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**A Strategic Assessment of Telecommunication Infrastructure Development and Economic  
Growth: A Panel Data Approach**

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**By**

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**ABSTRACT**

*The study investigated the dynamic relationship between telecommunication infrastructure and economic growth, using data from twenty-four low income, middle income and high income countries, including Nigeria for a 18 years period, from 1985– 2003. With a panel data set, this study used dynamic fixed effect and random effect models for estimation, which allowed us to test the relationship between country’s economic growth with initial economic condition, fixed investment, population growth, government consumption as well as telecommunication infrastructure. It was interesting to note that the results showed that telecommunication is both statistically significant and positively correlated to the real GDP per capita of these countries included in the study. The results were robust even after controlling for investment, population growth, past level of GDP per capita and lagged growth. The results further indicated that the telecommunication investment is subject to increasing returns, suggesting that countries gain more and more with the increase in telecommunication investment. The second test, Granger’s causality test confirmed the causal relationship between telecommunication infrastructure and economic growth, but the relationship is significant from telecommunication to GDP per capita side but insignificant on GDP per capita to telecommunication development side.*

**KEYWORDS: Telecommunication, Infrastructure, Economic Growth, Low Income, Middle Income, High Income, Countries, Real GDP Per Capita, Nigeria**

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**Introduction**

World is going to be global village due to the introduction of new and advanced technology and new innovations in technology make it more possible day by day. The widely spread economic activities both in real as well as in credit market is possible when they use advance technology to communicate. This is a fact that the world is rapidly moving towards an economic system based on the continuous and ubiquitous availability of information. Developing countries try to maintain and develop their technology in such a way that they can become a part of this global village. Recent developments in telecommunication technology have been an important tool to exchange the information to develop a sharp and valuable commodity market. During 21<sup>st</sup> century to move into post industrial, information based economic growth, countries and sector try to equip themselves with the necessary telecommunication system. A modern telecommunication infrastructure is not only important for economic growth but also to connect

domestic market of commodities as well as credit with international commodity and financial markets.

This would develop the smooth flow of foreign investment, positive value of net exports, increase the value addition in GDP of an economy etc. Once the industrial and agriculture development was considered to be a best tool to enhance economic growth of a country, every country gave more importance to these sectors in its plans and policies, but now the trend has changed because the advancement and development of these two major sector of an economy sustain on the development of other factors, the role of service sector, advancement in technology, and the contribution of foreign sector in economic growth by different ways increases, and the major area of interest for foreign sector or investment was service sector and still it is, countries with the existence of GATS, started to privatise their set up, and after realising the importance of communications, the telecommunication sector is now on their main priorities. With the advancement of telecommunication services, a new market mechanism, low cost structure and expanded value chain of firms is possible [Kambil and Short (1994)], on other hand in developing countries, the average price of agricultural commodities is high in the area where there is telephone facilities available than the area where there is no facilities to communicate, (Bayes, et al, 1999).

The telecommunication sector around the world has been undergoing dramatic reforms since 1980s. Developed countries started to developed or sustain their development in telecommunication in that era; on the other hand, developing countries also Started to develop their telecommunication infrastructure after realizing its importance in economic development. They have privatized state-owned firms and slowly introducing telecommunication sector reforms. Not only a policy development in this sector started but researchers also tried to contribute to develop a theoretical base for policy implications, but on limited scale.

Telecommunication sector succeeded to have an important focus as an essential component of the economic infrastructure. However, with the strong existence of General Agreement of Trade in Services (GATS) under WTO brought a revolutionary reform in telecommunications sector. Liberalization and deregulation in telecom sector, developing countries were also in a position to increase the contribution of telecom sector in GDP ratio. With the emergence of liberalization in this sector, the inflow of capital in the form of foreign direct investment increase.

Thus, market converted into perfect competition and many service providers came in the market of developing countries. Mobile phone market went to its boom and the high quality of services at low tariff expanded market and thus makes economies of scale possible. High speed internet and broadband introduced in business development which contributed significantly in the development of the industry in the country. On the other hand some countries such as Korea, Japan, and China not only developed their telecom service industry but also developed their telecom equipments market and raised the value of net export with the help of import of telecom equipments. Before 1990s there was the availability of fixed line services at limited level, but the revolutionary steps changed the overall structure of telecommunication industry and not only mobile phone companies but also the wireless internet service, and pay phone card service

provider expanded their business which, leads to financial transaction between different countries enhancing economic development.

Last decade saw a number of changes happening in telecommunications industry and most predominantly the emergence of Internet, innovations and inventions in electronic equipments and software applications. Globalisation and international trade on one end and ICT (Information Communication Technology) including telecommunications on the other end have created a new way of life to be lived. Numerous state-owned telecommunication operators were privatised. A wave of pro- competitive and deregulatory telecommunications policies swept the world. With the advancement in telecommunication technology, the world has experienced a rapid growth in communications. The need for an efficient, modern telecommunication sector is now regarded as crucial to economic development in transition countries. The basic telecommunication industry comprises a vast portion of the world's economy. The development of new technologies has increased the need to communicate internationally, to spread new ideas and new technologies.

### **Importance of Telecommunication Development for Economic Growth**

After 2000, the realisation the importance of telecom sector for economic growth has increased especially in developing countries. Countries struggled to advance their Telecommunication Infrastructure Development and Economic Growth 713 telecommunication infrastructure in different ways. It is a fact that this sector increased the economic contribution of foreign sector within the countries.

Telecom impact on economy can be decomposed into direct and indirect effect. The direct impact of telecommunication is very strong; it leads to attract the Foreign Direct Investment (FDI). The inflow of foreign capital in the country create different opportunities at Sectoral level, With the establishment of the setup of these Foreign Service providers, create highly paid jobs opportunities and demand for technical labour increase. With the same token the liberalization expanded the market and consumers had a greater choice to purchase. Not only service providers but the mobile phones and wireless companies also established a competitive equipment market and introduced advanced technology as well. On the other hand, the indirect employment with the establishment of call centres, customer service centres and cellular phone franchises increased, and a highly competitive labour market also established. Secondly telecommunication development also generated the business activities as well, firms now connected to each other very easily and the international market is also on the fingertips of businessmen through internet. The existence of new companies increased the working capacity of financial market as well and the foreign investor could easily approach the stock market of any country in any part of the world.

Telecommunication sector development made the development of any sector possible, this sector contributed actively in fiscal and monetary policies. Thus become an easy and reliable source to attract FDI in a country. This study focuses on the issues that how telecommunication development increases economic growth. A panel estimation is done here to learn the experience

of other countries that how they developed their telecom industry, and how the increase in fixed line and mobile phone teledensity (users per 100 people) affect economic growth.

What is the effect of telecommunication development on employment generation? What should be done to transform this increased tele-density into useful purpose and last but not least to see is telecommunication investment is increasing or decreasing returns to scale in the countries included in the panel. As Nigeria has an emerging telecom market so it is necessary to have an empirical solution to find out the rational of liberalisation and deregulation in telecom sector, this study tries to provide answers to all these problems.

### **Literature Survey**

Telecommunication infrastructure development got a great attention of researcher in many years. Zhu (1996) attempted to examine the causal relationship running from telecommunications investment to economic development only using a pooled time series analysis based on 17 years data from 23 countries, and found telecommunications investment countries, and found telecommunications investment countries, Madden and Savage (1998) analysed the relationship between telecommunications infrastructure investment and economic growth by taking a sample of transitional economies in Central and Eastern Europe. The study showed that overall, there appears to be two ways, or mutual causality between telecommunications investment and real economic growth at the aggregate level.

Boylaud and Nicoletti (2000) used factor analysis and panel data analysis to examine the effects of market entry, liberalisation and privatisation on productivity, prices and quality of service in long-distance fixed-line and in mobile telephony in Zahra, Azim, and Mahmood several OECD countries. In another study, Li and Xu (2001) examined the impact of privatisation and competition on fixed-line subscriptions, labour and factor productivity in the telecommunication industry worldwide.

A study of Yilmaz, et al. (2001) indicated that the accumulation of telecommunication infrastructure improves the overall productive capacity at the regional level by examining the impact of telecommunications infrastructure on economic output both at the aggregate and sectoral levels in the United States. Wallsten (2002) used data on telecommunication industry worldwide to analyse whether the sequence of reforms matters. Fink, et al. (2002) used data on 86 developing countries worldwide to analyse the impact of telecommunication policy reforms on industry performance.

Ding and Haynes (2004) empirically investigated the role of telecommunication infrastructure in long run regional economic growth in China for a sample of 29 regions for a 17 years' period, from 1986-2002. With a panel dataset, they used a dynamic fixed effects model for estimation, which allows to test the relationship between regional economic growth with initial economic condition, fixed investment, population growth, as well as telecommunications infrastructure. On the basis of the results, they showed that telecommunications is both statistically significant and positively correlated to regional economic growth in real GDP per capita in China. The results were strong even after controlling for investment, population growth, past levels of GDP per capita, and lagged growth. They further indicated that the telecommunication investment is

subject to diminishing returns, suggesting in this manner that regions at an earlier stage of development are likely to gain the most from investing in telecom infrastructure.

The result has been confirmed by more recent analysis of economic growth in OECD by Datta and Agarwal (2004) which indicates that telecommunications infrastructure plays a positive and significant role in economic growth using a similar (but not identical) data set as Roller and Waverman, which includes 22 OECD countries. A dynamic panel data method is used for estimation, which corrects for omitted variables bias of single equation cross-section regression. Again, country-specific fixed effects are included. Their results showed a significant and positive correlation between telecommunications infrastructure and growth, after controlling for a number of other factors.

### **Formulation of Hypothesis**

This study will try to analyse the impact of telecommunication development on economic growth with a macro economic data structure, its focus is on telecommunication development, i.e., there is positive impact of telecommunication infrastructure on economic growth, so we want to check the significant relationship of telecom and economic growth and make our hypothesis H1: There is a significant relationship between telecommunication infrastructure development and economic growth.

Against the null hypothesis of no relationship.

### **Methodology and Results of Findings**

As this study will focus to investigate the causal impact of telecommunication infrastructure with the help of panel data. As discussed earlier, a lot of studies also Telecommunication Infrastructure Development and Economic Growth successfully tried to show a significant impact of telecommunications infrastructure development on economic growth in a cross section framework which involves the estimation of single cross country regression but they assume and use traditional identical production function for all countries.1 To ignore the individual “country effect” leads to the possibility of biased results (Islam, 1995); Datta and Agarwal (2004)] and it can modeled the change over time in dependent variable, when the change over time is part of the research problem (Johnson, 1995) while the time effect can be modeled as a variable in the common production function and other panel regression model is not possible with lagged dependent variable because each record contains all time points and the lagged effect measure change (Finkel, 1995), Roller and Waverman’s study (2001), indicates that when “fixed effect” are ignored in their model, the importance of telecommunications in explaining productivity is too large to be true. However the primary use of the applying “random effect model” is its parsimony and it added only a single to the model. The important point to note by Allison (1994) that some researchers prefer to use fixed-effect models only when inferences are being made about the sample under consideration but prefer Random effect models when making inferences about larger population and if there is possibility to have some nuisance parameters, this decision rule is not relevant and this study focus on both random as well as fixed effect methods.

The present study focuses both on fixed and random effect to analyse the telecommunication development effect on economic growth. Then after analysing the fixed and random effect, this study will also focus to see the causal relationship of telecommunication infrastructure and economic growth. We can estimate a growth equation for each country by following the cross-sectional growth framework of Barro (1991), Levine and Renelt (1992)<sup>2</sup> and others is specified to examine the determinants of economic growth. To test the conditional convergence hypothesis<sup>3</sup> given by Solow and Swan (1956) and then endogenous growth theory, a Solow-type equation is used with a set of variables reflecting differences in the steady-state equilibrium. Beside to check the country specific effect, the lagged value of dependent variable also includes to check the short run autoregressive behaviour of dependent variable. On other hand countries dummy are used to countries according to their level of income. It is basically to check the optimum growth theory hypothesis.

### **Conclusion**

This study tries to show the role of development of telecommunication infrastructure and then show its effect on economic growth. For this purpose, 18 years data was taken, representing twenty four countries comprising low income, middle income and high income. Two tests have been used, first by applying a Solow type equation, fixed effect and random effect models have been performed to check the importance of macro level variables on economic growth, population, fixed investment, government expenditure etc, all of these variables showed a significant relationship with economic growth (either positive or negative). Secondly this study tries to prove the Telecommunication Infrastructure Development and Economic Growth causal relationship between telecommunication infrastructure and economic growth.

After applying fixed and random effect models, it confirmed the convergence hypothesis, which suggests that the countries with higher GDP per capita tend to grow at slower rate, the lag fix investment showing a negative but significant result because the negative sign of lag investment shows the fact that, almost in all countries, investment contains a high share of telecom investment, which is of short term period, because of the short term influence, it shows a negative trend. Population however with the help of panel dummy, showing almost a negative but significant result. The relationship between telecommunication development and per capita GDP growth was found to be highly positively correlated at 1 percent level of significance.

The results are robust even after controlling for investment, population growth, past level of GDP per capita, government consumption, and lagged growth in GDP per capita. The result from both models also indicates that telecommunication investment is subject to increasing return to scale, this factor occurs because the study includes most of the developing countries which are in the process of telecommunication development. Secondly we use index of teledensity and internet users, most of the countries are struggling for two, but internet infrastructure is giving high returns, so countries gain more with the development of telecommunication infrastructure. From the perspective of public policy, the results of this analysis provides strong evidence that providing an efficient and appropriate telecommunications infrastructure is significant for fostering economic growth, as well as reducing regional disparity and shrinking digital divide.

From almost all of the discussion, both theoretical and empirical, the same conclusion has been found that telecommunication can actively participate in the growth of an economy. We also analyse some important issues on theoretical side which are drawn from facts and very important to discuss. In most of developing countries, the telecom sector is facing a number of challenges which need to be covered; some of them are given below. The first and foremost challenge which is faced by developing especially low income countries is the low teledensity especially in the rural areas of these countries, the steps to overcome this problem are insignificant.

Low standard of services are provided. This is due to the problem that these countries have a lack of network securities, strategies and awareness. In most of the countries, the facility of disaster recovery is not developed, not only this but they have lack of data warehouses and dearth of international call centres which lead to the problem of inadequate and expansive international connectivity and active provision of alternative networks. Shortage of quality human resource in IT and telecom sector.

A main problem which is faced by these countries like Nigeria is that there is a lack of R&D activities in telecom sector, especially for indigenous production of telecom equipment; this factor leads to the problem that these countries become big importers of telecom equipments from other countries. The R&D coordination is not seen in these countries for the sharing of experience among the telecom R&D and manufacturing as well as service provider companies and universities.

Zahra, Azim, and Mahmood Low broadband penetration and high frequency charges within the country Because of state-owned monopoly in telecom sector, in most of the countries, there is restriction on the establishment of base station for mobile cellular telephony. These are some of the challenges which are faced by developing countries, there should be an open strategy to meet these challenges, and so that telecom sector can play an active role in the development of a country.

Regarding the impact of investment in telecommunication sector, it proves beneficial for most of the countries, especially the countries which want to develop their economy. The inflow of capital in the form of FDI in telecom investment is a major benefit for them, then the increase in tax revenues and job opportunities in this sector also give them an edge for growth, especially in developing countries. On the other hand, developed countries also take a great benefit in the form of service and telecom equipment provider countries. Most of the multinational service provider companies belong to high income countries. At the same time most of the developing countries are dependent on of these countries for telecom equipment. A comparative advantage situation arises here, but the situation after trade presents a different analysis here. Both countries are in trade, but both of commodities (telecom services, equipments) are provided by rich countries. It is a clear and conducive fact arises from our study that telecommunication development has a very strong impact on the growth of an economy, but here sound planning is required to fulfil the requirement of an economy, so that telecom sector can play a role in industrial, agricultural, financial and manufacturing sector of the economy. On other hand the use of internet makes the fastest source of communication and generating more business activities. This study tried its best to cover all of the aspects which may be important for

analyses, all of the issues has been discussed which are related to the problem in this study. The results both from theoretical as well as empirical analysis confirm a positive correlation between telecommunications and economic growth.

But the lack of data is a major problem which is faced during research, most of the lower income countries have insignificant data, and the problem of missing values, especially in telecommunication data, which may affect the result of the telecommunication effect on economic growth, so that the panels are converted to the range of eight countries in each panel. Only teledensity (no of fixed line and mobile phone users per 1000 people) and internet users (per 1000 people) have been taken for the purpose to made the index. Some of the other variables related to telecommunication like import and export of computers and other telecom equipments, number of total mobile phones, telephone mainline, and telephone revenue per mainline etc. have insignificant data even for high income countries, so we just rely on the two variables discussed above.

Most of the former studies have been analysing the telecommunications with having only a panel of either developed or developing countries, this study tried to cover all of income group countries, so that we can broadly measure the impact of telecom on economic growth in perspective of all of income groups throughout the world.

Different Econometric test e-g co-integration test, unit root test and covariance analysis, have to be performed to analyse the impact of the development of telecommunication infrastructure development on economic growth. This study is just a contribution to see the importance of this factor, the research doors are open for further Telecommunication Infrastructure Development and Economic Growth investigation which may better find out the policies to make telecommunication sector more effective for economic development, especially in context of Nigeria telecom sector. The R&D issues should be the priority because it is one of the growing sector of our economy.



**REFERENCES**

- Allison, Paul D. (1994) Using Panel Data to Estimate the Effects of Events. *Sociological Methods and Research* 23, 1999.
- Akhtar, H., and H. Waqar (2004) *Liberlising Telecom Sector in Pakistan; Issues and Prospects*. B.Z University Multan, Pakistan.
- Andonova, V. and D. L. Serrano (2007) *Political Institution and the Development of Telecommunication IZA DPN 2569*, Institute for the Study of Labour, USA.
- Barro, R. (1991) Economic Growth in a Cross Section of Countries. *Quarterly Journal of Economics* 106:2, 407–443.
- Bayes, A. et al. (1999) *Village Pay Phones and Poverty Reduction: Insights from a Grameen Bank Initiative in Bangladesh*. Centre for Development Research (ZEF), Bonn.
- Beil, O. R., G. Ford, and D. J. Jackson (2002) *On the Relationship between Telecommunication Investment and Economic Growth in the United States*, Telecommunication Department Research Centre, Florida.
- Belaid, H. (2002) *Telecommunication Infrastructure and Economic Development; Case from Developing Countries*, ERMES, Paris II University, Pantheon-Assas.
- Boylaud, O. and G. Nicoletti (2000) *Regulation, Market Structure and Performance in Telecommunications*. Economics Department, OECD.(Working Paper No. 237).
- Canning, D. (1999) *Does Infrastructure Cause Economic Growth? International evidence for Infrastructure Bottleneck*, Harvard Institute for International Development (Mimeo graphed).
- Ding, L., and E. K. Haynes (2004) *Telecommunication Policy Research Conference*, Washington. DC, October.
- Datta, A. and S. Agarwal (2004) *Telecommunication and Economic Growth; A Panel Data Approach*. *Applied Economics* 36, 1649-1654.
- Fink, C., M. Aaditya and R. Rathindran (2002) *An assessment of Telecommunications Reform in Developing Countries*. The World Bank Policy Research. (Working Paper 2909).
- Finkel, S. E. (1995) *Causal Analysis with Panel Data*. Thousand Oaks, Ca: Sage Publications.
- Grzybowski, L. (2006) *The Competitiveness of Mobile Telephony across the European*, University of Alicante, Alicante, Spain.
- Gillwald, A. (2004) *Telecommunication Sector Analysis*, Commission by TIPS for the South Africa Presidency, November 2004.
- Hardy, A. P. (1980) *The Role of the Telephone in Economic Development*. *Telecommunications Policy* 4:4, 278–286.
- Holtz-Eakin, D. (1993) *Solow and the States: Capital Accumulation, Productivity and Economic Growth*. *National Tax Journal* 46, 425–39.
- Hoon, Y. S. (2003) *Does Telecommunication Investment Cause Economic Growth? Evidence from Korea*. *Korean Telecommunication Policy Review* 2003, Korea.
- Zahra, Azim, and Mahmood Islam, N. (1995) *Growth Empirics: A Panel Data Approach*. *Quarterly Journal of Economics* 110:4, 1127–1170.

- Johnson, R. D. (1995) *Alternative Methods for the Quantitative Analysis of Panel Data in Family Research: Pooled Time series model* University of Nebraska, Lincoln.
- Kambil, A. and J.E. Short (1994). *Electronic Integration and Business network redesign: Roles-linkage Perspective*. *Journal of Management Information Systems* 10:4, 59–83.
- Levine, R. and D. Renelt (1992) *A Sensitivity Analysis of Cross-Country Growth Regressions: American Economic Review* 82: 4, 942 –963.
- Li, W. Q. and L. Xu (2001) *The Political Economy of Privatisation and Competition: Cross-Country Evidence from the Telecommunications Sector*. The World Bank. (Mimeographed).
- Maddala, G. S. (1999) *On the Use of Panel Data Methods with Cross-Country Data*. *Analysis of Economics and Statistics* 55–56.
- Madden, G. and S. J. Savage (1998) *CEE Telecommunication Investment and Economic Growth*. *Information Economics and Policy* 10: 2, 173–195.
- Mankiw, N.G., D. Romer, and D. N. Weil (1992) *A Contribution to the Empirics of Economic Growth*. *Quarterly Journal of Economics* 107:2, 407–437.
- Norton, S. (1992) *Transactions Costs, Telecommunications, and the Microeconomics of Macroeconomic Growth*. *Economic Development and Cultural Change* 41:1, 175–196.
- Pakistan Telecommunication Authority (2005) *PTA Annual Report 2005*.
- Pakistan Telecommunication Authority (2006) *PTA Annual Report 2006*.
- Pakistan Telecommunication Authority (2007) *PTA Quarterly Report 2007*.
- Roeller, L. H and L. Waverman (2001) *Telecommunication Infrastructure and Economic Development; A Simultaneous approach*. *American Economic Review* 91:4.
- Seven, L., and C. Calderon (2001) *The Effect of Infrastructure Development on Growth and Income Distribution*. World Bank Research Centre, Washington, DC.
- Sridhar, S. K. (2002) *Telecommunication Infrastructure and Economic Growth; Evidence from Developing Countries*, National Institute of Public Finance and Policy, New Dehli, India.
- Savage, S. J., A. Schlottman, and B. S. Wimmer (2003) *Telecommunications Investment, Liberalisation and Economic Growth*. Related Publication.
- Wallsten, S. J. (2003) *Privitising Monopolies in Developing Countries; The Real Effect Of Exclusivity Period in Telecommunication*, AEI-Brooking Joint Centre for Regulatory Studies, May.
- World Bank (2004) *World Bank Indicator*. World Bank, Washington, DC.
- Yilmaz, S., K. Haynes, and M. Dinc (2001) *The Impact of Telecommunications Infrastructure Investment on Sectoral Growth*. *Australasian Journal of Regional Studies* 7:3, 383–397.
- Yilmaz, S., and M. Dinc (2002) *Telecommunications and Regional Development: Evidence from the U.S. States*. *Economic Development Quarterly* 16:3, 211–228.
- Zhu, J. (1996) *Comparing the Effect of Mass Media and Telecommunication on Economic Development: A Pooled Time Series Analysis*.