

An Empirical Analysis of E-Government and Economic Growth Nexus: The Role of International Trade

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Abstract

The growing importance of e-government and international trade has captured the attention of policy makers who are determined to enhance the per capita income of an economy. This study presents new evidence on the impact of e-government on economic growth by considering the mediating role of international trade. Empirical analysis is based on the framework of macroeconomic growth model. The scope of the study is cross sectional multiyear average dataset of 147 countries across the globe. This paper presents first empirical research on the interactive effect of trade and e-government on economic growth. Two Stage Least Squares technique suggests that positive impacts of e-government and international trade on economic growth are strengthened by the interaction of trade and e-government. The economies of the world can benefit from trade if satisfactory quality of e-government has assured.

Keywords: Trade, Economic Growth, E-Government

JEL Classification: F14, O32, O33, O40, L86

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INTRODUCTION

The growing importance of international trade for economic prosperity of a nation has attracted the attention of many scholars from around the world (Freund and Weinhold, 2004; Meijers, 2013). However, the extant studies provide conflicting findings. The literature has illustrated both positive and negative effects of international trade on economic growth (see, for details, Majeed, 2016). The empirical studies, however, have ignored the role of information and communication technology (ICT) in shaping the relationship between international trade and economic growth.

Modern economic growth theories generally consider the importance of technology, research and development (R&D) and knowledge innovations to boost economic growth (Majeed & Ayub, 2018). These theories also recommend that investment in ICT is a potential source of rapid and sustainable economic growth. According to the World Bank (2016), digital technologies overcome information barriers, augment factors through automation and coordination, and transform products through scale economies and platforms. Consequently, digital technologies increase inclusiveness, efficiency, and innovations in a knowledge economy.

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There are few studies in the literature that have explored the impacts of information and communication technology (ICT) and international trade on economic growth (Majeed, 2016; Sassi and Goaid, 2013; Andrianaivo and Kpodar, 2011) but no study has considered the role of ICT implementation in public sector, referred as electronic government (e-government). There is a significant difference between ICT and e-government. The ICT refers to the “technologies that provide access to information through telecommunications” whereas e-government refers to online availability of government that hires services of ICT tools for delivery of its services to citizens, businessman, and stakeholders.

Numerous policy makers, national and international organization have consensus that e-government can play a key role in improving economic performance of a country. The concept of e-government refers to practicing tools and infrastructures of ICT in public administration, authorizing citizens, ameliorating the provision of public sector services, boosting transparency, and upgrading the efficiency of public policy. UNDP (2006) defines e-government as a government which adopts the tools of ICT infrastructure to share information and provide services to the masses of people. According to Von Haldenwang (2004), e-government denotes the implementation of information and communication technology in public sector planning and administration. The provision of rapid, convenient, efficient, and transparent services by public sector by the dint of information technology is named e-government (Tandon, 2005; and Chen et al. 2009).

Recently, some studies have provided the evidence on favorable effects of e-government on economic growth (Gul et al., 2020; Majeed & Malik, 2016a; Majeed & Malik, 2016b; Majeed & Malik, 2017). Majeed & Malik (2016a) provided empirical evidence on favorable role of e-government for international trade and growth. However, this study ignores the impact of international trade on economic growth through e-government. Majeed & Malik (2016b) highlighted the importance of financial sector and e-government for economic prosperity. Their study showed that the direct impact of e-government on economic growth is positive but insignificant, whereas its indirect impact through financial sector is significant and positive. Majeed & Malik (2017) also confirmed the positive impact of e-government on economic growth using a cross-country analysis. More recently, Gul et al. (2020), showed that e-government enhances economic growth of middle-income countries. These studies establish the importance of e-government for economic growth but do not consider the role e-government in mediating the growth impact of international trade.

E-government facilitates the international trade by mitigating the market frictions, transaction cost, information cost, and market information. Internet has positive consequences on trade. Different studies in the literature have proved that internet enhances trade by reducing fixed information cost of entering into the markets (Gnangnon & Iyer, 2018; Meijers, 2013; Freund & Weinhold, 2004). Recently, using an unbalanced panel dataset of 175 countries from 2000 to 2013, Gnangnon & Iyer (2018) found out evidence on the favorable role of internet for integration into the world trade in commercial services market. Thus, internet mediates the impact of international trade on economic growth. However, internet is just one dimension of e-government.

A large body of the literature has focused on trade growth nexus. However, the role of ICT in shaping the nexus between growth and trade is less focused. Particularly, the role of

e-government in explaining the impact of trade on growth is not investigated. It is imperative to investigate whether growth effects of trade vary depending upon the quality of e-government. Economies with high level of e-government are in a better position to take the advantage of global economy. Likewise, many studies have investigated the nexus between ICT and economic growth, but few studies have considered the role of trade. The existing studies have established the importance of e-government for economic growth but did not consider the indirect impacts of e-government on economic growth. The findings of the existing studies cannot be generalized as they have largely focused on developed countries or a small group of countries. Moreover, the potential issue of endogeneity between e-government and economic growth is not focused. In addition, the literature has mainly focused on ICT while relating the economic growth with trade development. There is not a single study in the literature that has considered e-government while addressing the trade and growth nexus.

We have sorted out both exclusive and interactive impacts of international trade on economic growth by answering following research questions. Does e-government boost economic growth? Does trade openness strengthen the contribution of e-government in economic growth?

This study contributes into the two strands of the literature namely trade growth nexus and ICT growth nexus in following ways: First, this study is first of its kind that has empirically explored the impact of international trade on growth depending upon the quality of e-government. Second, this study provides global evidence suggesting broader implications for global and national policies. Third, this study provides reliable estimates using instrumental variables estimation approach. Particularly, this study employs both internal and external instruments to validate empirical findings. Fourth, this study also disaggregates e-government into its different components to provide comprehensive analysis. Fifth, this study provides robust evidence using heteroskedasticity and autocorrelation consistent (HAC) approach and conducting a sensitivity analysis.

The paper is arranged as follows: section 2 enunciates the literature on e-government and economic growth nexus, section 3 provides insights on e-government and trade relationships, section 4 presents empirical methods, section 5 presents the discussion and findings, and last section 6 concludes the results and proposes policy implications.

E-Government and Growth Nexus

Software development has captured the attentions of policy makers who are adherent to enhance the economic performance of an economy. Software development has a significant contribution in information technology industries. Summer (1999) shed light on the importance of information technology in contributing to economic development of a country. However, this study is limited in its scope as it only focused on software development as a source of economic performance.

The theoretical literature advocates the positive relationship between e-government and economic development. E-government helps to tap the actual potential of an economy by diffusing the knowledge and information facilitates. There are few studies, which have empirically conducted the research on macro-economic consequences of e-government. In

theoretical literature the positive consequence of e-government on economic prosperity of country has discussed but empirical studies are limited.

Later studies focused on internet to explain growth differences across the world. For example, Choi and Yi (2009) investigated the empirical relationship between economic growth and internet for 217 countries over the period 1991-2000. They have applied static and dynamic panel data techniques to estimate the empirical results. The findings suggest that an increase in internet subscription boosts the growth about 0.05%. Internet is a component of e-government and it facilitates the online availability of public administration that contributes in economic growth by mitigating information cost and disseminating information.

Similarly, Czernich et al. (2011) empirically explored merely the broadband-growth nexus. They have applied Ordinary Least Squares (OLS) and Two Stage Least Squares (2SLS) to investigate the relationship between broadband and economic growth. The scope of their research was OECD countries over the time span 1996-2007. They have introduced dummy variables for broadband that is they assigned the value one if broadband has been adopted and zero otherwise. The findings supported the positive relationship between broadband and economic growth. The findings of this study cannot be generalized as it only focused on developed countries. Moreover, the results of this study are not reliable as it does not resolve the issue of endogeneity between broadband and economic growth.

In another study, Mahyideen et al. (2012) has scrupulously examined the contribution of ICT in economic prosperity of ASEAN countries. They have done their analysis for a period of 1976 to 2010 by employing heterogeneous co-integration technique. They argued that ICT improves the marginal productivity of input that, in turn, increases economic growth. The empirical findings confirm the long run relationship between ICT and economic growth. The evidence of this study is limited to the ASEAN region. Moreover, the issue of endogeneity is not resolved.

Aforementioned studies, generally focused on ICT, which is just one dimension of e-government. Recently, some studies have provided the evidence on favorable effects of e-government on economic growth (Majeed & Malik, 2017; Gul et al., 2020). Majeed & Malik (2017) also confirmed the positive impact of e-government on economic growth using a cross-country analysis. More recently, Gul et al. (2020), showed that e-government enhances economic growth of middle-income countries. These studies establish the importance of e-government for economic growth but do not consider the indirect impacts of e-government on economic growth.

Few studies have noted the channels through which e-government contributes to economic growth (Krishnan, Teo, and Lim, 2013; Majeed & Malik, 2016a, b). Krishnan, Teo, and Lim (2013) have conducted the empirical research on environmental degradation, corruption, and e-government. They have employed SEM (structural equation model) to find out the direct and indirect consequence of e-government on economic development. The scope of their studies was cross sectional data of 105 countries across the world covering the years from 2004 to 2008. The findings of their studies inferred the insignificant direct effect of e-government on growth, but it is supported through environmental degradation and corruption.

Majeed & Malik (2016a) provided empirical evidence on favorable role of e-government for international trade and growth. However, this study ignores the impact of international trade on economic growth through e-government. Majeed & Malik (2016b) highlighted the importance of financial sector and e-government for economic prosperity. Their study showed that the direct impact of e-government on economic growth is positive but insignificant, whereas its impact through financial sector is significant and positive. Recently, Majeed and Shah (2018) provided the evidence on favorable effects of e-government on economic growth for Asian economies.

The above discussion suggests that the research on the role of ICT for economic growth has flourished in the recent decades. The research generally focused on regional analysis. Earlier studies mainly focused on ICT and the recent studies are considering the role of e-government, but less attention has been paid to the channels through which e-government fosters economic growth. Moreover, the potential issue of endogeneity between e-government and economic growth is not focused.

E-Government's Contribution in Economic Growth through Trade

This section provides the discussion on the linkages between e-government, trade and economic growth. Trade is an engine of economic growth. The trade barriers in terms of tariffs discourage international economic integration. Similarly, non-tariff barriers such as different transaction, communication and fixed entry costs also hamper smooth trade flows. The only dismantling of tariffs is not necessary for trade promotion but communication infrastructure is also crucial (Majeed and Ahmad, 2006). E-government dismantles non-tariff barrier by reducing different transaction, communication and fixed entry costs and facilitates interactions among traders.

Internet has positive consequences on trade. Different studies in the literature empirically proved that internet enhances trade by reducing fixed information cost of entering into the markets (Meijers, 2013; Freund and Weinhold, 2004). Freund and Weinhold (2004) proposed that internet used by government stimulates export and imports. They mainly focused on a puzzle that does internet stimulate bilateral trade or not? To analyze the results, they employed the panel data of 56 developing countries ranges from 1995 to 1999. The variables they used in their research paper are growth of exports, growth of measure of internet like webs called host, and geographical distance between the trading partners. The results of their estimation demonstrate that internet positively affects export by reducing fixed information cost of entering the international market, but internet is not directly affected by export and geographical differences. The results of their estimations indicate that during period 1997 to 1999 internet causes 1% increase in export.

Majeed and Ahmad (2006) empirically investigated the determinants of exports for developing countries. They proposed that in present era communication tools have become part and parcel of life and communication facilities such as television and telephones are important determinants of export. Scope of their study was panel data of 75 developing countries over the years of 1970-2004. In order to capture heterogeneity, they have applied fixed effects model in their study. Empirical results of their estimation infer that telecommunication technology such as telephone is also an important determinant of export.

Statistics indicates that the 1% increase in telephones per 1000 inhabitant will bring 0.003% increment in exports. The study confirms that telephones and communication tools have significant positives effect on export.

Clarke and Wallsten (2006) also empirically confirmed that internet stimulates trade in developing countries. They employed the data of developed and developing countries firms to prove internet as export stimulus. They empirically found the contributions of internet in trade of both developed and developing countries and checked the relationship exclusively for developed and developing countries. The results of their study estimated by 2SLS and OLS show that internet has significant impact on developing countries export but insignificant effect on developed countries export. The instruments used for internet were monopoly over the data line and monopoly over internet service producer.

Meijers (2013) empirically explored growth-internet, internet-trade, and trade-growth nexus to confirm that internet has positive significant impact on trade openness. He used the panel data of almost 162 countries over the time period of 1990-2008. His findings were based on empirical model estimated by static and dynamic panel data techniques, Panel Granger Causality test, and simultaneous equation model such as 2SLS, 3SLS and SUR (Seemingly Unrelated Regression).

Results indicate the presence of unilateral causality between internet and trade from internet to trade. There is also unilateral causality between internet and economic growth from economic growth to internet and unilateral causality between trade and economic growth from trade to economic growth but not vice versa. Results of simultaneous equation model confirm that internet has indirect impact on economic growth through trade whereas direct effect of internet on economic growth is almost insignificant in all the econometrics techniques. Findings are contrary to Clarke and Wallsten (2006) because they argued that the internet has positive impact only on the trade of developing countries.

Kurihara and Fukushima (2013) checked the relationship between trade and internet. They stated that the number of internet users have been increased in Asia since 2005 and become doubled from 2007 to 2011. They highlighted that internet enhances trade by delivering information regarding different goods in various regions. They employed Gravity Trade Model in their study which proposes that bilateral trade between two countries is directly proportion to product of their GDP and inversely proportion to distance between the countries. They employed panel data set of 34 developed and 24 Asian countries for year 2005 and 2010. The result infers that internet has positive significant impact on trade for both developed and Asian developing countries. The coefficient of internet of Asian countries in 2005 was stronger than that of the coefficient of internet in developed countries which illustrates that internet in developing has stronger positive impact on trade than developed countries in 2005. Limitation of their study is that they excluded some trading partner due to unavailability of data.

Yadav (2013) studied the impact of internet in Asian and Sub-Saharan African countries. He proposed that internet has significant impact on exports and imports of firms in Asian and Sub-Saharan African countries. He mentioned that firm has to face fixed information costs in order to enter in international market but internet enables firm to shun entry costs. He took the data of 23,789 manufacturing and services firms for 52 developing countries of

Asia and Sub-Saharan Africa from 2006 to 2010. Empirical model was estimated by OLS, Logit and Probit models. Results of estimation show that internet has increased exports of different firm on extensive margin and also import of firms but not on intensive margin. The impact of internet on service markets was not significant. He further illustrated that exporting firms earns high profit than non-exporting firms, pays high wages, have greater productivity, and contributes in world economic development.

In the light of above literature, it can be concluded that e-government has positive impact on trade by facilitating interaction and communication among different trading partners. Tools of information systems such as e-mail and search engine, Skype and video-conferencing help firm to escape from fixed information cost of entry. Producers can easily get information regarding their products such as demand, price, and input and can communicate with one another from thousands of miles. Most of the empirical studies infer that to enjoy the fruit of trade, developing and less developed countries should invest more on installation of ICT infrastructure in public sector to bolster the world economic development.

The literature has mainly focused on ICT while relating the economic growth with trade development. There is not a single study in the literature that has taken into account e-government while addressing the trade and economic growth nexus. The rising importance of e-government has opened the avenue of research on e-government and its consequences on macroeconomic variables. This manuscript has mainly looked trade impact on economic development in the presence of e-government. Figure 1 summarizes the indirect impact of e-government on economic growth through trade.

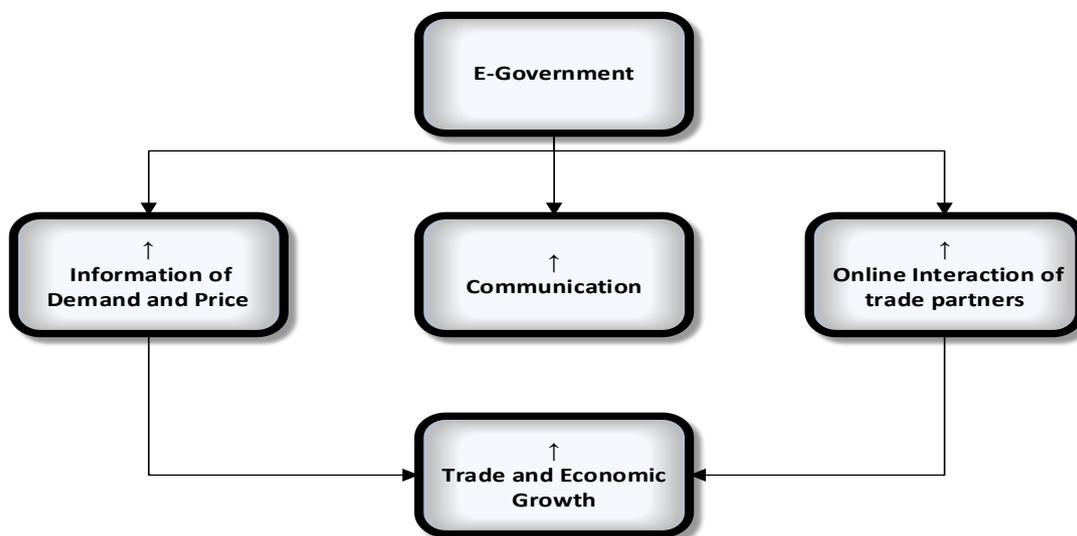


Figure 1: The impact of e-government on growth through trade

METHODS

The essence of this paper is to find empirically the link between e-government, international trade, and economic growth. The impact of e-government on economic prosperity of country has estimated provided the given level of international trade. The empirical analysis is based on a simple macroeconomic model developed Mankiw, Romer and Weil (1992).

$$y = f(A, k, n, h)$$

$$y_i = \beta_0 + \beta_2 A_i + \beta_3 k_i + \beta_4 n_i + \beta_5 h_i + e_i \quad (1)$$

y is per capita income, A refers to the state of technology, k is physical capital, and n refers to the work force. Our model evolved from the above model of Mankiw, Romer and Weil (1992) having capital, labor force and human capital as inputs in output production functions. The pioneer model assumes constant returns to scale. The difference is that physical capital, labor force and human capital not merely explain divergence in per capita income among countries (Majeed, 2019) but the state of technology also drives the economic fate of a country. Following Barro (1998) we have introduced initial level of per capita income as independent variable to grab the convergence effects.

$$y_i = \beta_0 + \beta_1 A_i + \beta_2 y_{initial,i} + \beta_3 k_i + \beta_4 n_i + \beta_5 h_i + e_i \quad (2)$$

The state of technology also explains the divergence among the income of the countries. The technological progress has been proxied by different factors such as information technology (Clarke and Wallsten, 2006; Meijers, 2013; and Noh and Yoo, 2008), information and communication technologies (Sassi and Goaid, 2013; Majeed, 2018; Majeed & Ayub, 2018). Instead of ICT technology we are going to proxied technology by e-government that is a wider measure of technological progress. It covers wide range of ICT infrastructure and skilled human capital that can operate the e-government. The quality of e-government not merely explains the state of technology in a country but also explains the state of implementation and adoption of the technologies. The equation 2 can be written as

$$y_i = \beta_0 + \beta_1 E_{government}_i + \beta_2 y_{initial,i} + \beta_3 k_i + \beta_4 n_i + \beta_5 h_i + e_i \quad (3)$$

The rising importance of trade has captured the attention of policy makers who are determined to exalt the economic development of a country. After incorporating trade into the model, equation (3) can be written as follows:

$$y_i = \beta_0 + \beta_1 y_{initial,i} + \beta_2 E_{government}_i + \beta_3 k_i + \beta_4 n_i + \beta_5 HC_i + \beta_6 Trade_i + e_i \quad (4)$$

The theoretical literature on e-government has underscored the positive contribution of e-government on economic growth. It might be possible that the impact of increase in e-government quality may be different provided the difference in international trade of countries. This idea can be expressed by introducing the interactive terms of $(E_{government}_i \times Trade_i)$ in right side of linear production function. E-government indirectly affects economic growth through trade. E-government supports trade by facilitating interaction among different trading partners. The impact of e-government on economic growth may vary in different liberalized economies. It can be positive in high liberalized economies and can be negative in poor liberalized economies. Thus, to estimate it empirically we have introduced interactive term of e-government and trade in equation (4).

The marginal impact of e-government on economic growth is not constant but depends on the level of international trade.

$$y_i = \beta_0 + \beta_1 y_{initial,i} + \beta_2 Egovernment_i + \beta_3 k_i + \beta_4 n_i + \beta_5 h_i + \beta_6 Trade_i + \beta_{26} Egovernment_i \times Trade_i + \beta_8 Z_i + e_i \quad (5)$$

Trade is measured as a share of export plus import in total GDP, e is an error term and Z is the vector of control variables such as government consumption, population, and inflation. The impact of change in trade on economic growth can be different provided the difference in e-government quality. The sole impact of e-government on economic growth is measured by coefficient β_6 whereas net marginal impact of trade in relationship with e-government will also depend on coefficient β_{26} .

$$\frac{\partial y_i}{\partial Trade} = \beta_6 + \beta_{26} Egovernment_i \quad (6)$$

The presence of trade and interactive term of e-government and trade will let us scrupulously explore the impact of international trade on economic growth in the presence of e-government. The exclusive effect of e-government on economic growth is represented by β_2 of interactive term is omitted and net marginal impact of e-government on growth will also depend on the coefficient β_{26} .

$$\frac{\partial y_i}{\partial Egovernment_i} = \beta_2 + \beta_{26} Trade_i \quad (7)$$

The net marginal impact of e-government on growth is not constant but depends on trade integration. Similarly, the net marginal impact of trade on economic growth is also not constant and depends on e-government. The data was taken from the World Development Indicators and E-government Development Index provided by World Bank and United Nations. The empirical is based on the multiyear averages of data from of countries across the world.

The multiyear averages of data ranging from 2003 to 2018. The data of e-government has extracted from EGDI (e-governance development index). E-government data refers to the online availability of government and web connections to deliver its services. E-government index is the weighted average of three indexes that is web connectivity, telecom infrastructure, and skilled labor. All the components have assigned equal weights of 0.33. Data ranging in zero to one refers to worst to best quality of e-government. The discretion of variables and data sources is given in appendix (Table A1).

DISCUSSION AND FINDINGS

Table 1 reports the results of regression of e-government and trade on economic growth using panel OLS. Column (1) in table 1 indicates that the impact of e-government on economic growth is positive and significant implying that 1% increase in e-government leads to 0.9% increase in economic growth. Moreover, the coefficient of the interactive term of e-government and trade shows that 1% increase in e-government quality in relationship with trade causes 0.0043% increase in economic growth. Thus, empirical results confirm that e-government is also contributing in economic growth through trade. The coefficient of initial income is positive and significant in column (1) of table 1.

Empirical results in 2nd, 3rd and 4th column of table 1 are remained consistent with first regression after incorporating other control variables. The results illustrate that the effect of

e-government on economic growth in absence of trade is significant. In 5th column of Table the results for developing countries show that coefficient of interactive term of e-government and trade is positive but insignificant.

Table 1. Empirical Findings of E-government, Trade, and Economic Growth (OLS)

Growth Dependent	(1)	(2)	(3)	(4)	(5)	(6)
Y_ initial	0.707*** (0.0344)	0.704*** (0.0340)	0.702*** (0.0340)	0.677*** (0.0347)	0.658*** (0.0486)	0.682*** (0.0383)
Capital	0.0295** (0.0116)	0.0302*** (0.0114)	0.0299*** (0.0114)	0.0319*** (0.0112)	0.0256 (0.0161)	0.0239* (0.0133)
Labor	0.0126 (0.173)	0.0446 (0.171)	0.0354 (0.171)	-0.0189 (0.169)	0.272 (0.242)	-0.0302 (0.179)
HC	0.235*** (0.0708)	0.266*** (0.0715)	0.274*** (0.0716)	0.280*** (0.0708)	0.159 (0.105)	0.226** (0.0874)
E-government	0.931*** (0.273)	0.861*** (0.271)	0.915*** (0.275)	0.668** (0.283)	1.354** (0.537)	
EG*Trade	0.00473*** (0.00133)	0.00396*** (0.00136)	0.00380*** (0.00137)	0.00248* (0.00144)	0.00146 (0.00260)	
Inflation		-0.0490** (0.0236)	-0.0460* (0.0237)	-0.0308 (0.0244)	-0.0509 (0.0370)	
Govt-Con			0.0586 (0.0484)	0.0644 (0.0475)	0.0234 (0.0725)	
Financial Dev				0.107*** (0.0406)	0.125* (0.0634)	
Online service						0.502 (0.351)
Telecom infra						0.674** (0.329)
OS*Trade						0.00250 (0.00176)
Tel*Trade						0.000947 (0.00363)
Constant	1.030 (0.870)	0.966 (0.859)	0.842 (0.863)	1.339 (0.869)	0.708 (1.266)	1.371 (0.906)
Observations	132	132	132	130	68	132
R-squared	0.951	0.953	0.953	0.956	0.864	0.952

Note: Standard errors in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Results in 6th column of table 1 illustrate the effect of trade on economic growth in the presence of online service and telecom service. The coefficient of cross terms of e-government components and trade indicates that online service and telecom infrastructure is not contributing in economic growth in the presence of trade but overall effectiveness of e-government infrastructure on economic growth is supported by trade. The net marginal effect of e-government on economic growth is not constant but it depends on trade that can be expressed by taking derivative of baseline model with respect to e-government.

$$\frac{\partial \log Y}{\partial EG} = 0.931 + 0.0047 \text{Trade}$$

The net effect of e-government on economic growth is 0.9347% (0.931 + 0.0047) that is positive. Contribution of e-government in economic growth also depends on trade. E-government impact on economic growth originates from trade. Sole impact of e-government on economic growth is 0.931% in the absence of trade. While in presence of trade the impact of e-government on economic growth is increased from 0.931% to 0.9347%, so it means the impact is strengthened by trade. We can conclude that e-government is strongly contributing in economic growth through trade or in other words trade is strengthening the positive impact of e-government on economic growth.

In order to cope with the problem of cross-sectional heterogeneity, heteroskedasticity and autocorrelation consistent (HAC) regression is employed. Findings of HAC indicate that e-government has a positive and significant impact on economic growth. The coefficients of initial income throughout all the four regressions are remained positive and significant. The coefficients of cross terms of “trade and e-government” are positive and significant.

Table 2. Empirical Findings of HAC

Growth (Dependent)	(1)	(2)	(3)
Y_initial	0.696*** (0.0417)	0.677*** (0.0409)	0.682*** (0.0432)
Capital	0.0281*** (0.00912)	0.0319*** (0.00691)	0.0307*** (0.00894)
Labor	0.00937 (0.206)	-0.0189 (0.193)	-0.00194 (0.202)
Human Capital	0.251*** (0.0718)	0.280*** (0.0678)	0.280*** (0.0746)
E-government	1.232*** (0.268)	0.668** (0.282)	1.037*** (0.297)
Inflation	-0.0451** (0.0194)	-0.0308 (0.0210)	-0.0363* (0.0208)
Govt_Con	0.0517 (0.0522)	0.0644 (0.0509)	0.0588 (0.0530)
Trade	0.118** (0.0469)		0.106** (0.0474)
EG*Trade		0.00248* (0.00137)	
Financial dev		0.107*** (0.0351)	
EG*FD			0.0907* (0.0463)
Constant	0.592 (1.022)	1.339 (0.965)	0.723 (0.996)
Observations	132	130	130
R-squared	0.952	0.956	0.953

Note: Robust standard errors in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

In table 2, the coefficient of interactive term of trade and e-government illustrates that 1% increase in e-government quality in relationship with trade causes 0.0025% increase in economic growth. Empirical findings of HAC regression depict that trade is enhancing the

contribution of e-government in economic growth. The net marginal effect of e-government on economic growth is not constant but it is the function of trade. The net marginal impact of e-government on economic growth in the presence of trade is 0.6705% (0.668+0.0025) which is stronger than its exclusive impact.

$$\frac{\partial \log Y}{\partial EG} = 0.668 + 0.0025Trade$$

The empirical results of first stage of baseline model illustrate that instruments are strong and valid. The share of urban population and fixed telephone are significantly affecting e-government. Among internal instruments initial per capita income, human capital and labor force have significant impact on e-government.

Table 3. First Stage Results (2SLS)

E-government (dependent)	(1) All countries	(2) All countries	(3) All Countries	(4) All countries
Y _{initial}	-0.0107 (0.00991)	-0.0110 (0.0100)	-0.00887 (0.0100)	-0.0104 (0.0101)
Capital	0.0186 (0.0254)	0.0177 (0.0258)	0.0269 (0.0263)	0.0292 (0.0277)
Labor	0.169*** (0.0428)	0.170*** (0.0432)	0.167*** (0.0430)	0.165*** (0.0430)
Human Capital	0.104*** (0.0151)	0.104*** (0.0157)	0.0976*** (0.0161)	0.0963*** (0.0162)
EG*Trade	0.000400 (0.000310)	0.000380 (0.000325)	0.000428 (0.000324)	0.000335 (0.000337)
Fix_Tele	0.00530*** (0.000575)	0.00526*** (0.000605)	0.00528*** (0.000601)	0.00515*** (0.000626)
Urban_pop	0.00193*** (0.000458)	0.00195*** (0.000476)	0.00181*** (0.000481)	0.00182*** (0.000483)
Inflation		-0.00130 (0.00611)	-0.00128 (0.00607)	-0.000414 (0.00633)
Govt_Con			-0.0188 (0.0118)	-0.0181 (0.0118)
Financial_Dev				0.00738 (0.00920)
Constant	-0.823*** (0.218)	-0.823*** (0.219)	-0.780*** (0.219)	-0.762*** (0.223)
Observations	130	130	130	129
R-squared	0.895	0.895	0.898	0.899
F-stat	149.19	129.52	116.87	105.12

*Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

The R-square in 1st column of table 3 is 0.895% that shows about 90% variation in e-government is explained by instrumental variables. The values of F-stat and R² indicate that our instruments are strong. First stage results of 2SLS only tell the strength of instruments. To check the validity of instrument Sargan and Basmann test of over identified restriction are employed in table 4 below. The test of over identified restriction indicates that our instruments are valid.

Table 4. Tests of Over Identifying Restrictions

Ho: Instruments are Exogenous		
Tests	Chi (2)	P-value
Sargan test	4.86867	0.369
Basmann test	4.632	0.383

The results of Second Stage are reported in table 5. The column (1) in table 5 indicates that e-government has positive impact on economic growth. The coefficient of e-government reveals that 1% increase in e-government in absence of trade causes 1.418% increase in economic growth. The coefficient of initial income is remained positive and significant even after controlling with control variables. The interactive term of e-government and trade is positive and significant that reveals 1% increase in e-government in presence of trade causes 0.0037% increase in economic growth. The results exhibit that e-government also contribute in economic growth through trade.

Table 5. Second Stage Results (2SLS) – Equation 8

Growth (dependent)	(1)	(2)	(3)	(4)
	All Countries	All Countries	All countries	All countries
E-government	1.418*** (0.351)	1.354*** (0.352)	1.374*** (0.358)	1.452*** (0.379)
Y _{initial}	0.711*** (0.0355)	0.709*** (0.0352)	0.706*** (0.0357)	0.701*** (0.0353)
Capital	0.526*** (0.0978)	0.504*** (0.0982)	0.492*** (0.101)	0.547*** (0.105)
Labor	-0.168 (0.176)	-0.152 (0.175)	-0.155 (0.175)	-0.167 (0.174)
Human Capital	0.0434 (0.0794)	0.0701 (0.0814)	0.0765 (0.0811)	0.0714 (0.0807)
EG*Trade	0.00369*** (0.00122)	0.00328*** (0.00125)	0.00322** (0.00125)	0.00318** (0.00128)
Inflation		-0.0290 (0.0221)	-0.0282 (0.0222)	-0.0341 (0.0231)
Govt_Con			0.0246 (0.0459)	0.0252 (0.0455)
Financial_Dev				-0.0145 (0.0360)
Constant	0.784 (0.957)	0.812 (0.947)	0.791 (0.944)	0.715 (0.939)
Observations	130	130	130	129
R-squared	0.957	0.958	0.958	0.959

Note: Standard errors in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The net marginal effect of e-government on growth can be expressed as:

$$\frac{\partial \log Y}{\partial EG} = 1.418 + 0.0037Trade^{***}$$

The net marginal impact of e-government on trade is equal to 1.4217% (1.418 + 0.0037). The net effect of e-government on economic growth is stronger than its exclusive impact,

which denotes that trade is supporting the contribution of e-government in economic growth. In 2nd, 3rd and 4th column of table 5 the coefficients of cross term of trade and e-government remained positive and significant. Physical capital has also positive significant impact on economic growth whereas labor supply and human capital have insignificant impact on economic growth.

The coefficient of inflation infers that 1% increase in inflation causes 0.029% decrease in economic growth. The sign of coefficient of inflation is consistent with literature. Results demonstrate that 1% increase in initial income of country will cause 0.711% increase in economic growth. The sign is also consistent with convergence theory because most of the countries in our data are developing countries which have low initial income so there is positive relationship between low initial income and economic growth.

CONCLUSION

This study presents new evidence on the impact of e-government on economic growth by considering the mediating role of international trade. For this purpose, we have introduced the interactive term of e-government with international trade. We have used OLS in cross-sectional data to empirically explore the linkage between e-government and economic growth through international trade. Then we have used HAC regression to tackle the heteroskedasticity in cross-sectional data set. Finally, to tackle the problem of endogeneity in empirical model we have used 2SLS model.

The results of cross-sectional analysis indicate that e-government has positive impact on economic growth. The coefficient of e-government indicates that 1% increase in e-government quality increases economic growth about 1.06%. The components of e-government are also positively contributing in economic growth. The coefficient of online service indicates that 1% increase in online service boosts up economic growth about 0.77%. The cross term of trade and e-government is positive and significant which denotes that e-government is also contributing in economic growth through trade. Trade is reinforcing the positive impact of e-government on economic growth.

Our study has contributed in the literature through different aspects: First, to the best of our knowledge this is the first empirical study that has checked the effectiveness of e-government on economic growth through trade. Second, the scope of this study is for large numbers of countries across the world. Empirical analysis is also exclusively done for developing countries to suggest favorable policy for developing countries. Third, the study also addresses the issue of simultaneity and endogeneity in the model by using IV techniques.

There are certain limitations of the study. First, long-term effect of e-government on economic growth are not checked because of unavailability of the data for longer time span. Second, sensitivity analysis is limited to few additional control variables. This study has a scope of vast future research. It can be extended for specific regions of the world such as European or Asian countries. Future studies can investigate the interactive effect of e-government on economic growth through other channels such as employment, inequality, and productivity.

In the light of empirical findings, it is recommended that government may rely more on online services and web connections to provide its services. To extract maximum positive consequences of trade on economic growth e-commerce and e-procurement can be

promoted. In addition, investment in human capital needs to be enhanced to take the maximum advantages of global economy through e-government.

REFERENCES

- Andrianaivo, M., & Kpodar, K. (2011). *ICT, financial inclusion, and growth evidence from African countries*. International Monetary Fund working paper, 11/73.
- Barro, R.J. (1998). *Determinants of economic growth: a cross-country empirical study (1st ed.)*. Massachusetts, USA: MIT Press Books, The MIT Press.
- Chen, A. J., Pan, S. L., Zhang, J., Huang, W. W., & Zhu, S. (2009). Managing e-government implementation in China: A process perspective. *Information & Management*, 46(4), 203-212.
- Choi, C., & Hoon Yi, M. (2009). The effect of the internet on economic growth: Evidence from cross-country panel data. *Economics Letters*, 105(1), 39-41.
- Clarke, G. R., & Wallsten, S. J. (2006). Has the internet increased trade? Developed and developing country evidence. *Economic Inquiry*, 44(3), 465-484.
- Czernich, N., Falck, O., Kretschmer, T., & Woessmann, L. (2011). Broadband infrastructure and economic growth. *The Economic Journal*, 121(552), 505-532.
- Freund, C. L., & Weinhold, D. (2004). The effect of the Internet on international trade. *Journal of International Economics*, 62(1), 171-189.
- Gnangnon, S. K., & Iyer, H. (2018). Does bridging the internet access divide contribute to enhancing countries' integration into the global trade in services markets?. *Telecommunications Policy*, 42(1), 61-77.
- Gul, F., Majeed, M. T., Ahmad, I., Vahid, Z. L., Daniel, M. F., & Máté, D. (2020). The nexus of E-government and increased productivity relative to income level comparison. *Business, Management and Education*, 18(1), 88-105.
- Krishnan, S., & Teo, T. S. (2013). Moderating effects of governance on information infrastructure and e-government development. *Journal of the American Society for Information Science and Technology*, 63(10), 1929-1946.
- Kurihara, Y., & Fukushima, A. (2013). Impact of the prevailing internet on international trade in Asia. *Journal of Sustainable Development Studies*, 3(1), 1-13.
- Mahyideen, J. M., Ismail, N. W., & Law, S. H. (2012). A pooled mean group estimation on ICT infrastructure and economic growth in ASEAN-5 countries. *International Journal of Economics and Management*, 6(2), 360-378.
- Majeed, M. T. (2016). Economic growth, inequality and trade in developing countries. *International Journal of Development Issues*, 15(3), 240-253.
- Majeed, M. T. (2018). Information and Communication Technology (ICT) and Environmental Sustainability in Developed and Developing Countries. *Pakistan Journal of Commerce and Social Sciences*, 12(3), 758-783.
- Majeed, M. T. (2019). Social capital and economic performance of the Muslim world: Islamic perspectives and empirical evidence. *International Journal of Islamic and Middle Eastern Finance and Management*, 12(4), 601-622.

- Majeed, M. T., & Ayub, T. (2018). Information and communication technology (ICT) and economic growth nexus: A comparative global analysis. *Pakistan Journal of Commerce and Social Sciences*, 12(2), 443-476.
- Majeed, M. T., & Malik, A. (2016a). E-government, economic growth and trade: a simultaneous equation approach. *The Pakistan Development Review*, 499-519.
- Majeed, M. T., & Malik, A. (2016b). E-government, financial development and economic growth. *Pakistan Journal of Applied Economics*, 26(2), 107-128.
- Majeed, M. T., & Shah, A. (2018). An empirical analysis of economic performance of Asian economies: The role of electronic government. *Review of Economics and Development Studies*, 4(1), 91-102.
- Majeed, M. T., and Ahmad, E. (2006). Determinants of Exports in Developing Countries. *The Pakistan Development Review*, 45(4), 1265-1276.
- Majeed, T., & Malik, A. (2017). E-government and economic growth: a panel data analysis. *Kashmir Economic Review*, 26(1), 1-18.
- Mankiw, N. G., Romer, D., & Weil, D. N. (1992). *A contribution to the empirics of economic growth* (No. w3541). National Bureau of Economic Research.
- Meijers, H. (2014). Does the internet generate economic growth, international trade, or both?. *International Economics and Economic Policy*, 11(1-2), 137-163.
- Noh, Y. H., & Yoo, K. (2008). Internet, inequality and growth. *Journal of Policy Modeling*, 30(6), 1005-1016.
- Sassi, S., & Goaid, M. (2013). Financial development, ICT diffusion and economic growth: Lessons from MENA region. *Telecommunications Policy*, 37(4), 252-261.
- Summers, Lawrence (1999) Reflections on Managing Global Integration, *Journal of Economic Perspectives (U.S.)*, 13, 3-18.
- Tandon, H. (2005). E-governance: an Indian perspective. *Policy and Society*, 24(3), 142-169.
- United Nations (2018). *United Nations e-government survey 2010: Leveraging e-government at a time of financial and economic crisis*. New York: Department of Economic and Social Affairs. Available from http://www.unpan.org/egovkb/global_reports/08report.htm.
- United Nations Development Program (UNDP, 2006). Fighting corruption with e-government applications. *APDIP e-note 8*. Available from <http://www.unapcict.org/ecohub/resources/apdip-e-note-8-fighting-corruptionwith-e>.
- Von Haldenwang, C. (2004). Electronic government (e-government) and development. *The European Journal of Development Research*, 16(2), 417-432.
- World Bank (2016). *World development report 2016: Digital dividends*. World Bank, Washington, DC.
- Yadav, N. (2014). The Role of Internet Use on International Trade: Evidence from Asian and Sub-Saharan African Enterprises. *Global Economy Journal*, 14(2), 189-214.

Appendix

Table A1: Summary of variables and data sources

Variables	Definition	Source
Per capital GDP	“GDP per capita at constant (2005) U.S dollars.”	[1]
E-government	“The online presence and web connection of government in order to deliver its responsibilities.”	[2]
Online service	“Degree of the webconnectivity and online accessibility of government.”	[2]
Telecom service	“Degree of telecommunication substructure of the government.”	[2]
Human capital	“Gross secondary school enrollment of total population.”	[1]
Physical capital	“Fixed capital formation (Gross) percentage of GDP.”	[1]
Labor supply	“Share of labor force participation total % of population	[1]
Financial development	Self generated index by taking the principal component analysis of ratio of credit provided to private sector by bank and GDP and ratio of credit provided to private sector by financial sector and GDP.”	[1]
Trade	“Export plus import percentage of GDP.”	[1]
Inflation	GDP deflator	[1]
Urban population	“Percentage of urban population in total population.”	[1]
Fix_Telephone	“Fixed telephone lines per 100 inhabitant.”	[3]

[1] World development indicator (2018); [2] Global e-government reports; [3] ITU statistics