

Governance and Information & Communication Technology in Islamic Countries: A Generalized Method of Moments Inference

Bilal Mehmood^a, Syed Husnain Haider Rizvi^b, Syed Sajjad Haider Rizvi^{c*}

^a*Department of Economics, Government College University, Lahore, Pakistan*

^b*Quaid College Network, Lahore, Lahore, Pakistan*

^c*Indus Foundation For Human Development, Pakistan*

Abstract

Role of governance is undisputedly pivotal in managing the resources of a nation. Its importance for a better society and economy has been widely discussed in literature (North, 1990; Kaufmann et al., 2000; La Porta et al., 1999). Moreover, the 21st century has brought novel changes such as advent of information and communication technology (ICT). Information revolution has reformed societies and economies around the globe. Accordingly, this paper combines the two above-mentioned phenomena in this paper and puts forward a hypothesis that ICT has a positive influence on governance. In addition to ICT, Human Development Index (HDI) is also expected to have positive influence on governance. To conduct rigorous statistical analysis of the relevant variables, we use a widely used robust estimation technique, known as Generalized Method of Moments (GMM). This statistical technique has the ability to cope with endogeneity and heteroskedasticity in the presence of instrumental variables. In addition, Granger causality has been applied to test the causality between the two governance and ICT. Recommendation on the basis of findings are made after the statistical analysis is conducted.

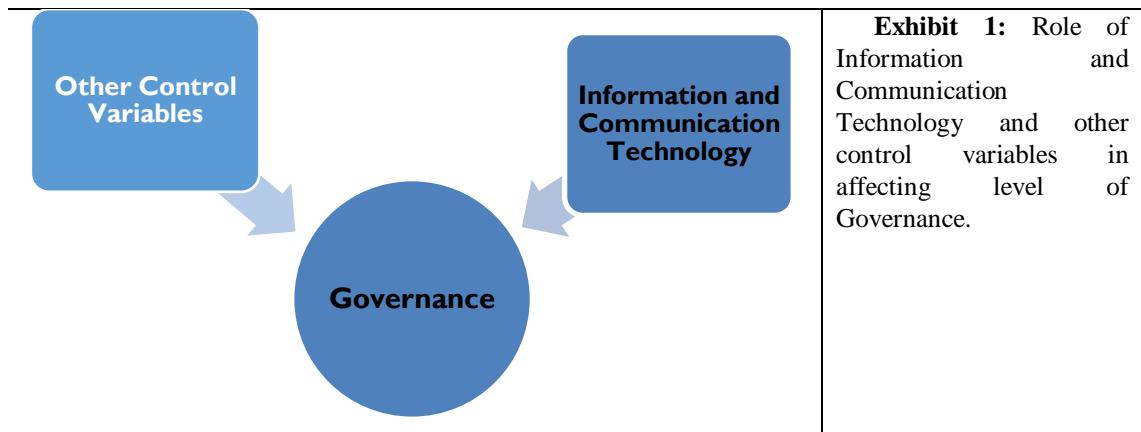
Keywords: Governance, Information and Communication Technology, Human Development Index, Generalized Methods of Moments.

1. Introduction

Governance is a wide concept, and exists at household, village, municipality, nation, region and/or global levels (Ntalaja, 2002). The United Nations emphasizes on 'good governance' as an essential component of the Millennium Development Goals (MDGs), because such governance creates a framework for fighting poverty and inequality. This paper tries to synthesize ICT and governance in an empirical framework. The purpose of doing so is to find the impact of the ICT and governance. This shall contribute to literature on two emerging areas namely governance and ICT. The scope of research in this case is limited to Islamic countries that share Muslim legacy and code of life.

*Corresponding author. Tel.: +92-111-000-010
E-mail address: digital.economist@gmail.com

Literature on governance should incorporate newer factors which have persuasive effect on globe and hence on governance. Such factors include Information and communication technology (ICT) as well. ICT has affected every sphere of the economy and society. Korotayev & Tsirel (2010) suggested that since 1990's, world is living the 5th of Kondratiev waves in the form of information technology era. Governance is no exception to it. e-governance is prime example of impact of ICT on governance. Unluckily the data on e-governance is still in its stage of infancy. Research on e-governance is, therefore, is infeasible in many cases. For the sample of Islamic countries, such data scarcity hampers the growth of literature. This study investigates the relationship between ICT and governance under the hypothesis that ICT does affect the state of governance. This mechanism can be explained using exhibit 1.



Other control variables include population, tertiary education, level of democracy and human development index.

1.1 Hypothesis

Governance is undisputedly essential in handling the resources of a nation and its importance for a better society and economy has been widely discussed in literature (North, 1990; Kaufmann et al., 2000; La Porta et al., 1999). Moreover, the 21st century has brought novel changes such as advent of information and communication technology (ICT). Information revolution has reformed societies and economies around the globe. Accordingly, this paper combines the two above-mentioned phenomena in this paper and puts forward a hypothesis that ICT has a positive influence on governance. This paper conducts empirical analysis of determinants of governance quality in Muslim countries. Consequently, the hypothesis is constructed as follows:

H_A: Governance quality is influenced by Information and Communication Technology, Democracy and Human Development in Muslim Countries.

2. Literature Review

We shed light on the existing literature that deals with governance, information and communication technology and human development. In fact, literature on the mutual relationship of these variables is non-existent. One of the studies that links these two variables into a framework is Human Development Report 2001 (UNDP, 2001). World Development Report (2002) also focuses not so much on the validity of the argument but the degree to which the ICTs foster development (WDR 2002). Literature that brings together ICT and governance is scarce, however, we list the following studies:

Kakabadse et al. (2003) shed light on the recent problems of democracy and the effect of ICT on the current and future quality of democratic governance. They analyse four general models of e-democracy triggered by interactive ICT. These models include electronic bureaucracy, information management, populist and civil society. They examine the impact of ICT on the roles, responsibilities, and accountability of citizens, elected representatives, the media, and corporations. They suggest strategies for revamp democratic governance.

Cecchini & Scott (2003) consider the case of rural India and investigate that ICT applications contributed to reduce poverty by providing healthcare facilities to rural areas of India and improving their access to government and financial services and education. They investigate that poor people's opportunities enhanced by using ICT applications. Transparency has increased through computerized milk collection centers in rural India and it leads to immediate payment to farmers. Farmers and artisans are connected with markets through ICT. Dairy Information System Kiosk (DISK) provided information through database that holds histories of all the members of dairy portal. This system facilitates farmers and artisans and provides them transparent and efficient cooperative system. ICT also improve healthcare for the poor. Auxiliary nurse Midwives (ANMs) started in rural India. ANMs' saved work time up to 40% through transmission and data collection facilitated by PDAs. In addition, by expanding usage of government services ICT empowered the poor. Furthermore, ICT widen access to microfinance and reduce risks is a difficult endeavor. Education and required skills are necessary to get benefit from ICT. In this paper Cecchini and Scott described a simple model in which they explained that digital divide exists in rich and poor. Poor's value of time is low just because of low productivity and underemployment whether Poor's cost of ICT capital is high.

Arcelus, Sharma, & Srinivasan (2005) developed two hypotheses relating to Human Development Index and Technological Achievement Index. They used eight factor measures for technological innovation known as Technological Achievement Index (TAI) and it is presented by the Human Development Report 2001 (UNDP, 2001). TAI was used for capturing the ability of countries by product innovation, through research, diffusion of recent innovation, and spread of old innovation over a broad area and grow or build human skills for technological erudition. They used HDI for measuring health knowledge and wealth. The purpose of the paper is inquire if TAI is more acceptable than HDI. Moreover, eight factors included in TAI were needed redundant for its composition. They also justify that HDI considered potential index for technological progress, as compare to TAI. For first hypothesis they used spearman correlation coefficient between TAI and HDI and conclude that differences in country ranking were rejected. HDI and TAI show same information and same country ranking. For second hypothesis they used spearman correlations for computation of TAI and its eight factors are redundant and there is multicollinearity among variables.

Harindranath & Sein (2007) examined the role of information and communication technology in development process. By using secondary data brings together the conceptual frameworks showed

manifold impacts, assumptions, range of views, actors that played their role in development project of information and communication technology. In Andhra Pradesh the state of India, specific case of an e-government initiative known as e-Seva was examined. They demonstrated the sense between frameworks and e-Seva project. They contributed to an edifice of explanatory knowledge. For developing prescriptive knowledge it would be helpful. By combining different conceptual frame works, it gave us better understanding that implementation of information and communication technology in developing projects would leads to development and social wellbeing.

Shirazi (2008) empirically finds that ICT development in Middle East has mitigated its digital divide with developed countries. Moreover, he find that ICT supports democracy and freedom of expression. He uses archival data for the time span of 1995-2003. Rohman (2010) discussed two different sides. On one side telecommunication sector has achieved good penetration rate during past decade in Asia. However, at the same time performance of poverty reduction, education and health sector is low in Asia. Rohman tried to relate long-term relationship between socioeconomic variables (health, education) and telecommunication sector. There are different development stages for Asian countries in field of building their ICT industry. High penetration rates of broadband and telephony have been observed in East Asian countries like Korea and Japan. Diffusion process is at early stages in some South and South-east Asian countries. Penetration rate of fixed line, computer, TV, and internet subscriber were used as a variable for ICT analysis. Their findings reveal that to support a better level of welfare, there is a need for further innovation in ICT sector.

Shirazi (2012) extends his earlier work in published in 2008 by extending his analysis to meta analysis and subjected archival data for 146 countries for time span of 1996-2010. He found the effect of ICT, education, rule of law, GDP and institutional resistance on democratic freedoms at a global level. This paper exposes that ICT encourages democratic freedom across the globe. As per findings, broadband gap is larger between the least developed nations and the most developed countries.

This brief reviews affirms the absence of empirical analysis that shows the relationship between ICT and governance at macro level. Therefore, this paper fills the gap by doing so.

3. Dataset and Methodology

For empirical analysis, 41 Islamic countries have been selected. These include Afghanistan, Albania, Algeria, Bahrain, Bangladesh, Benin, Cameroon, Central African Republic, Chad, Egypt, Ethiopia, Gambia, Guinea, Guinea-Bissau, Indonesia, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Malaysia, Mali, Mauritania, Morocco, Niger, Nigeria, Oman, Pakistan, Qatar, Saudi Arabia, Senegal, Sierra Leone, Sudan, Syria, Tanzania, Togo, Tunisia, Turkey, United Arab Emirates and Yemen. In this case, there is a micro-panel dataset since 12 years (2000-2011) compose the time span which is short. Data is extracted from international databases namely, World Development Indicators (WDI), World Governance Indicators (WGI) and International Telecommunication Union (ITU). For governance indicator, a composite proxy is developed using the six components in WGI. For overall representation of ICT, four components of ICT can be aggregated into a composite indicator. Data for level of democracy is taken from Polity IV Project: Political Regime Characteristics and Transitions, 2012.

To avoid the dynamic panel bias (Bond, 2002; Baum, 2006), dynamic specification GMM is preferred for use. For a recent application of GMM, see Mehmood & Azim (2013) and Mehmood & Azim (2014). The problem of endogeneity is easily addressed in dynamic models. The system GMM

estimate accounts for macroeconomic variables that usually depict random-walk behavior (Bond, 2002; Roodman 2007; Baum, 2006; and Roodman, 2009). Time dummies are also planned to be included to improve model diagnostics by mitigating potential heterogeneous cross-section dependence (Sarafidis et al., 2006). It also removes universal time-related shocks from the error term. To find the direction of causality, causality tests are also employed.

4. Estimable Model

Following models is to be estimated using Generalized Method of Moments (GMM):

$$\text{GOV}_{i,t} = \alpha_i + \alpha' (\text{GOV}_{i,t-1}) + \beta (\text{ICT}_{i,t}) + \gamma (\text{PP}_{i,t}) + \delta (\text{SERT}_{i,t}) + \kappa (\text{POL}_{i,t}) + \lambda (\text{HDI}_{i,t}) + \Omega (\text{T}_t) + \varepsilon_{i,t} \dots \quad (1-e)$$

Where, **GOV** is governance indicator, **ICT** is the composite index of information and communication technology,[†] **PP** is total population, **SERT** is school enrollment, tertiary (% gross), **POL** is level of democracy and **HDI** shows the human development index. **T_t** is vector of time dummies and **Ω** their respective coefficients and $\epsilon_{i,t}$ is the error term. **i** shows countries and **t** years.

4.1 Pre-estimation Tests for Endogeneity and Heteroskedasticity

Macroeconomic models are usually prone to endogeneity and econometric issues like heteroskedasticity. In order to cope with both of these issues and to select a suitable estimator, following tests are applied. Table 1 shows the two tests for endogeneity. Both Wu-Hausman F test and Durbin-Wu-Hausman χ^2 test are significant at 5% level of significance showing presence of endogeneity.

Table 1: Durbin-Wu-Hausman Tests for Endogeneity

Null Hypothesis (H_0): Regressor is Exogenous			
Test	Notation	Statistic	p-value
Wu-Hausman F test	F(1, 419)	4.742	0.030
Durbin-Wu-Hausman χ^2 test	$\chi^2(1)$	4.756	0.029

These tests show that there is endogeneity in the model and instrumental variables should be incorporated in the model. However, heteroskedasticity can be present in this model, which is tested as follows:

4.2 Decision on Using IV Regression or GMM: Heteroskedasticity Tests

[†] Estimated as = (Fixed telephone lines per 100 inhabitants) + 0.2 × (Mobile cellular telephone subscriptions per 100 inhabitants) + 0.2 × (Fixed broadband Internet subscribers) + 0.2 × (Fixed Internet subscribers per 100 inhabitants) + 0.2 × (Internet users per 100 inhabitants).

As per Baum et al. (2003), presence of heteroskedasticity in model with endogeneity, calls for GMM estimator. Following tests are applied for inquiring the suitability of GMM in this case:

Table 2: Tests for Heteroskedasticity

Null Hypothesis (H_0): Disturbance is Homoskedastic	Test	$\chi^2(6)$	p-values
Pagan-Hall General Test Statistic		8.788	0.118
Pagan-Hall Test w/assumed Normality		8.295	0.141
White/Koenker nR_c^2 Test Statistic		19.290	0.002
Breusch-Pagan/Godfrey/Cook-Weisberg		18.638	0.002

Source: Authors' calculations

In table 2, results of White/Koenker nR_c^2 and Breusch-Pagan/Godfrey/Cook-Weisberg test statistics are statistically significant at 1% level of significance while Pagan-Hall General test and Pagan-Hall test w/assumed normality are not. Therefore, it is unsafe to rule out the presence of heteroskedasticity and GMM estimator should be opted for. Learning from Bond (2002), Baum (2006), Roodman (2007), Baltagi (2008) and Roodman (2009), we use SYS-GMM to estimate the impact of ICT on governance in sample countries. Baltagi (2008) suggests that SYS-GMM usually yields more efficient and precise estimates as compared to DIFF-GMM due to improved precision and reduced finite sample bias.

4.3 GMM Estimates of Model

Hansen test of over-identifying restrictions is a joint test of model specification and appropriateness of the instruments. This test statistics indicates that the model is well specified and the instrument vector is appropriate. Moreover, Arellano-Bond test for the second order serial correlation is also estimated, which signals that there is no evidence of 2nd order serial correlation in the estimated models.

Table 3: SYSTEM GMM Estimates

Dependent Variable: Governance Indicator ($GOV_{i,t}$)	Coefficient	Standard Errors
	s	
GOV_{i,t-1}	0.321 ***	0.046
ICT_{i,t}	0.311 **	0.127
PP_{i,t}	-0.053 **	0.024
SERT_{i,t}	-0.019	0.032
POL_{i,t}	0.021 ***	0.004
HDI_{i,t}	0.579 *	0.296
C	-0.027	0.316
Time Dummies		
yrtd_02	-0.253 **	0.017
yrtd_03	-0.351 ***	0.008
yrtd_04	-0.331 ***	0.008
yrtd_05	-0.420 ***	0.006

yrtd_06	-0.290**	0.007
yrtd_07	-0.225**	0.006
yrtd_08	-0.196	0.008
yrtd_09	-0.115	0.004
yrtd_10	-0.087**	0.003
Other Tests and Parameters		
Observations = 384	Countries = 41	Instruments = 35
		F(6, 41) = 4.50 [p = 0.001]
Hansen J-Test: p-value = 0.652		
Difference in Hansen tests / C-tests: [p = 0.990, p = 0.971, p = 0.995 & p = 0.903]		
Source: Authors' calculations		

Note: Following Roodman (2007) and Mileva (2007), SGMM is applied on model with arguments **small**, **twostep** and **robust**. Use of **small** argument makes small sample adjustment.

5. Interpretation

Table 3 depicts the dynamic nature of the model by statistically significant coefficient (0.321) at 1% level of significance lagged value of governance ($GOV_{i,t-1}$). Model estimates reveal the existence of a positive relationship between governance ($GOV_{i,t}$) and information and communication technology ($ICT_{i,t}$). Statistical significance is at 5% level of significance. This relationship affirms the hypothesis that information and communication technology bring betterment in the level of governance. This is expected since use of ICT by public allows them to remain aware of current policy steps of government. Such policy-savvy state of public keeps the government under pressure of being accountable. Moreover, ICT also helps in increasing the transparency in implementation of government policies.

Population has a negative impact on level of governance as seen by the negative coefficient statistically significant at 5%. It is in lines with expectations since a country with big population is usually tough to govern. Mostly, the densely populated countries have lower levels of macroeconomic performance. It can be attributed to paucity of government resources and reach to bring about higher levels of macroeconomic performance. Secondary school enrollment ratio at tertiary level ($SERT_{i,t}$) is also used in the regression that captures the effect of higher education on governance. A negative relationship is found in this case, implying that higher education does not improve governance in selected countries. Moreover, this coefficient is statistically insignificant. It can be attributed to two of the reasons. Firstly, that people with higher education do not become a part of government machinery. They are likely to join the research and teaching professions. However, statistical significance remains an unfulfilled criterion for this coefficient.

Governance is suspected to be affected by level of democracy (or autocracy). Therefore, we include a proxy for level of democracy from Polity-IV database. Estimation of its coefficient shows that governance improves as the level of democracy. The coefficient is positive and statistically significant at 1%. Finally, the level of human development is linked with governance in the economy. A positive affinity is found between the two variables and is statistically at 10% level of significance. A population with higher levels of education, health and per capita income is a population with higher level of awareness. Such population naturally is likely to extract better governance from government. In other words, public with higher levels of human development is more likely to have a more demanding influence on government. This can have a favorable effect of improving the quality of governance.

Time dummies inclusion has helped in improving the statistical diagnostics of the model and are listed in the table above. Overall significance of the model is at 1% level of significance as shown by F-test of joint significance. The condition that number of observations is greater than number of instruments holds in this case i.e. $(384 > 35)$. Hansen test of correct specification and over-identifying restrictions has a p-value of greater than 0.05. i.e. $(p\text{-value} = 0.652 > 0.05)$ implying that all over-identified instruments are exogenous. The Arellano & Bond test for first order ' M_1 ' and second order ' M_2 ' correlation i.e. AR(1) and AR(2) are estimated. M_1 is statistically significant at 1% level of significance since $(M_1)_{p\text{-value}} = 0.000 < 0.01$ and M_2 is statistically insignificant since $(M_2)_{p\text{-value}} = 0.692 > 0.05$. This fulfills the desired condition that there is no second order serial correlation in residuals.

C-test (Baum, 2006; Roodman, 2006) for the validity of subsets of instruments are estimated. These four tests have same criteria, i.e. $p\text{-value} > 0.05$. All four probability values ($p = 0.990$, $p = 0.971$, $p = 0.995$ & $p = 0.903$) are greater than 0.05, implying that subsets of instruments for level and difference equations are also valid.

6. What Causes What? Governance vs. Information and Communication Technology

Next logical question in relationship between governance and ICT is direction of causality between them. Table 4, lists the results of panel Granger causality test. Probability values of F-statistics show the higher governance does not cause ICT but ICT causes higher levels of governance indicator. This shows that there is no feedback effect of governance on ICT in selected Islamic countries. While ICT has a causal effect on governance.

Table 4: Panel Granger Causality Test Results

Null Hypothesis	F-Statistic	p-value
GOVERNANCE does not Granger Cause ICT	0.189	0.828
ICT does not Granger Cause GOVERNANCE	3.556	0.029

Note: Estimations conducted using EViews 8.

7. Discussion

This paper has inquired the role of information and communication technology (ICT) in shaping the governance in selected Islamic countries. Findings from statistical analysis reveal that ICT does affect the governance in a favorable way. The impact of other control variables like population, tertiary education, level of democracy and level of human development have logical relationships. This study have contributed to literature in a substantial way. Since such empirical framework composed of ICT, population, tertiary education has not be developed before. Recommendations are made on the basis of findings. Since the empirical analysis has revealed some factors that positively contribute to the level of governance, the improvement in these factors is advisable. An improvement in these factors shall lead to amelioration in governance. ICT is the main factor that the paper has chosen. Its improvement, however,

is not a major problem even in developing countries. Due to negligible marginal costs and continuous improvement in state of technology, the prices of ICT, both hardware and software, have been on the fall.

Moreover, the global inclination towards adoption of ICT has further facilitated the widespread of ICT even in developing countries. Other determinants like population should be controlled in order to ease the pressure on government and allow it to perform in a better way. Higher education also has no significant effect and cannot be relied upon to positively affect governance. Perhaps a secondary level of education is more pertinent in this regard. Since it is more adjacent to people in the sphere of governance. Improving levels of democracy and human development can also help in ameliorating the state of governance. Further research in this regard can be micro level studies that can provide better understanding of these factors on governance.

References

Arcelus, F., Sharma, B., & Srinivasan, G. (2005). Assessing the information content of the technology achievement index in the presence of the human development index. *Economics Bulletin*, 15(4): 1-5.

Baltagi, B. H. (2008). Econometric analysis of panel data: Econometric Theory. 4th Edition, John Wiley & Sons, Ltd Wiley.

Bappenas, B.-S. & UNDP, (2001). Indonesia human development report 2001: Towards a New Consensus: Democracy and Human Development in Indonesia.

Baum, C. F. (2006). An introduction to modern econometrics using Stata: Stata Corp.

Baum, C.F., Schaffer, M.E., & Stillman, S. (2003). Instrumental variables and GMM: Estimation and testing, *Stata Journal*, 3(1): 1-31.

Bond, S. (2002). Dynamic panel models: A guide to micro data methods and practice. Institute for Fiscal Studies, Department of Economics, UCL, CEMMAP (Centre for Microdata Methods and practice) Working Paper No. CWPO9/02. Retrieved from <http://cemmap.ifs.org.uk/wps/cwp0209.pdf>.

Cecchini, S., & Scott, C. (2003). Can information and communications technology applications contribute to poverty reduction? Lessons from rural India. *Information Technology for Development*, 10(2): 73-84.

Harindranath, G., & Sein, M. K. (2007). Revisiting the role of ICT in development. Paper presented at the Proceedings of the 9th International Conference on Social Implications of Computers in Developing Countries, São Paulo, Brazil.

Kakabadse, A., Kakabadse, N. K., & Kouzmin, A. (2003). Reinventing the democratic governance project through information technology? A growing agenda for debate. *Public Administration Review*, 63(1): 44-60.

Kaufmann, D., Kraay, A. & Zoido-Lobaton, P. (2000). Governance matters: From measurement to action, *Finance and Development*, 37(2), Washington DC: International Monetary Fund.

Korotayev, A. V. & Tsirel, S. V. (2010). A spectral analysis of world GDP dynamics: Kondratieff waves, Kuznets swings, Juglar and Kitchin cycles in global economic development, and the 2008-2009 economic crisis. *Structure and Dynamics*, 4(1). Retrieved from: <http://www.escholarship.org/uc/item/9jv108xp>

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., & Vishny, R. (1999). The quality of government. *Journal of Law, Economics, and Organization*, 15(1): 222-79.

Mehmood, B., & Azim, P. (2013). Does ICT participate in economic convergence among Asian countries: Evidence from dynamic panel data model. *Informatica Economica Journal*, 17(2): 7-16.

Mehmood, B. & Azim, P. (2014). Total factor productivity, demographic traits and ICT: Empirical analysis for Asia. *Informatica Economică*, 18(1): 8-16.

Mundial, B. (2002). World development report. Building institutions for markets. Washington: Banco Mundial.

North, D.C. (1990). Institutions, institutional change and economic performance, Cambridge: Cambridge University Press.

Nzongola-Ntalaja G., (2002). UNDP role in promoting good governance, Seminar for the International Guests at the Congress of the Labour Party of Norway, Oslo

Rohman, Ibrahim Kholilul, (2010). Who enjoys ICT development? An investigation into the role of ICT development in Asian countries using dynamic panel data. 5th Communication Policy Research South Conference (CPRsouth5), XI'an, China. Available at SSRN: <http://ssrn.com/abstract=1724474> or <http://dx.doi.org/10.2139/ssrn.1724474>

Roodman, D. (2007). How to do xtabond2: An introduction to “Difference” and “System” GMM in Stata, Working Papers 103, Center for Global Development.

Roodman, D. (2009). A note on the theme of too many instruments. *Oxford Bulletin of Economics of Statistics*, 71(1), 135-158.

Sarafidis, V., Yamagata, T., and Robertson, R. (2006) A test of cross-section dependence for a linear dynamic panel model with regressors. Faculty of Economics, University of Cambridge, available on line at: <http://www.econ.cam.ac.uk/faculty/robertson/HCS Dtest14Feb06.pdf>.

Shirazi, F. (2008). The contribution of ICT to freedom and democracy: An empirical analysis of archival data on the Middle East. *The Electronic Journal of Information Systems in Developing Countries*, 35(6): 1-24.

Shirazi, F. (2012). A Global Perspective of the Impact of ICTs on Economic Growth and Democratic Freedom. *International Journal of E-Business Development*, 2(2), 45-52.