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# The Nexus among Globalization, ICT and Economic Growth: An Empirical Analysis

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**Abstract**

Globalization has integrated the world through interaction among countries and people with the help of information and telecommunication technology (ICT). The rapid mode of globalization has put a new life in ICT and economic sector. The key focus of this study is to examine the nexus among the globalization, ICT and economic growth. This study uses autoregressive distributed lag model (ARDL), vector error correction model (VECM) and econometric method spanning from 1990 to 2015. The empirical result highlights that the globalization stimulates economic growth of a country. In addition, both the internet penetration and the mobile phone usage contribute to the economic growth. Lastly, this article contributes important policy lessons on strengthening the economy by utilizing ICT with the rapid globalization.

**Keywords**

ARLD and VECM, Economic Growth, Globalization, ICT, Pakistan

## 1. Introduction

In the 20th century, the rapid globalization enhanced the development of information and communication technology (ICT) industry as compared to previous centuries. Technology introduces conventional messaging; we can send pictures, videos, and texts across the globe in a few seconds time [1]. The development in the ICT sector through globalization is supposed to contribute in the economic development of a country in both the developed and the developing countries. On the other hand, the mobile phone services are a preferred mode of access for customers, particularly, in the developing countries. Technology plays an important role in the development and expansion of economic activities [2]. Presently, ICT has become a main pillar of the economy; approximately, all the stakeholders including organizations and consumers use mobile phones, internet, and computers for a business activity like providing the consumers a variety of products and improving quality of products.

Among the developing countries, Pakistan is a rapidly globalized nation that experienced an increase in inviting international organization, foreign direct investment (FDI) and international trade. Thereby



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due to higher rate of globalization, the ICT sector in Pakistan has experienced fast growth since the late 1990s. The Pakistan Telecommunication Re-organization Act was implemented in 1996 and later on, in 2004 the liberalization and de-regulation of telecommunications subscription occurred [3]. Most lately, Pakistan has the third largest landline and mobile network, which is due to almost zero restrictions on foreign investment and movement of investment [4,5].

In the late 90's the ICT sector was coupled with rapid economic growth. This sector has adopted modern technology infrastructure along with latest applications in world economies from the last one decade. These applications have initiated new technological advancement and improvement in all sectors of national economy. ICT and its applications remove the trade and investment barriers globally by providing a close linkage between customers, suppliers and firms. Furthermore, the ICT create new opportunities in education and health, which accelerates the diffusion of information all over the world. In fact, the significance of ICT shows that the technologies are rationale.

Against the above background, it is important to investigate the nexus between globalization, ICT and economic growth in Pakistan, which is particularly useful for promoting growth in Pakistan. However, literature review reveals that none of the existing studies has investigated the causal relationship among globalization, ICT and economic growth in the context of Asia-Pacific countries so far. Three main motivating factors led to carry out this study. First, Pakistan is a densely populated region having a favorable ground for the ICT; however, no specific useful study is available in the context of the relationship between ICT and economic growth during the era of globalization. Hence, proper investigation is required in Pakistan. Second, Pakistan needs to adopt effective policies for the development of ICT infrastructure that could prove a good example for other developing South Asian countries. Similarly, the ups and down and speedy structural changes in Pakistan ICT sector provide important policy measures for the other governments to articulate their information industry.

There is a need to explore the factors from the perspective of various parties in developing countries. The contributions of the current study to the existing literature are as follows. Firstly, it is an innovative attempt to analyze the role of ICT contribution to economic growth considering the role of globalization in Pakistan. Secondly, this study will contribute much to the ICT and economic growth literature considering latest data by employing robust estimation procedure. Lastly, we have used ARDL, most robust data estimation approach, for longest available data from 1990–2015, that produces more reliable and efficient estimates.

This research study contains the following sections: Section 2 consists of a brief literature review. In Section 3, a methodological method and data are presented. Results and discussion are given in Section 4, and Section 5 includes the important policy recommendations of the study.

## 2. Literature and Background

An important characteristic of the ICT infrastructure is a positive network externality, which describes that the number of users is directly proportional to the value derived by other users [6]. It means with the increase in a number of users; there will be an increase in a value derived by the users. This characteristic gives ICT an edge over the other service sector such as road, bridges, transit, and ports. Resultantly, higher telecommunications infrastructure leads to higher economic growth in a country [7].

Earlier in the literary history, neo-classical growth-theory economists like [8-10] implicitly defined

that technology increase the growth and development process, these conventional models consisted of diminishing marginal productivity and substitution of labor and capital. Therefore, strengthening the investment ratio and savings, which is a basic driver for economic growth. Later on, new classical economists [11,12] modified the Solow model by including innovation, infrastructure and increasing return of scale into this model, which make it more suitable for analyzing in a growth model. In the beginning of 21st century, the technology was supported by communications, which strengthen the productivity and improved the living standard and well-being of the society [13-15]. Moreover, the modern technology lowers the cost of production and also provides easy access to information which supports consumers to get good quality products at reasonable prices [1].

Some other studies depict a positive impact of ICT on growth like [16,17]. In this regard, Dewan and Kraemer [18] validates a positive contribution of ICT for economic growth for developed countries. The authors explain the idea of "productivity of paradox of ICT," which describes that absence of basic infrastructure and poor policies for ICT investment and inappropriate government policies are the main factors hampering the ICT development in the developing countries. Ashraf and Hoque [19] examines the ICT impact on growth for more than 100 countries for a period of 1996–2005. The authors conclude that with the development of ICT economic growth enhances. For a single country, various studies support technology and growth hypothesis. These studies include: Batuo [20] for African region, Ishida [21] for Japan; Inani and Tripathi [22] uses ARDL approach to determine the relationship between ICT and growth for India, Jalava and Pohjola [23] for Finland; Tang and Tan [24] for Malaysia; Kumar [25] for Nepal; Saidi et al. [26] for Tunisia; Kumar [27] for Vietnam; and Gao and Rafiq [28] for Pakistan. From the above background support, this research study investigates the ICT role for the development of economic growth in Pakistan during 1990–2015.

# 3. Econometric Technique and Data Source

## 3.1 Estimation Model Specification

The main theme of this research study is to investigate the relationship between ICT and economic growth by the significance of the labor force, FDI, and urbanization. To discover the relationship between the variable of interest we formulate the following model:

$$GDP_t = \alpha_0 + \beta_1(ICT_t) + \beta_2(GLOB_t) + \beta_3(URB_t) + \xi_1 \quad (1)$$

where GDP represents economic growth, mob show number of mobiles users, tele means some telephone users per year, URB stand for percentage increase in urban population per year, GLOB shows globalization index and ε stands for the stochastic term.

## 3.2 Econometric Strategy

### 3.2.1 Bound testing method

To reach the goal and achieve the objective, this study uses ARDL and VECM models to find cointegration and direction of causality. In the case of time series data, it is important to check the stationary of all the series to avoid the spurious regression. If the variables are non-stationary, so results obtained in this case are meaningless. According to Nasir and Rehman [29], by taking the first difference

of all variables, the series can be made stationary. Several-integration techniques have been suggested in the literature by [30,31] for short-run and long-run estimates. However, ARDL bounds model is a preferred over other co-integrating technique for small sample size. This produces an unbiased estimate of long-run relationship [32]. The proposed model that should be estimated for co-integration for underlying variables is shown as follow:

$$\Delta\left(\text{gdp}\right)_t = \partial' + \sum_{\gamma=1}^{p} \partial'_y \Delta\left(\text{gdp}\right)_{t-k} + \sum_{\gamma=0}^{p} \partial'_k \Delta\left(\text{ICT}\right)_{t-k} + \sum_{\gamma=0}^{p} \partial'_L \Delta\left(GLOB\right)_{t-k} + \sum_{\gamma=0}^{p} \partial'_m \Delta(URB)_{t-k} + \tau_0 \left(\text{gdp}\right)_{t-1} + \tau_1 (ICT)_{t-1} + \tau_2 (GLOB)_{t-1} + \tau_3 (URB)_{t-1} + \xi_{1t} \tag{2}$$

The null hypothesis for no cointegration is H0 ≠ πY ≠ πRE ≠ πc ≠ πL ≠ 0 against the alternative hypothesis which is H1= πY = πRE = πc = πL = 0. Where Δ represents difference operator and ε indicates the residual term. If the lower critical bound value is greater than computed value, we will reject the hypothesis of cointegration. The critical value of the upper and lower bound is defined by [32]. If the computed F-values lie within the upper and lower bound value result would be inconclusive, after confirmation of cointegration, we can proceed with the analysis to find out the long and short run estimates.

### 3.2.2 VECM Granger causality

For finding the direction of causality among the variables, we apply VECM model. In Table 4, it is confirmed that co-integration exists among variables. After confirmation of cointegration, we proceed our analysis to test the causality among the variables. Causality under ECM is the most appropriate technique, which defines both causalities. The significant negative value of ECMt-1 is an indication of long-run causality. Further, we estimate the coefficient of lag difference and Wald statistic to the difference between all independent variables for short-run relationship. Granger causality VECM approach is expressed as follow:

$$\begin{bmatrix} log\ G\ DP_t \\ log\ I\ CT_t \\ log\ G\ LOB_t \\ log\ U\ RB_t \end{bmatrix} = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \\ \beta_4 \end{bmatrix} + \begin{bmatrix} \beta_{11k} & \beta_{12k} & \beta_{13k} & \beta_{14k} & \beta_{15k} & \beta_{16k} \\ \beta_{21k} & \beta_{22k} & \beta_{23k} & \beta_{24k} & \beta_{25k} & \beta_{26k} \\ \beta_{31k} & \beta_{32k} & \beta_{33k} & \beta_{34k} & \beta_{35k} & \beta_{36k} \\ \beta_{41k} & \beta_{42k} & \beta_{43k} & \beta_{44k} & \beta_{45k} & \beta_{46k} \end{bmatrix} + \begin{bmatrix} \Delta\ log\ G\ DP_{it} \\ \Delta\ log\ I\ CT_{it} \\ \Delta\ log\ G\ LOB_{it} \\ \Delta\ log\ U\ RB_{it} \end{bmatrix} + \begin{bmatrix} \rho_1 \\ \rho_2 \\ \rho_3 \\ \rho_4 \end{bmatrix} ecm_{it-1} + \begin{bmatrix} \vartheta_1 \\ \vartheta_2 \\ \vartheta_3 \\ \vartheta_4 \end{bmatrix} \tag{3}$$

The term *t* indicates the period (1990–2015), *I* is *i*=1,2,3… up to 31, while exit-1 is a lag error and $\vartheta_{it}$ depicts the stochastic error term.

## 3.3 Data Description

In this study, we used data for Pakistan spanning from 1990 to 2015 consistent with the data availability. ICT infrastructure is measured through a number of telephone users per 1,000 and Internet penetration and real GDP per capita measurement is called economic growth. Further, urbanization is measured as percentage (%) of urban population. Data on ICT, GDP per capita and urbanization are borrowed from the World Bank website (https://www.worldbank.org/). Globalization is taken as an index, and the data is collected from KOF index. The trend in the series can be visually seen in Fig. 1.

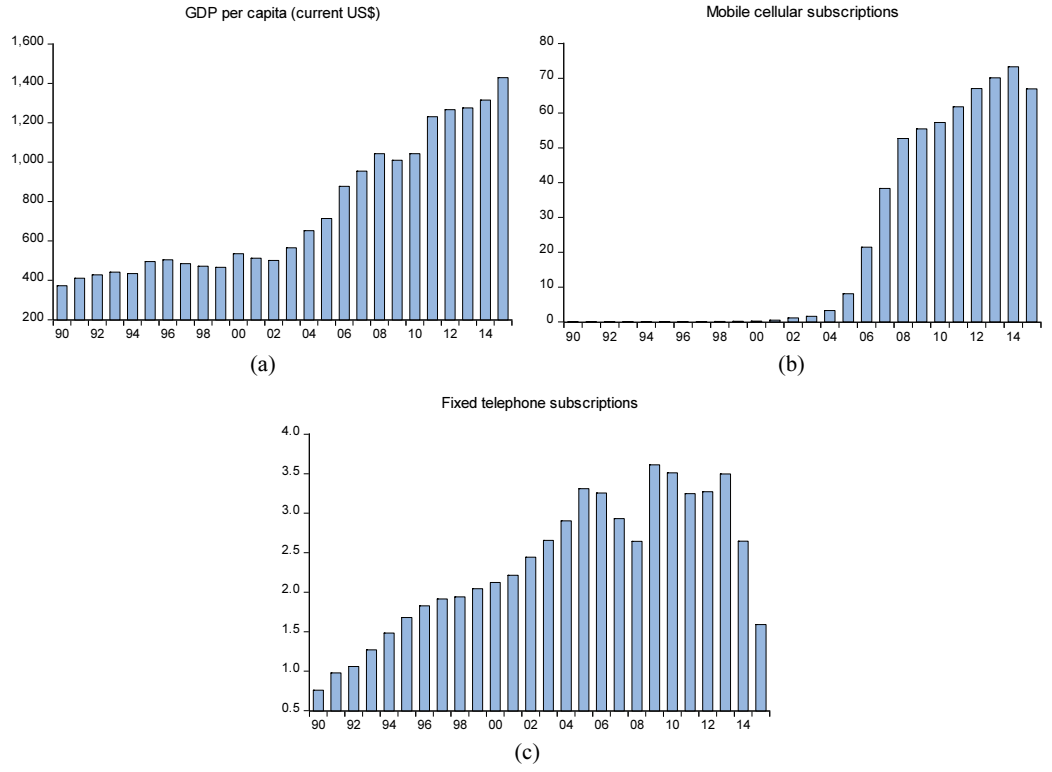


**Fig. 1.** Data on (a) real GDP, (b) mobile phone, and (c) fixed telephone subscription in Pakistan (1990–2014).

# 4. Analysis and Discussion

## 4.1 Unit Root Analysis

To find out the stationarity of variables, normally we used DF-GDL test and Phillips Pearson (PP) tests. The purpose of using DF-GLS and PP at the same time is that to check the consistency of the results. Outcomes from both the unit root tests suggest all the variables are non-stationary at level but integrated at the first difference $I(1)$. The results are given in Table 1.

**Table 1.** Unit root analysis

| Variable | ADF | | | | PP | | | |
|---|---|---|---|---|---|---|---|---|
| | At level | | First deference | | At level | | First deference | |
| | t-value | Prob | t-value | Prob | t-value | Prob | t-value | Prob |
| lnGDP | 0.2732 | 0.971 | -4.2076 | 0.003 | 0.2202 | 0.968 | -4.1913 | 0.003 |
| $\ln ICT_{internet}$ | -6.8481 | 0.000 | -3.8162 | 0.010 | -1.6606 | 0.4381 | -5.7346 | 0.000 |
| $\ln ICT_{mobile}$ | -0.9964 | 0.737 | -3.4048 | 0.021 | -2.2068 | 0.208 | -3.4530 | 0.018 |
| lnGLOB | -3.8401 | 0.007 | -2.7642 | 0.078 | -3.5434 | 0.015 | -2.6848 | 0.091 |
| lnURB | -1.5995 | 0.466 | -2.7495 | 0.081 | -3.0378 | 0.045 | -2.6142 | 0.011 |

## 4.2 Cointegration Results

As all the variable are integrated at first difference, which is indicates that we can use ARDL co-integration methodology for this study. Before applying ARDL, the necessary condition is to choose lag length criteria. We used conventional model selection criteria underlying VAR and confirmed that optimal lag length is two (Table 2).

**Table 2.** Bound testing and diagnostic test

| | Bound testing | | | Diagnostic tests | | |
|---|---|---|---|---|---|---|
| | **F-value** | **Lag order** | **Decision** | **ARCH** | **LM** | **REMSEY** |
| Model A: GDP=LOGICTint LOGGLOB LOGURB | 4.7762 | 1, 1, 0, 0 | Conclusive | 0.1356 [0.716] | 1.2906 [0.299] | 1.4832 [0.238] |
| Model B: GDP=LOGICTmob LOGGLOB LOGURB | 4.5051 | 1, 0, 0, 0 | Conclusive | 2.7232 [0.133] | 2.3860 [0.122] | 2.2571 [0.152] |

*, **, and *** indicate the level of significance at 1%, 5%, and 10%, respectively.

The next step is to test the hypothesis of cointegration through computing the value of F-statistics. The null hypothesis for no cointegration is H0 ≠ πfdi ≠ πlb ≠ πmob ≠ πtele ≠ πurb ≠ 0 where the hypothesis is H1 = H0 = πfdi = πlb = πmob = πtele = πurb = 0. The computed values for the entire models are presented in Table 3.

**Table 3.** Result of long-run short run

| **Variable** | **Model 1: Internet penetration** | | **Model 2: Mobile phone penetration** | |
|---|---|---|---|---|
| | **Coefficient** | **Probability** | **Coefficient** | **Probability** |
| Long-run estimation | | | | |
| LOGICT $_{internet}$ | -0.0068 | 0.0817 | | |
| LOGICT $_{mobile}$ | | | 0.3170 | **0.0083** |
| LOGGLOB | 1.6729 | 0.0002 | -15.748 | **0.0500** |
| LOGURB | 3.3503 | 0.0000 | -5.7750 | **0.2319** |
| Constant | 0.0459 | 0.0000 | 0.0753 | **0.0354** |
| Short-run estimation | | | | |
| LOGICT $_{internet}$ | -0.0143 | 0.1726 | | |
| LOGICT $_{mobile}$ | | | -0.1740 | **0.0191** |
| LOGGLOB | 0.8447 | 0.0977 | 2.6551 | **0.0863** |
| LOGURB | -0.4247 | 0.4452 | 4.5493 | **0.0445** |
| CointEq (-1) | -0.1901 | 0.7665 | -0.6881 | **0.0002** |
| Diagnostic tests result | | | | |
| $R^2$ | 0.99 | | 0.99 | |
| Adjusted $R^2$ | 0.98 | | 0.98 | |
| F-statistic | 153.7 | | 205.8 | |
| Prob (F-statistic) | 0.000 | | 0.000 | |
| Durbin-Watson stat | 2.351 | | 2.362 | |
| $\chi^2$-RAMSEY | 1.483 | | 2.339 | |
| $\chi^2$-ARCH | 0.135 | | 0.218 | |
| $\chi^2$-LM | 1.290 | | 1.924 | |

*, **, and *** indicate the level of rejection of null hypothesis at 1%, 5%, and 10%, respectively.

The results suggest that cointegration exists, therefore, we reject null hypothesis of cointegration. This shows that a long-run relationship exists between ICT, economic growth, globalization, and urbanization. After the bound test, we apply Johansen cointegration approach [30], as given in Table 4. The results from Johansen cointegration suggest two statistics; trace statistic and eigenvalue statistic. The results of both statistics indicate there is cointegration among variables of interest. Therefore, it implies that results derived from the bound testing approach are robust, and we can pursue ARDL to calculate the long- and short-run dynamic.

**Table 4.** Results of long-run and short-run causality analysis

| | Variable | Short-run causality (Wald-statistic) | | | | Long-run causality (t-statistic) |
|---|---|---|---|---|---|---|
| | | **ΔLog GDP** | **ΔLog ICTint** | **ΔLog GLOB** | **ΔLog URB** | **$ecm_{t-1}$** |
| Model 1 | LOGGDP | - | 0.026 [0.8719] | 1.970 [0.175] | 0.323 [0.5761] | -0.036 [0.5761] |
| | $LogICT_{internet}$ | 2.032 [0.1694] | - | 0.475 [0.4982] | 1.204 [0.2855] | -0.191 [0.285] |
| | LOGGLOB | 0.781 [0.4439] | 1.381 [0.2536] | - | 4.606 [0.0443] | -0.112 [0.0443] |
| | LOGURB | 0.286 [0.5981] | 0.187 [0.6698] | 9.908 [0.0051] | - | -0.155 [0.0005] |
| Model 2 | LOGGDP | - | 0.172 [0.6827] | 2.0276 [0.1699] | 0.441 [0.5139] | -0.045 [0.5139] |
| | $LogICT_{mob}$ | 1.114 [0.3037] | - | 0.5503 [0.4668] | 1.441 [0.2440] | -0.046 [0.2440] |
| | LOGGLOB | 0.019 [0.8899] | 1.980 [0.1746] | - | 14.59 [0.0011] | -0.116 [0.0011] |
| | LOGURB | 0.807 [0.3795] | 0.332 [0.5706] | 5.065 [0.0358] | - | -0.152 [0.0004] |

Value in parenthesis shows the probabilities values.
*, **, and *** indicate the level of rejection at 1%, 5%, and 10%, respectively.

## 4.3 Long- and Short-Run Results

The prerequisite tests of the study such as the stationary level and cointegration recommend for estimation of long- and short-run results between variables under consideration. The results are tabulated in Table 4. We have employed a model for internet and mobile phone penetration. For the coefficient of internet penetration, the result is positive and significant (see model 1). Similarly, the coefficient of mobile phone penetration is also positive and significant (see model 2). The findings reveal that ICT subscription cause to boost the economic growth in Pakistan. Furthermore, it can be deduced that an increase in telephone subscription alleviates the number of user and encourage investment in the ICT. The large number of mobile phone and internet user contribute to economic growth. These results are inconsistent with [33-37]. Moreover, regarding the impact of globalization on economic growth, the coefficient of globalization is positive and significant both in model 1 and 2, implying that globalization stimulates economic growth. The contribution of globalization in economic growth can be attributed to the globalization-led increase in FDI inflow and trade activities. Similarly, the information exchange and investment transfer through globalization promote the ICT, which in turn stimulates the economic growth.

The results depict that increase in urbanization further increase the telephone and mobile phone users, resultantly, promoting the economic growth in Pakistan. This is in consistent with study of Farhani and Ozturk [38] for Tunisia, Ghosh and Kanjilal [39] for India, and Zhao and Wang [40] for China, as China

has one of the fastest urbanization over the past three decades, which results in promoting economic growth in China.

### 4.4 Granger Causality Analysis

The analysis of our study shows that in short-run, the value of joint Wald $\chi^2$ is statistically significant. A bi-directional causality is estimated in short-run between mobile phone and economic growth. These findings are similar with the results of [41]. Furthermore, bidirectional causality exists between the telephone and economic growth and our results are also consistent with Haghshenas, Kasimin [42] and Lee [33], who have found bi-directional causality for Iran and Japan and South Korea respectively. however, our findings are dissimilar to [33], who has reported unidirectional causality for China. Moreover, our results are also dissimilar to Yousefi [43], who has found no causality between ICT and growth for middle and lower income panel of countries.

For long-run causality analysis, the findings of this study observed bi-directional causality between ICT and economic growth. It further elaborates that an increase in the number of landline telephone and mobile phone subscribers strengthen the economic growth including GDP and FDI. The telecommunication de-regulation policy employed in 2004 by opening up of fixed-line telephone rights to other operators attracted enormous investment in the country. Similarly, economic growth caused to enhance the ICT infrastructure in the country [44]. In the case of mobile phone, this study validated a bi-directional causality between mobile phones and economic growth. In Pakistan, after broadband liberalization policy in 2004, government issued mobile phone providers' licenses, which contributed extensively to growth. During 2004–2005, the contribution of ICT sector was approximately 45% of the total GDP of the country. Our findings are similar to the study of [45], they found bi-directional causality between ICT variables and economic growth for the United Arab Emirates (UAE). The results presented by the authors can be concluded that ICT and FDI cause's economic growth, while the increase in urbanization increases ICT usage that further strengthens the economic growth. The advancement in ICT sector has affected the norms of people, lessen distances, fasten the business and commercial dealings and opened new jobs and investment opportunities [46].

The role of globalization is insignificant in the economic growth of Pakistan. The reason behind the previous statement is that technology and knowledge transfer come via trade and FDI is not more effective to stimulate economic growth. The government needs to focus to improve ICT knowledge and technology that further contribute to economic growth.

## 5. Conclusions and Recommendations

The study was intended to find out the nexus among globalization, ICT, urbanization and economic growth in Pakistan. For this purpose, we employed the ARDL and VECM Granger causality by using data from 1990–2015.

The empirical results highlighted some important findings. The study confirms the presence of co-integration among the variables have a positive contribution of ICT to the economic growth of Pakistan. Moreover, the labor force has significant relationship and conducive to economic growth in overall analysis for Pakistan. FDI has a long run relationship with economic growth. Finally, urbanization is

conducive to economic growth in both run in our study analysis. Furthermore, bi-directional causality is observed between ICT and growth, and globalization and growth in both short and long run analysis.

The study provides interesting policy insights for other developing countries in the Asian Region as follows. Firstly, the effective utilization of ICT provides a solid contribution to growth and the government can play a key role in nurturing of ICT. For this purpose, an effective strategy and an ambitious policy initiative at each stage of ICT development are the key factors in the success. Secondly, the production of ICTs may not always be a strong contribution to growth due to the increasing global competitive environment and faster technological changes that is why this sector is under enormous pressure to maintain its performance. Due to limited resources, a country like Pakistan should give a higher priority to promoting the adoption of ICT rather than investment in the production of ICT. Third, "new wine in old bottle" industrial policy may not work well in the recent global marketplace. Currently, China and India are changing the global dynamics of competition and production in the field of ICT. Therefore, policymakers in Pakistan need to reform their development strategies. In this regard, Pakistan can take help from countries like China and South Korea to integrate the ICT sector with modern data applications for the development of the economy. Hence, the policymakers should utilize the ICT applications in Pakistan that overcome the negative externalities as exercised by the United States and European Union (EU). Furthermore, the government needs to provide subsidies over the value-added services to support the adoption of the ICT services throughout the country.

Finally, countries like Pakistan due to the poor law and order situation, weak political and economic institutions and terrorism, is undergoing the worst chaotic conditions. Moreover, the economy of Pakistan is mainly dependent on the foreign investment for its growth and development. The ICT, like the very few other service sectors; can attract foreign investment in huge amount. Increasing foreign investment, can provide the basis for raising the living standards of the people of Pakistan. Hence, the development in the ICT sector can prove as the game changer for Pakistan economic development.

## 6. Limitations of the Study

First, this study is based on the data taken for Pakistan, as Pakistan has a favorable ground for ICT penetration as well as open market for foreign investors in this sector. Nevertheless, the data may limit generalization that can be addressed by replicating this study for other countries. Second, the current study analyzed secondary data sets about the status of ICT in Pakistan. The collection and analysis of primary data on macroeconomic study for whole country is complicated so secondary data was incorporated for the study. In future, we can consider some other factors such as inflation rate, law and order situation, security measurements, market size, physical infrastructure, literacy rate, external debts and political instability in Pakistan.

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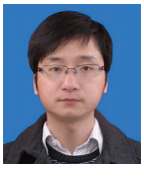

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