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E-government, Economic Growth and Trade: A Simultaneous Equation Approach

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Does e-government promote trade and economic growth? This paper attempts to answer this question by employing simultaneous equation estimation approach and using a cross-section data of 147 countries. This is first study which has empirically estimated the bilateral relationships between economic growth and e-government, trade and e-government and trade and economic growth. The findings indicate that e-government is a stimulant of both economic growth and trade. The results predict the presence of a bilateral relationship between e-government and economic growth, trade and e-government, and unilateral causality exists from trade to growth.

JEL Classification: F14; H10; O40
Keywords: E-government; Economic Growth; Trade

1. INTRODUCTION

The study on economic growth is dated back from Adam Smith (1776) discussed in his famous book "wealth of nation". There are many theories of economic growth presented by different economists, according to the situation that have been prevailed during that time [Ricardo (1817); Harrod (1939); Domer (1946); Solow (1956)]. The pioneer of theoretical framework of economic growth is Solow (1956) and his model was employed by Barro (1991); Mankiw, Romer, and Weil (1992); and Quah (1993, 1997).

Trade is an important topic that has been captured the attention of policy makers since the start of previous century. The debate on trade has been dated back from many decades but yet there is no consensus about the positive consequences of trade on economic growth. The positive influence of trade on economic growth is empirically supported by [Edwards (1998); Wacziarg (2001); Greenaway, *et al*. (2002)] whereas [Rodriguez and Rodrik (1999)] doubted the robustness of positive relationship between trade and economic growth. In this study we empirically check the association of trade with economic growth by incorporating e-government. The trade and e-government have bilateral relationship. Trade promotes e-government by diffusion of technologies and on the other hand e-government promotes trade by overcoming non- tariff barriers and asymmetric information.

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E-government is referred to online availability of government to provide quick and efficient services to masses of people. Von Haldenwang (2004) defined e-government as a practice of information and communication technology (ICT) in public administration. E-government facilitates government in efficient provision of services to citizen by employing ICT infrastructure [Tandon (2005); Chen, *et al.* (2009); and Krishnan and Teo (2012)].

The theoretical studies on e-government emphasise its role in enhancing the efficiency of public sector and public administration [Al Kibsi, *et al.* (2001); Von Haldenwang (2004); and West (2004)] and increasing the marginal productivity of labour by mitigating the disguised unemployment [Grimes, Ren, and Steven (2012)]. In spite of its importance the empirical research on e-government is on embryonic stages. After reading vast literature we got insights about empirically investigating its role in promoting trade and economic.

E-government contributes in economic growth through trade openness by providing online availability of government and web connections. Trade also significantly contributes in output growth by tapping full potential of world resources that will help to mitigate poverty, malnourishment, infant mortality rate, illiteracy, unemployment, and inequality. The consensus about the positive relationship between trade and economic growth is yet not achieved. The advocates of positive relationship between trade and economic growth are [Rivera-Batiz and Romer (1990); Grossman and Helpman (1991); Edwards (1998); Wacziarg (2001); and Greenaway, *et al*. (2002)] whereas [Rodriguez and Rodrik (1999)] questioned the robustness of positive association between trade liberalisation and economic growth. Most of the studies empirically confirm the positive association between trade and economic growth. Thus, to reap full potential of trade we have to mitigate tariff and non-tariff barriers. The hindrance in the way of trade openness is not only tariffs but also non-tariff barriers such as asymmetric information, transportation cost and low interaction between traders.

The non-tariff barriers in the way of liberalise economy can be overwhelmed by e-government through cheap access to refine information and interaction between traders. E-government can upsurge economic development of country by facilitating trade. There are few studies which have taken into account of internet role in facilitating trade liberalisation [Choi and Hoon Yi (2009); Clarke and Wallsten (2006); Freund and Weinhold (2004); Vemuri and Saddiqi (2009)]. These studies predicted internet as a trade stimulant.

The impact of e-government on trade in empirical literature is missing. We fill this gap by taking into account of bilateral relationships between trade, e-government and economic growth by employing simultaneous equation model. Our study empirically explores e-government-trade, trade-economic growth and e-government-trade nexus. By advocating the bilateral relationship between trade and economic growth we are able to find the direct and indirect impact of trade on economic growth through e-government.

The study is arranged as follows: Section 2 presents the literature on economic growth, e-government and trade. Section 3 discusses the empirical framework of our study. Section 4 describes data and its statistical analysis. Section 5 presents and interprets empirical findings of simultaneous equation model. Finally Section 6 concludes and suggests policies.

2. LITERATURE REVIEW

In this section we explore the literature on the relationships between economic growth, e-government and trade.

2.1. E-government and Economic Growth

E-government provides efficient services to masses of people that stimulate economic growth. The efficient provision of responsibilities towards nation facilitates trade by providing cheap access to information and efficient allocation of resources to those projects that reap high returns, and facilitate interaction among investors. The electronic government through information and communication infrastructure enhances productive potential of economy. E-government stimulates output growth of the country by disseminating information and spilling over the knowledge and cutting down transaction and transportation cost. Salvatore (1996) points out that East Asia "miracle" was based on strong government support for domestic industry while stimulating competition and efficiency among domestic firms.

Summer (1999) illustrated the importance of software development in setting up new information based modern economy. He demonstrated that information technology is contributing significantly in output growth of a country. Shamim (2007) empirically analysed the effect of telecommunication technologies on output growth by taking data of 61 countries over the year of 1990 to 2001. She proposed that telecommunication technologies provide refine information, mitigate the data processing cost and asymmetric information, and facilitate interaction between buyer and seller. The results indicated that positive impact of financial development is mediated by e-government or telecommunication technology.

Choi and Yi (2009) investigated empirically the effect of internet on output growth using the panel data for 217 countries from 1991 to 2000. The findings indicate that 1 percent increase in internet subscribers up surges growth about 0.05 percent. Krishnan, Teo, and Lim (2013) argued that impact of e-government on growth is mediated by control of corruption and environmental degradation. They use averaged data over the period 2004-2008. Their finding inferred that direct impact of e-government on economic prosperity is insignificant and its impact on growth is intermediated by control of corruption and environmental degradation.

According to Czernich, *et al.* (2011) broadband "fast speed internet" has positive effect on output growth. They have empirically investigated the impact of broadband on economic growth by taking data of OECD countries over the years of 1996 to 2007. Their results indicate that broadband upsurges growth up to 3.9 percent. Mahyideen, *et al.* (2012) proposed that ICT upsurge economic development by enhancing productivity and cutting down production cost. They empirically explored the relationship between economic prosperity and information and communication technologies (ICT) for ASEAN countries from 1976 to 2010. The results of granger causality supported long run relationship between ICT and economic growth.

2.2. Trade and Economic Growth

There is vast theoretical as well as empirical literature on the impacts of trade liberalisation on economic growth but debate is yet not settled. The contradiction in

consequences of trade on growth in not only lies between theoretical but also lies within empirical literature. The positive impacts of trade liberalisation on output growth are advocated by theoretical models of many economists [Grossman and Helpman (1991); Rivera-Batiz and Romer (1990); and Devereux and Lapham (1994)] and theoretical framework on negative implication of trade on economic growth is proposed by Redding (2002). Likewise, empirical studies have also polarised into positive and negative consequences of trade liberalisation on economic growth. The positive impact of trade on economic growth in empirical studies is advocated by [Edwards (1998); Wacziarg (2001); and Greenaway, *et al*. (2002)] whereas Rodriguez and Rodrik (1999) doubted the robustness of positive effect of trade on output growth. The negative relationship between trade-growth nexus is demonstrated by Clemens and Williamson (2000); and Vamvakidis (2002).

Winter (2004) doubted on robustness of positive impact of trade on economic growth. He demonstrated that relationship between economic growth and trade depends on omitted variables in regression. He proposed that consequences of trade on economic growth can vary in the case of inclusion of education, corruption, institutional strength, political stability, and level of development of a country. Using a panel data for 42 countries, Parikh (2006) estimates the effect of trade liberalisation on growth and growth on trade balance. The study finds out that trade liberalisation promotes growth in most countries, but the growth itself has a negative impact on trade balance.

Kneller, *et al*. (2008) empirically founded relationship between trade liberalisation and economic growth is heterogonous in different countries. He has taken panel data of 37 countries and introduced dummy variable that is one for the time period when it starts to liberalise. Their findings inferred that trade liberalisation has increased overall growth rate of post-liberalisation period about 2.4 percent per annum but out of 37, the growth rate of 20 countries has decease in after liberalisation. Shachmurove and Spiegel (2010) analysed the welfare of nations in a globalised economy. They point out less welfare effects in a more globalised world.

2.3. E-government and Trade

The impediments of trade are not only tariffs but also non-tariff barriers such as transaction cost and lack of information. Collier and Gunning (1999) alleged that particular obstacle in the way of economic growth in Africa is transaction cost. E-government through online availability and web connection can fill this gap in the way of open economy. E-government also accelerates trade by decreasing transaction cost, facilitating interaction between traders, providing refine and clear information on quality, demand and supply, markets, and prices of different products.

Mattoo, Rathindran, and Subrama (2001) empirically investigated the impact of liberalisation in service on economic growth of the country. He argued that consequences of service liberalisation are different from trade liberalisation. The empirically results of the study inferred that telecommunication services and financial services have positive and significant impact on output growth whereas impact of financial services is stronger than telecommunication services. They conclude that the economy having open telecom and financial services tends to grow 1.5 percent higher.

We cannot blame merely tariff as a resistance of trade liberalisation but various transactions, communication, and fixed entry costs also responsible for restricting smooth trade in the country. Majeed and Ahmad (2006) in their study of determinants of exports in developing countries enunciated the importance of communication technologies in encouraging exports. They proposed that communication technologies such as internet and mobile phones have significant impact on exports of developing countries.

Clarke and Wallsten (2006) scrutinised the impact of internet on trade for both developing and developed countries. The findings of their study suggested that internet has positive impact on trade only in developing countries. Meijers (2014) investigated growth-internet, internet-trade, and trade-growth nexus by taking archive data of 162 countries over the time period 1990-2008. The result of simultaneous equation model confirmed that the growth impact of internet is mediated by trade whereas direct effect of internet on growth is insignificant.

Kurihara and Fukushima (2013) examined how internet facilitates trade in 34 developed and 24 Asian countries for year 2005 and 2010 by employing gravity trade model. Their findings indicate that internet has stronger positive effect on trade in developing countries than developed countries in 2005. Yadav (2014) studied the impact of internet on exports and imports of 52 Asian and sub-Saharan African countries from 2006 to 2010. He proposed that internet has significant effect on export and import of firms in extensive and intensive margin in Asian and Sub-Saharan African countries. He mentioned that firm has to face fixed information cost to enter into international market but internet save firms from entry costs. Freund and Weinhold (2004) also supported that internet is a trade stimulant in a sample of 56 developing countries.

The above literature shows that trade-growth nexus is empirically investigated by economist, but the association of this nexus with e-government is ignored. Furthermore, the existing literature focuses different components of e-government such as internet to explain growth but does not incorporate a comprehensive measure of e-government. The present study fills these gaps in the literature.

3. SIMULTANEOUS EQUATION MODEL

E-government stimulates economic growth directly and also indirectly by stimulating trade. Trade regulates e-government by integrating different economies which facilitate diffusion and spillover of knowledge whereas e-government enhances trade by facilitating interaction between traders and foreign investors. The prevailing case of interrelationship among three endogenous variables calls for a need of simultaneous equations model. The empirical framework of our study is based on three simultaneous equations to estimate direct and indirect impacts of e-government on economic growth.

3.1. Equation of Economic Growth

The model of economic growth employed in our study is stemmed from Solow (1956) which has CRS (constant returns to scale) and two inputs

$$y = f(A, K, L)$$

Mankiw, *et al.* (1992) extended the theoretical models of Solow (1956) and Koopmans (1969) by relaxing the convergence condition. According to absolute

convergence theory the poor countries will catch up the per-capita of rich countries due to high marginal productivity of capital. In order to fulfil the convergence condition we have introduced initial per-capita in our empirical growth model.

$$y_i = \beta_0 + \beta_1 y_{initial,i} + \beta_2 A_i + \beta_3 K_i + \beta_4 L_i + e_i \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

The advocates of endogenous growth model see divergence in per-capita income due to divergence on technological potential of country. The steady state growth rate of country varies due to differences in technological progress and innovations [Barro (1991) and Barro and Sala-i-Martin (1991)]. Technological progress has proxied by information and communication technology in different studies and intuition behind using ICT "as a proxy for technology" is high labour marginal productivity due to information and communication technology [Jorgenson, *et al.* (2007); van Ark, *et al.* (2008); Oliner, *et al.* (2008)]. Few studies emphasised on information technology (internet) in order to measure the divergence in per-capita due to gaps in technological potential [Clarke and Wallsten (2006); Meijers (2014)]. We measure technology by e-government. The equation 1 is modified as

$$y_i = \beta_0 + \beta_1 y_{initial,i} + \beta_2 EG_i + \beta_3 K_i + \beta_4 L_i + e_i \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

The technological diffusion across the world can be driven by economic integration of world. The economic integration will help in diffusion and spill over knowledge and information and excite innovation in the country. Acemoglu and Ventura (2002) proposed the model that describes convergence in per-capita in terms of international trade. We also address the impact of trade on economic growth following same rationale. The left side variable is economic growth, K is capital stock, and L is labour force. The error term of equation is shown by e_i.

$$y_i = \beta_0 + \beta_1 y_{initial,i} + \beta_2 EG_i + \beta_3 K_i + \beta_4 L_i + \beta_5 Trade_i + e_i \quad \ldots \quad (3)$$

3.2. Equation of Trade

The economic integration of world can be stimulated by e-government through its information and telecommunication infrastructures, skilled labour, and web connectivity. Different studies have explored merely internet as a stimulant of trade liberalisation [Kurihara and Fukushima (2013); Meijers (2014); and Yadav (2014)].

We are interested to explore reverse relationship between trade liberalisation and economic growth. The equation three explains the impact of trade on economic growth but in equation 4 we have incorporated economic growth as a determinant of trade. E-government stimulates trade by delivering cheap information and facilitating interaction among traders.

$$Trade = \alpha_0 + \alpha_1 Trade_{initial,i} + \alpha_2 y_i + \alpha_3 EG_i + \alpha_4 Tariff_i + \alpha_5 Exchange\ rate_i + u_i \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

In order to determine the indirect impact of e-government on trade we have introduced interactive term of economic growth and e-government. The exchange rate is an important determinant of trade. Trade liberalisation depends on protection level in a country. The tariff rate is a measure of trade protection in a country and exerts a negative influence on trade liberalisation.

$$Trade_i = \alpha_0 + \alpha_1 Trade_{initial,i} + \alpha_2 y_i + \alpha_3 EG_i + \alpha_4 Y * EG_i + \alpha_5 Exchange\ rate_i + \alpha_6 Tariff_i + u_i \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

3.3. Equation of E-government

The adoption of ICT tools by government for efficient provision of its services depends on economic growth of the country. The installation of latest technology in public sectors is regulated by economic performance of the country. The latest technology is usually innovated and adopted by developed countries because they have sufficient budgets to shift public sector from primitive to modern public administration. According to Comin and Hobjin (2004) famous technologies are first embraced by most of the developed countries. Czernich, *et al*. (2011) proposed that there is reverse causal relationship between e-government and economic growth. The other possibility of impact of output growth on e-government is state intervention. The installation and penetration of ICT infrastructure in public sector is regulated by state intervention in economic decisions of country and state intervention is regulated by economic growth of the country [OECD (2009)].

$$EG_i = \gamma_0 + \gamma_1 EG_{initial,i} + \gamma_2 y_i + z_i \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (6)$$

The diffusion of technology is stirred by economic and social integration of countries. Here we are going to address only trade as a measure of economic integration, to find out that how it promotes e-government. The equation 6 can be written as

$$EG_i = \gamma_0 + \gamma_1 EG_{initial,i} + \gamma_2 y_i + \gamma_3 Trade_i + z_i \quad \ldots \quad \ldots \quad (7)$$

According to Czernich, *et al*. (2011) access to broadband usually comes from fixed telephones and TV-cables lines. The fixed telephone lines regulate online presence of government. Anderson (2008) proposed that according to UDT (urban density theory) internet subscription depends on urban population because cost of internet decreases as share of urban population increases because of knowledge spillover, availability of other substitutes of internet such as broadband. For these reasons we incorporated fixed-telephones line and share of urban population as determinants of e-government

$$EG_i = \gamma_0 + \gamma_1 EG_{initial,i} + \gamma_2 y_i + \gamma_3 Trade_i + \gamma_4 Fixed\ tele_i + \gamma_5 Urban_i + z_i \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (8)$$

4. DATA DESCRIPTION

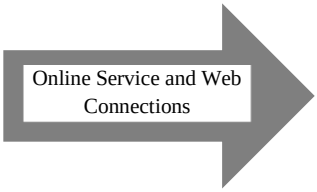
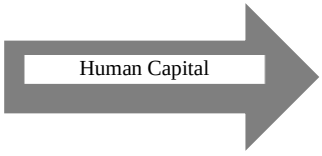
The secondary data of 147 countries for the years of 2003 to 2012 is employed in this study. We have supported our study through cross sectional data by taking averages of dataset from 2003 to 2012. The main reason behind the choice of cross sectional data is missing data of e-government. The data on e-government is not continuous but have missing values. So the best alternate was to take the multiyear averages of data produce more efficient and robust results than single year data. The cross sectional data of multiyear averages give less sensitive results [Wiggins and Ruefli (2005)].

E-government index is weighted average of online service and web connection, telecommunication infrastructure, and human capital that can use the tools of information and communication technologies. All the components of e-government have equal weight of 0.33. The data lies in the range of 0 to 1: zero indicates worst e-government quality whereas one indicates best e-government quality.

The measure of economic growth is natural log of per capita GDP (at current U.S dollars) whereas 1990 is base year of initial per-capita income, measure of tariff is tariff rate of weighted mean, measure of physical capital is gross fixed capital formation (percentage of GDP), and measure of trade liberalisation is export plus import (percentage of GDP).The data source of these variables is WDI [World Development Indicators (2014)]. The data of fixed telephone lines is derived from ITU (International Communication Union).

Table 4.1

Dimensions of E-government

Description of E-government Dimensions	
	It measures the extant of online and web content availability and focused on growing web connection and online presence which improves the accessibility of information by utilisation of multimedia which facilitates online delivery of transactional services and communication between government and citizens.
	The telecommunication infrastructure is founded on five indicators: internet users, personal computers, fix-telephones lines, mobile phone subscription, and broadband subscription (all the indicators are in per 100 inhabitants).
	Human capital is based on four indicators that are adult literacy rate, gross secondary enrolment, gross secondary enrolment, and gross tertiary enrolment.

Figures 1, 2 and 3 show a positive association of trade and e-government with economic growth and with each other. The bar charts (Figures 4 and 5) indicate that trade is high in countries having good quality e-government (see Appendix).

Table 4.2

Summary Statistics of Data

Variable	Observation	Mean	Min	Max
Y	147	11692.31	179.401	94654.22
Y_{inital}	145	5342.72	182.797	36337.09
Capital	147	23.4887	9.85652	68.78322
Labour	147	63.29	41.42	86.63
E-government	147	0.44781	0.08738	0 .87
Exchange Rate	133	675.99	0.344	25000
$EG_{initial}$	145	0.40274	0.0000	0 .92706
Trade	147	89.4306	27.0795	303.446
$Trade_{initial}$	142	73.24068	14.56329	210.161
Urban _population	147	1.39e+07	21606	3.00e+08
Fix_Telephone	147	19.6930	0 .04629	65.9294
Tariff	146	6.616705	4.839402	21.42

Table 4.2 presents the summary statistics of data. The minimum value of e-government is 0.087 that is the value for Niger. Niger has poorest e-government quality and Denmark has best e-government quality. United States has minimum trade to GDP ratio that is only 27 percent and Luxembourg has highest trade to GDP ratio and per capita income. Burundi has lowest per capita income. The country having lowest tariff rate is Macao (China) and country having highest tariff rate is Liberia.

In order to avoid biased result it is necessary to check the functional forms of specified equations. Linktest[1] serves to find that whether functional form of the equation is correct or not. Table 4 presents the results of linktest which indicate that coefficients of hat square are not significant in Equations 3 and 8 which is a signal of no concern of specification error in the equations. Hat square is the square of the independent variables in an auxiliary regression to check leverage. The insignificance of hat square illustrates that the variance in independent variables is not causing fluctuation in dependent variables.

[1]Specification error in model occurs when one or more irrelevant variables are incorporated or one or more relevant variables are omitted in the specified equation. When relevant variables are excluded from the model or irrelevant variables are included in the model, the common variance they share with excluded/included variables may be wrongly attributed to those variables. In the case of such specification errors, the error term tends to inflate and creates biased results. Specification error in any equation leads to biasness in all the results. Prior to estimate the model we have checked the specification of our model by employing the linktest. The test generates two variables, predicted independent variable (_hat), square of predicted variable (_hatsq). The model is then re-estimated using these two variables as predictors. If model is free from specification error then hatsq should not have much prediction power. Table 4.3 indicates that hatsq has not explanatory power and our all equations are free from specification error.

Table 4.3

Linktest Results

Dependent Variable: Natural log of per-capita GDP				
Variables	Coef	Std. Err	T	P>|t|
_hat	1.374505	0 .316188	4.35	0.000
_hatsq	-0.022062	0 .018553	-1.19	0.236
_cons	-1.542248	1.318649	-1.17	0.244
Dependent Variable: Trade liberalisation				
_hat	1.318894	1.333089	0.99	0.324
_hatsq	-0.0367583	0 .153453	-0.24	0.811
_cons	-0.6875192	2.886441	-0.24	0.812
Dependent Variable: E-government				
_hat	0.96947	0.091681	10.57	0.000
_hatsq	0.031816	0.093483	0.34	0.734
_cons	.0062143	0 .020458	0.30	0.762

5. EMPIRICAL FINDINGS

We have applied *Seemingly Unrelated Regressions (SUR), Two Stage Least Squares (2SLS),* and *Three Stage Least Squares (3SLS).*[2] The *SUR* model takes into account correlation among error terms of all the equations. The empirical finding of SUR model indicates that there is a positive and significant relationship between economic growth and e-government. The coefficient of e-government in 1st column of Table 5.1 implies that 1 percent increase in e-government quality brings 3.67 percent increase in economic growth. The coefficient of trade in 1st column of Table 5.1 is also positive and significant which implies that 1 percent increase in trade causes 0.35 percent increment in economic growth. The coefficient of initial per capita income 1st column of Table 5.1 implies that 1 percent increase in initial income will upsurge growth about 0.52 percent.[3]

The 2nd column of Table 5.1 presents the empirical finding of equation 5. The results confirm that e-government is a trade stimulant. The coefficient of economic growth in 2nd column of Table 5.1 implies that 1 percent increase in economic growth will cause 0.10 percent increment in trade. The findings indicate the reverse causal relationship from economic growth to trade. The interactive impact of "e-government and

[2]There is significant systematic difference between *OLS* and *SUR* model, *OLS* and *2SLS*, *OLS* and *3SLS* according to Hausman Test. The variance-covariance matrix of error terms indicates correlation between the error terms of Equation 3, equation5, and equation8. The correlation between error terms of equation3 and equation5 is 0.13, equation3 and equation8 is 0.172, and equation 5 and equation 8 is 0.105 that is significant and greater than 10 percent. 3SLS technique takes into account of both endogeniety and correlation among error terms, 2SLS only takes into account of endogeniety, and SUR model takes merely into account of correlation between error terms. In order to check the robustness of results we have employed all the techniques of Simultaneous equation model. All equations in simultaneous equation model are identified according to order condition because the number of endogenous variables included in equation less one (M-1) is less than the number of exogenous variables excluded in equation [Gujrati (2003)]. The internal instruments are used to tackle endogeniety. The instruments are initial quality of e-government, physical capital, labour force, fixed telephone lines, initial urban population, initial per capita income, exchange rate, and tariffs.

[3]The sign of initial per-capita income can be positive in the case of poor or developing economies because they will likely to grow rapidly. The hypothesis of "catching per-capita of rich economies by poor economies is consistent with convergence theory that is supported by Solow (1956).

economic growth" on trade is negative and significant. The net effect of e-government on trade is 2.07 (2.33- 0.26) whereas net effect of economic growth on trade is -0.16 (0.10-0.26). It indicates that high per capita income is not strengthening the positive impact of e-government on trade, the likely reason of this effect may be self-sufficiency of a country after certain threshold level of high per capita income.

The high economic growth can make country self-sufficient that probably has negative impact on trade due to cutting down imports and exports (retaliation of foreign country due to decreasing theirs exports). Our data also indicates that United States has lowest trade to GDP ratio. Tokarick (2008) stated that rich countries use an array of protectionism policies in agriculture sector in order to protect their farm industry. They usually protect their agriculture sector by employing import qoutas, tariff on imports, and subsidies. Stiglitz and Charleton (2005) also stated that the spending on agriculture subsidies in OECD countries is more than 300 billion US$ per annum. Exchange rate has insignificant impact on trade liberalisation whereas initial trade value of trade has positive significant impact on trade liberalisation. The coefficient of tariff indicates that 1 percent increase in tariff rate will decrease trade about 1 percent.

The findings of equation 8 are reported in 3rd column of Table 5.1. The coefficients of trade and economic growth in 3rd column of Table 5.1 infer that 1 percent increase in trade and economic growth will improve quality of e-government about 0.038 percent and 0.032 percent. The initial urban population and fixed telephone lines have also positive influence on e-government. The findings of SUR indicate that there is bilateral relationship between per capita income and e-government, per capita income and trade liberalisation, and trade and e-government.

Columns (4-6) of Table 5.1 present the results of 2SLS model. The results show that there is a bilateral causality between "e-government and trade" and "per capita income and e-government". There is unilateral causality between trade and per capita income from trade openness to per capita income. Initial urban population and fixed telephones lines is positively influencing the e-government quality. High per capita income is offsetting the positive impact of e-government on trade due to certain threshold level of per capita income when country adopts protection policy.

In 7th to 9th column of Table 5.1 the empirical findings of *3SLS* are discussed. The results of 3SLS indicate that there is a bilateral relationship between e-government and per capita income and trade and per capita income. However, there is one way causality between e-government and trade that is from e-government to trade. The results of SUR model, 2SLS and 3SLS are almost consistent. All the simultaneous equation techniques confirm that e-government is a stimulant of trade but high per capita income offset its positive impact on trade because of protection in the form of subsidies to its sectors [Stiglitz and Charleton (2005)].

Simultaneous equation econometric techniques is ideal to estimate the simultaneous equation if all the equation are correctly specified. If one of the equations is miss specified then estimation with simultaneous equation approach will spread biasness in all the equation. In that case OLS is recommended. In order to evade from biasness and for sensitivity analysis we have applied Ordinary Least Square model. Table 5.2 presents the results of OLS which also infer that there is a two way causality between e-government and trade liberalisation and e-government and per capita income but unilateral causality

between trade liberalisation and per capita income that is from trade to per capita income. The coefficient of e-government in 1st and 2nd column of table 5.2 indicates that 1 percent increase in e-government quality will enhance per capita growth about 3.22 percent and trade about 2.188 percent, respectively. The coefficient of trade in 1st and 3rd column of Table 5.2 denotes that 1 percent increase in trade increase per capita growth about 0.247 percent and e-government quality about 0.034 percent, respectively.

Table 5.1

Empirical Results of Simultaneous Equations Model

	Empirical Findings of Simultaneous Equation Model								
	SUR Model		2SLS				3SLS		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Independent Variables	(Eq3) Growth	(Eq5) Trade	(Eq8) E-gov	(Eq3) Growth	(Eq5) Trade	(Eq8) E-gov	(Eq3) Growth	(Eq5) Trade	(Eq8) E-gov
$Trade_{initial}$		0.55***			0.53***			0.51***	
		(0.045)			(0.057)			(0.055)	
EG*Y		-0.26***			-0.321*			-0.209	
		(0.0824)			(0.169)			(0.161)	
Exchange Rate		0.00715			0.00876			0.00778	
		(0.0099)			(0.0110)			(0.0099)	
Tariff		-0.0101*			-0.0108			-0.0119*	
		(0.0060)			(0.0068)			(0.0061)	
ln(per capita)		0.101**	0.032***		0.159	0.046***		0.175*	0.062***
		(0.0478)	(0.00479)		(0.102)	(0.00701)		(0.0978)	(0.00627)
E-gov	3.67***	2.33***		3.67***	2.601*		5.08***	1.140	
	(0.416)	(0.815)		(0.451)	(1.526)		(0.411)	(1.449)	
$Y_{initial}$	0.53***			0.53***			0.33***		
	(0.055)			(0.059)			(0.053)		
Capital	0.319**			0.242			0.242*		
	(0.145)			(0.158)			(0.131)		
Labour	-0.281			-0.311			0.0125		
	(0.282)			(0.304)			(0.259)		
Trade	0.35***		0.038***	0.46***		0.0309**	0.55***		0.0138
	(0.109)		(0.00932)	(0.148)		(0.0151)	(0.143)		(0.0143)
Urban pop			0.010***			0.011***			0.010***
			(0.00203)			(0.00248)			(0.00221)
$E\text{-}gov_{initial}$			0.519***			0.484***			0.397***
			(0.0349)			(0.0411)			(0.0365)
Fix_Tele			0.002***			0.0012**			0.0010**
			(0.00040)			(0.00049)			(0.00042)
Constant	1.364	1.30***	-0.376***	1.242	1.040	-0.450***	0.344	1.190*	-0.447***
	(1.427)	(0.345)	(0.0617)	(1.591)	(0.645)	(0.0857)	(1.366)	(0.619)	(0.0785)
Observations	127	127	127	127	127	127	127	127	127
R-squared									
Observation	0.880	0.622	0.956	0.877	0.613	0.951	0.854	0.592	0.937
F-stat	127	127	127	127	127	127	127	127	127
Chi-Square	959.11	217.22	2846.20	177.23	31.73	474.64	912.74	197.42	2468.93

Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

The positive sign of the coefficients of initial urban population and fixed telephones lines is consistent with urban density theory[4] and the study of Anderson (2008). Anderson proposed that online service and broadband are usually delivered from

[4]The increase in initial urban population decreases the cost of information and telecommunication technology due different substitutes of information technologies such as internet, broadband, and others.

fixed telephone lines and cable TV lines. We have also controlled our result by introducing the control of corruption (as a proxy of institution) in growth equation and our results remain consistent (see Table A3 in Appendix).

Table 5.2

Empirical Findings of Ordinary Least Squares

	Empirical Findings of OLS Ordinary Least Square Technique		
	(Equation 3)	(Equation 5)	(Equation 8)
Variables	Economic Growth	Trade	E-gov
$Trade_{initial}$		0.560***	
		(0.0473)	
EG*per Capita		-0.231***	
		(0.0858)	
Exchange Rate		0.00519	
		(0.0103)	
Tariff		-0.00952	
		(0.00628)	
ln (per capita)		0.0669	0.0254***
		(0.0497)	(0.00497)
E-government	3.215***	2.188**	
	(0.431)	(0.849)	
$Y_{initial}$	0.581***		
	(0.0572)		
Capital	0.314**		
	(0.152)		
Labour	-0.437		
	(0.295)		
Trade	0.247**		0.0344***
	(0.112)		(0.00961)
Urban Population			0.00937***
			(0.00212)
$EG_{initial}$			0.554***
			(0.0364)
Fix_Tele			0.00208***
			(0.000423)
Constant	2.261	1.496***	-0.314***
	(1.494)	(0.359)	(0.0641)
Observations	127	127	127
R-squared	0.882	0.624	0.957
F-stat	180.63	33.20	540.65
Observation	127	127	127

Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

6. CONCLUSION

E-government is an important tool that enhances trade. The online service of e-government promotes frequent interactions among traders and improves the quality of information regarding price, quality, and demands of goods. It can serve as an efficient tool to increases marginal productivity of labour and alleviate disguise unemployment in country by increasing trade. E-government is an important tool to mitigate non-tariff barriers lies in the way of liberalise and open economy. It facilitates a country in tapping the full potential of world resources.

We determine the relationships between economic growth and e-government, trade and e-government and trade and economic growth employing simultaneous equation estimation approach and a cross-section data of 147 countries. The bilateral relationships between trade and e-government are supported by SUR, OLS, and 2SLS whereas 3SLS model support one way causality between trade and e-government from e-government to trade openness.

Kim (2001) argued that main reason behind resistance in e-government is insufficient allocation of budget in area of e-government that will result into inappropriate usage of IT infrastructure. The lack of modern education and training on usage of information technology keep public servant unaware about usage of IT tools and impede development of e-government. In order to tap full potential of resources and trade liberalisation, the investment on e-government may make mandatory.

APPENDIX

Table A 1

Summary of Variables of Interest and Their Data Sources

Variables	Description	Sources
Economic growth	Natural log GDP per capita at current US $.	[1]
Initial per-capita	Natural log of per-capita GDP in 1990 (measured in current U.S dollars.	[1]
E-government	The extent of the online availability of the government, telecom infrastructure, and human capital.	[2]
Initial level of E-governemnt	The year 2003 is taken as a initial value of e-governemnt index.	[2]
Physical capital	Gross fixed capital formation in percentage of GDP.	[1]
Labour supply	Share of labour force participation total % of population.	[1]
Exchage rate	Official Exchage rate measured as the average value of local currency in terms of U.S dollars.	[1]
Trade	Export plus import share of GDP.	[1]
Inflation	GDP deflator.	[1]
Urban population	Initial level of urban population (year 1990).	[1]
Fix_Telephone	Fixed telephone lines per 100 inhabitants.	[3]
Tariff	Weighted mean applied tariff is the average of effectively applied rates weighted by the product import shares corresponding to each partner country.	[1]

[1] World development indicator (2014); [2] Global E-government reports (2003-2012); [3] International telecommunication Unions (2014)

Table A 2

Correlation Matrix

Variables	1	2	3	4	5	6	7	8	9
1. Per capita	1.000								
2. Trade	0.01	1.000							
3. EG	0.733	0.075	1.000						
4. Tariffs	-0.4078	-0.1421	-0.6021	1.0000					
5. Capital	-0.062	0.226	-0.021	0.1421	1.000				
6. Labour	-0.015	-0.157	-0.267	0.2628	0.0237				
7. Urban_pop	0.568	0.0484	0.6814	-0.4035	-0.0043	0.657	1.000		
8. Fix_Tele	0.788	0.0635	0.848	-0.4837	-0.0344	0.7576	0.6447	1.000	
9. Exchange rate	-0.1055	-0.1297	-0.0693	0.0629	0.0665	0.0776	-0.0068	-0.0665	1.000

Table A3

SEM with Control Variables

	SUR			2SLS			3SLS		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Models	(Eq3)	(Eq5)	(Eq8)	(Eq3)	(Eq5)	(Eq8)	(Eq3)	(Eq5)	(Eq8)
Variables	Growth	Trade	E-gov	Growth	Trade	E-gov	Growth	Trade	E-gov
$Y_{initial}$	0.542***			0.554***			0.316***		
	(0.0639)			(0.0694)			(0.0605)		
Labour	-0.253			-0.223			0.0717		
	(0.289)			(0.315)			(0.257)		
Capital	0.324**			0.237			0.210		
	(0.145)			(0.159)			(0.131)		
E-government	3.716***	2.314***		3.850***	3.023**		5.088***	2.027	
	(0.439)	(0.816)		(0.481)	(1.357)		(0.434)	(1.288)	
Trade	0.348***		0.0380***	0.497***		0.0295**	0.611***		0.0129
	(0.109)		(0.00932)	(0.148)		(0.0149)	(0.142)		(0.0142)
Corruption Control	-0.0394			-0.0826			0.0213		
	(0.0852)			(0.0922)			(0.0781)		
$Trade_{initial}$		0.550***			0.515***			0.474***	
		(0.0456)			(0.0541)			(0.0517)	
ln(per capita)		0.101**	0.0316***		0.193**	0.0453***		0.268***	0.0605***
		(0.0479)	(0.00479)		(0.0839)	(0.00686)		(0.0805)	(0.00618)
EG*Y		-0.259***			-0.376***			-0.337**	
		(0.0825)			(0.141)			(0.135)	
Exchange Rate		0.00705			0.0100			0.0106	
		(0.00988)			(0.0109)			(0.00977)	
Tariff		-0.0101*			-0.0106			-0.0112*	
		(0.00601)			(0.00686)			(0.00608)	
$E\text{-}gov_{initial}$			0.520***			0.489***			0.401***
			(0.0349)			(0.0405)			(0.0362)
Urban Population			0.00992***			0.0105***			0.00981***
			(0.00203)			(0.00245)			(0.00224)
Fix_Tele			0.00194***			0.00126**			0.00107**
			(0.000404)			(0.000489)			(0.000426)
Constant	1.098	1.310***	-0.373***	0.442	0.829	-0.433***	0.0299	0.672	-0.437***
	(1.540)	(0.346)	(0.0618)	(1.722)	(0.539)	(0.0834)	(1.420)	(0.518)	(0.0779)
Observations	127	127	127	127	127	127	127	127	127
R-squared	0.880	0.622	0.956	0.876	0.604	0.951	0.850	0.560	0.939

Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

Table A3

List of Countries

List of Under Developed, Developing, and Developed Countries
Under Develop Countries
Armenia, Bangladesh, Benin, Burkina Faso, Burundi, Central African Republic, Chad, Comoros, Congo. Dem, Ethiopia, Gambia, Guiana, Kenya, Kyrgyz Republic, Liberia, Malawi, Mali, Mozambique, Nepal, Nigeria, Rwanda, Tajikistan, Togo, Uganda, Zimbabwe.
Developing Countries
Albania, Algeria, Angola, Argentina, Azerbaijan, Belarus, Belize, Bhutan, Bolivia, Botswana, Bulgaria, Cape Verde, China, Cameroon , Columbia, Congo. Rep, Costa Rica, Cuba, Djibouti, Dominican Republic, Ecuador, Egypt, El Salvador, Fiji, Georgia, Ghana, Guatemala, Guyana, Honduras, Hungary, India, Indonesia, Iran, Jamaica, Jordan, Kazakhstan. Lao PDR, Lebanon, Lesotho, Macedonia. FYR, Malaysia, Mauritania, Mauritius, Mexico, Moldova, Mongolia, Montenegro, Morocco, Namibia, Nicaragua, Niger, Pakistan, Panama, Papua new Guinea, Paraguay, Peru, Philippine, Romania, Senegal, Serbia, Solomon island, South Africa, Serbia, Sri Lanka, St Lucia, St. Vincent and the Grenadines, Suriname, Swaziland, Syria, Thailand , Tonga, Tunisia, Turkey , Ukraine, Uzbekistan , Vanuatu, Venezuela, Yemen.
Under Developed Countries
Australia, Austria, Bahamas, Bahrain, Barbados, Belgium , Brunei Darussalam, Canada, Chile, Cyprus, Czech Republic, Denmark, Equatorial Guiana, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Korea. Rep, Latvia, Lithuania, Luxembourg, Macao SAR, China, Malta, Netherland, New Zealand, Norway, Oman, Poland, Portugal , Russia, Saudi Arabia, Slovak Republic, Slovenia, Spain, Sweden , Switzerland, Trinidad and Tobago, United Kingdom, United States, and Uruguay.

Fig. 1. Relationship between Growth and E-government

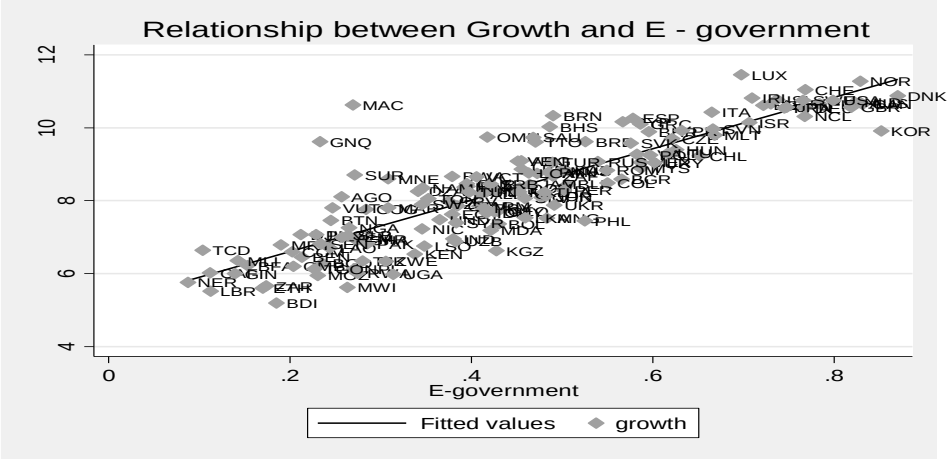


Fig. 2. Relationship between Trade and Growth

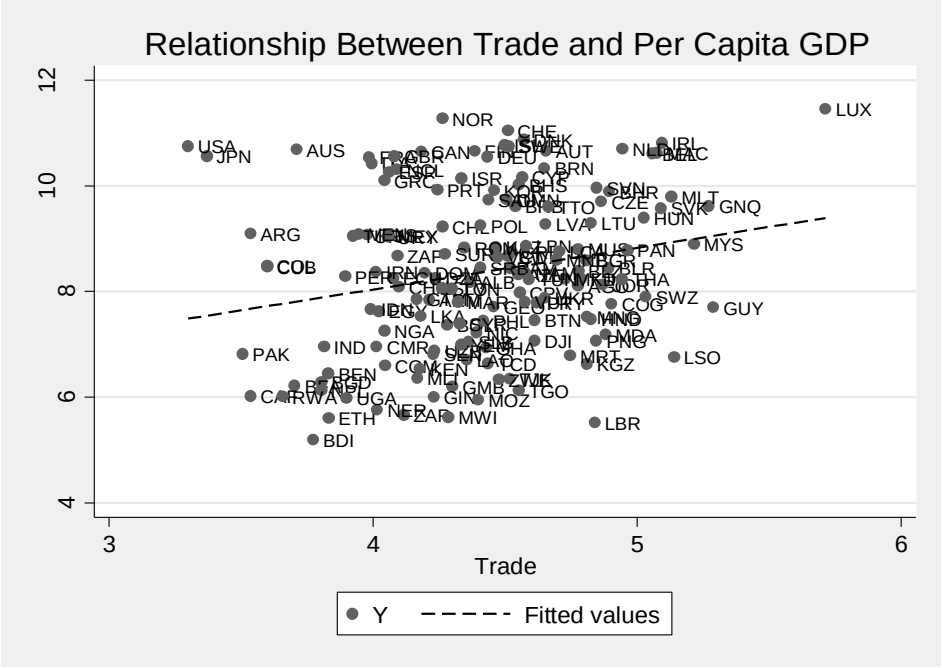


Fig. 3. Relationship between E-governemnt (EG) and Growth

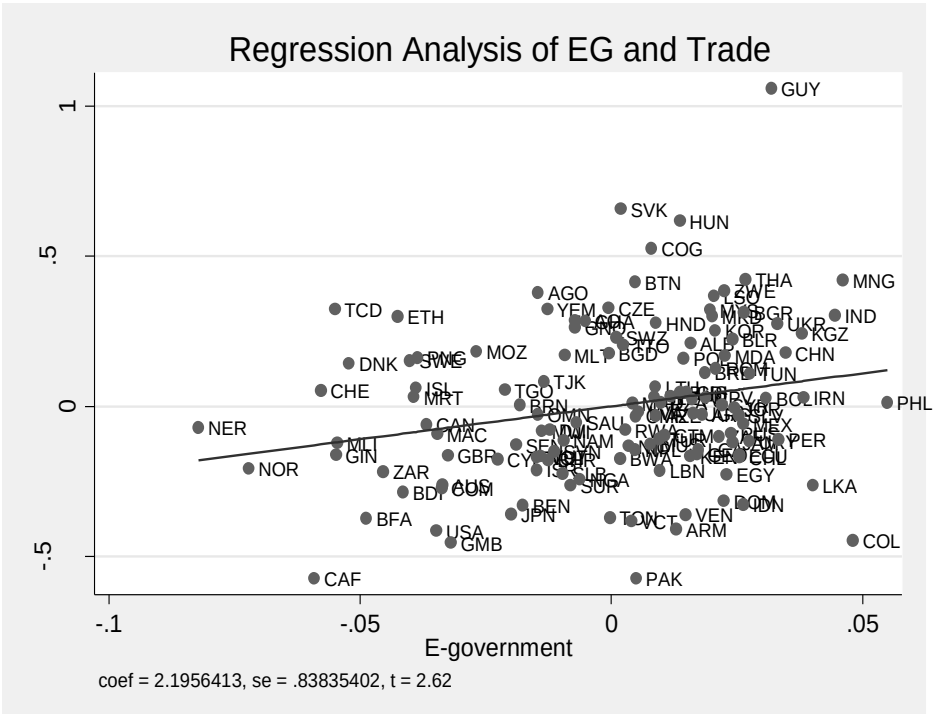


Fig. 4. E-government (EG) and Share of Trade in GDP in Different Geographical Regions

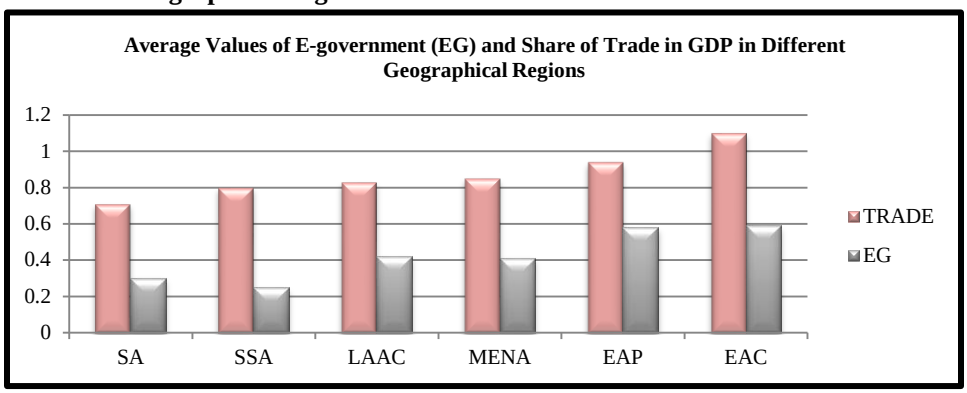
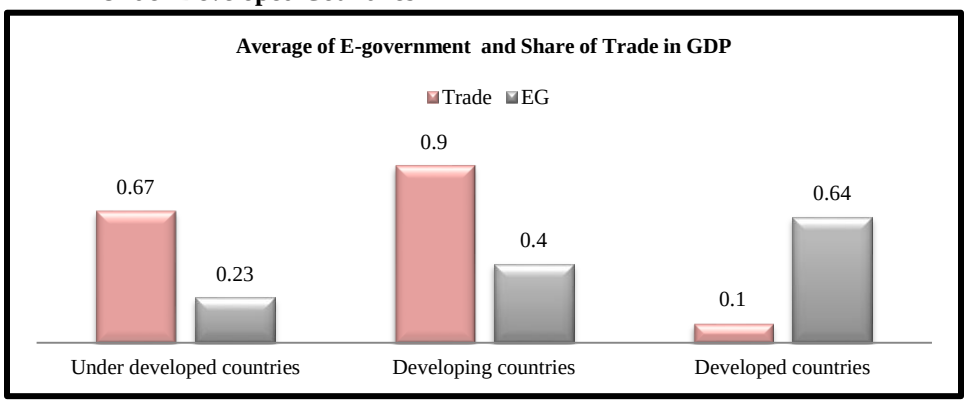


Fig. 5. E-government and Share of Trade in GDP in Developing, Developed and Under Developed Countries



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