general) on governance will be enhanced by more complete theories and databases. Although it is highly unlikely that cross country differences in governance cause cross country differences in ICTs and country characteristics, it is possible that both governance and ICT infrastructures are caused by the same omitted factors.

Contributions and Future Research

In spite of some limitations, the study makes a number of contributions to the literature and provides implications for policy makers. First, while most studies on the effects of ICTs are limited to firm or individual level of analysis, there is a need for understanding the impact of ICTs at the country level [Melville et al., 2004; Srivastava and Teo, 2008]. Our study contributes to the emerging literature by studying the relationship of ICT factors with country-level governance indicators. Future research can analyze other aspects of the macro-level impacts of ICTs, for example, on public health and sustainability.

Second, models of disclosure and transparency have mostly been used for analyzing the benefits to firms. We use the models [Bushman et al., 2004] to develop our exploratory framework for understanding the relationship of various ICTs with country-level governance. Our findings help extend the findings of the impact of ICT from micro level (corporate governance) to macro level (country governance).

Third, most studies have focused on the study of individual aspect of ICTs whereas ours expands the scope to include a range of ICT factors. The findings enrich our understanding of the impact of different ICTs on governance indicators. A government can consider the use of each ICT factor in the overall picture of ICTs to maintain or improve its governance effectiveness.

Fourth, through our empirical study, which uses secondary data to analyze country governance, we examined relatively unexplored macro-level relationships. Further, we make novel use of publicly-available, fee-based databases to enhance our understanding about the impact of ICTs on governance indicators. In addition, we consolidated and demonstrated the use of ICT factors and governance indicators, which have the potential to become the gold standard for future macro-level studies.

Fifth, the study provides an interdisciplinary perspective by integrating the information technology and governance literatures and providing a comprehensive literature review for future researchers.

Our research also offers several implications for practitioners, policy makers, and public administrators at country and global levels. First, it provides insight into the governance environment of individual countries, thereby enabling global firms to make wise investment decisions. Second, our study suggests that ICTs have a positive relationship with country-level governance indicators. This finding has implications for governments and policy makers across the globe. They should make concerted efforts toward developing the ICT infrastructure and encourage the use of various ICTS such as e-government, e-procurement, e-business and e-democracy. Third, our results show all categories of ICT infrastructure have a significant relationship with various governance indicators, with the exception of *Institutional Efficiency and Sustainability*, indicating that governments (and countries) must adopt an integrated, cohesive and coordinated approach to ICT investments and infrastructure implementation. They must choose carefully the ICT types (e.g., wireless vs. landline) and adopt a leapfrog strategy to maximize gains from investments. Finally, the study provides empirical evidence to public administrators and policy makers to justify investments in a range of ICTs in their respective countries.

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