

# Does Investment in Information and Communication Technology Lead to Higher Economic Growth: Evidence from Bangladesh

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## Abstract

This paper investigates whether investment on ICT leads to higher economic growth considering Bangladesh case for the period 1997-2013 using linear regression analysis. Though statistically not significant, positive association between ICT investment and economic growth has been found. This lack of significance of result can be attributed to smaller share of ICT investment in GDP and shorter time span available for the country than required for conducting rigorous statistical analysis. Besides presenting a comprehensive picture of the current status of ICT indicators in Bangladesh, the study has also tested the comparative position of SAARC countries in terms of major ICT indicators. Findings reveal that Bangladesh is lagging behind in most of these indicators. Complementary infrastructure development, training on ICT, collaboration with international specialists, export promotions of ICT products and services etc. are some recommendations made here to uphold the effectiveness of ICT investment for Bangladesh.

**Keywords:** information and communication technology, economic growth, Bangladesh, internet, regression

## 1. Introduction

Embracing Information and Communication Technology (ICT) has been offering a nation with competitive advantage, convenience and quality of life. The way people work, communicate, and spend time is now profoundly being influenced by use of ICT. According to Digital Planet, a publication by World Information Technology and Services Alliance (WITSA), global ICT spending grew from \$2 trillion in 1999 to approximately \$4.7 trillion in 2013 in spite of the great recessionary decline of 3% in 2009 from the 2008 level of spending.

The contributions of IT (Information Technology) to economic growth have drawn the attention of researchers and policy analysts since long ago. A large number of studies have tried to explore the role of investment in economic growth and development of nations. Application of ICT can make production more efficient by enhancing existing products and creating new products and services. IT can improve organizational efficiency and responsiveness by increasing its connectivity with the market, customers, suppliers and other stakeholders. IT use will increase national productivity by improving both labor productivity and capital productivity. IT is also expected to increase economic growth by creating new industries related to IT use. Though economic growth may be affected adversely if IT use leads to elimination of jobs due to redesign of business processes, these losses should be compensated by the new employment opportunities created by economic growth in IT and non-IT areas.

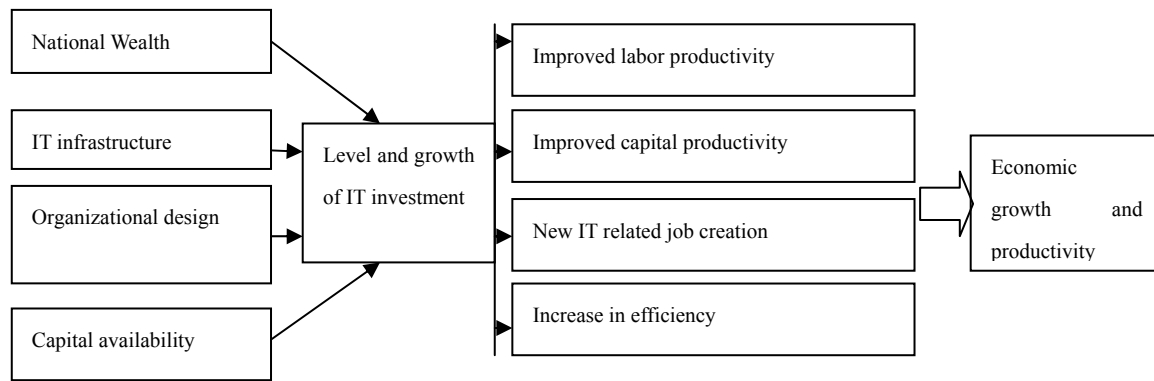


Figure 1. Investment in ICT leading to economic growth: theoretical framework

Particularly in developed nations, investment in ICT has proved to be a key driver of economic growth. It is turn for the developing nations to embrace information technology to spur their growth. Otherwise, they will be economically and socially marginalized and lagged behind.

Today, there is little or no doubt that technology innovation and diffusion can play a critical role in stimulating economic growth and productivity. But unfortunately, most of the research in this area has focused on the developed countries. This phenomenon has been empirically examined for developing countries in a very limited number of studies. Bangladesh, a developing country in the South Asia, is extensively focusing on Information and Communication Technology (ICT) with a view to realizing the vision of *Digital Bangladesh 2021*. In Bangladesh, like most of other South Asian countries, ICT sector has a negligible contribution to GDP less than 1%, but this sector is gradually developing with various government policy supports. ICT sector in Bangladesh has crossed a long road over the last few decades as evidenced by remarkable progress in developing the ICT infrastructure and delivering e-services at the doorsteps of the citizens in the country. Surprisingly, this very important issue has received little research attention in Bangladesh. Our paper is expected to fill up this gap.

This paper has noble contribution to the existing literatures in a number of ways: (i) the paper assessed the contribution of ICT investment to economic growth of Bangladesh at macro level for the first time in literature, (ii) unlike earlier studies, this paper tested the role of ICT investment by using significantly larger data set and applying quantitative tools, (iii) it has provided a comprehensive presentation on current status of Bangladesh ICT sector in comparison to remaining countries (India, Pakistan, Nepal, Maldives, Sri Lanka, Bhutan and Afghanistan) of South Asian Association for Regional Cooperation (SAARC) using latest information, (v) several recommendations have been made that can be pertinent to policy making for further development of the industry.

The paper is organized as follows: the available literature on similar studies is outlaid in section 2. It is followed by a description of the present status of ICT sector in Bangladesh and a comparative analysis of major ICT indicators in section 3. Section 4 gives a brief description of the model and methodology along with empirical results of the analysis. Finally, section 5 discusses some relevant policy implications and draws conclusion.

## 2. Literature Review

Though ICT is a much-discussed topic, it hasn't lost its appeal to researchers, academics and policymakers yet. We have focused on the country-specific as well as cross-country literatures mostly related to the impact of ICT investment on economic growth. In addition, we review literatures on this issue available for Bangladesh.

For a number of years, economists and researchers were skeptical regarding the role ICT could play in fueling economic growth through improving productivity. In fact, early and detailed empirical studies found little or no significant contribution of ICT to economic growth, a phenomena, named as productivity paradox. The "productivity paradox" of information Technology is that, massive investments in the underlying technology failed to produce the expected improvement in aggregate output statistics (Banker & Kauffman, 1988; Brynjolfsson, 1993; Strassmann, 1990; Weill, 1992; Wilson, 1995 etc. among others). One explanation of this phenomenon is that improvement in product quality or variety due to IT spending might be overlooked in aggregate output statistics. Furthermore, in some cases, the potential benefits of investment in IT were not realized as many firms didn't undertake the necessary restructuring and cost-cutting measures. Besides that, this apparent lack of relationship might accrue due to productivity or investment measurement problem, over-investment relating to agency costs etc. (Brynjolfsson & Yang, 1996).

Among country-specific literatures, a number of studies have found that the adoption of new technologies in the USA largely led to the surge in productivity in the country during the second half of the 1990s. Even empirical analysis found that approximately one half of the increase in U.S. productivity during 1996-1999 accrues to advancement in information technology (Oliner & Sichel, 2000). By applying *Production Possibility Frontier* concept, Jorgenson and Stiroh (2000) drew conclusion that the fall in ICT prices and the consequent increase in TFP speeded up the average labor productivity between 1995 and 1999.

In India, a study by Kaur and Malhotra (2014) attempts to investigate the causal relationship between telecommunication development and GDP as well as various sectoral components of GDP using data over a period of 1976-2012. The results of the study reveal a long run relationship between growth of telecommunication and economic growth at aggregate level as well as at sectoral levels. In Korea, the ICT-growth nexus has been examined by Jeong et al. (2001) using aggregate data covering the period 1980-1995 and ICT has been found to have positive and significant impact on growth. In a similar paper, Sadr et al. (2012) explored the causal relationship between ICT development and economic growth in Iran over a period of 1980-2010. The result of this study reveals a one-way causal relationship from economic growth to ICT development for the country. In addition, Castel and Gorris (2007) applied Cobb-Douglas production function to analyze the impact of ICT and diverse complementary elements (e.g. workers' qualification, management attitude, innovation of process etc.) on three productivity measures using survey data from 1225 Spanish firms and found ICT intensity to be moderately positively correlated to productivity improvement.

By considering the sample of only developing countries, few cross-country studies (such as Balamoune, 2002; Lee and Khatri, 2003; Chen and Dahlman, 2004) have concluded that higher IT investments have resulted in higher economic growth in those countries. Some of the similar studies incorporated both developed and developing countries (such as Pohjola, 2001; Kraemer & Dedrick, 2001; Plice & Kraemer, 2001; Lee et al., 2005). But these studies have argued that, unlike the developed world, developing nations could not ripen the significant and positive outcomes of IT investment due to the low level of IT investment relative to GDP during the period of the 1980s and early 1990s. Similar conclusion is drawn by Dewan and Kraemer (2000) who conducted a study using panel data from 36 countries over the period 1985-1993. The authors concluded that returns on ICT investment are positive and significant for developed countries, but not statistically significant for developing economies due to relatively smaller investment in IT infrastructure and other enabling investments. On the other hand, Khuong Vu (2005) thoroughly examined the role of ICT investment in stimulating economic growth for 50 major ICT spending countries which together account for over 90% of the global ICT market. Controlling for the growth in aggregate capital and labor inputs, the Ordinary Least Square (OLS) result implies that for the entire group of the 50 economies, output growth across economies is strongly associated with the level of ICT stock per capita.

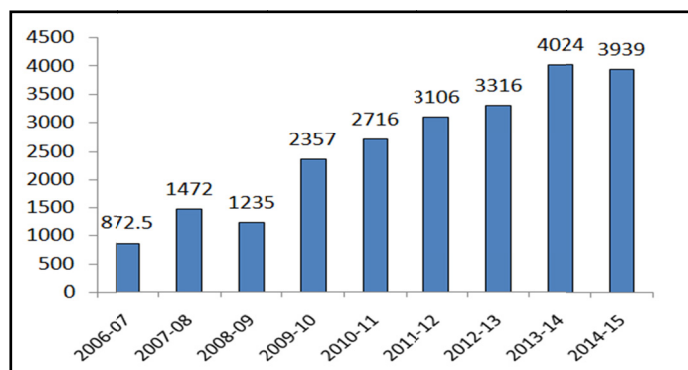
Using panel data for 33 developing countries Hawash and Lang (2010) conducted a panel data regression over the period 2002-2006 and concluded that IT adoption along with higher educational attainment strongly affected Total Factor Productivity (TFP) growth in developing countries. Besides that, Kraemer and Dedrick (1994) found a significant relationship between growth rates in IT investment and both productivity and economic growth at the national level for twelve Asia-Pacific countries using data from 1984 to 1990. Besides that, Farhadi and Fooladi (2011) studied the impact of (ICT) use on economic growth and found a positive relationship between the growth rate of the real GDP per capita and the ICT Use Index for 159 countries throughout the world. Interestingly, they found that the ICT use in the high income group of countries has a higher effect on economic growth than other groups.

ICT has great potential to boost Bangladesh's economic growth. There should be more appreciation of the importance of ICT as economy turbocharger. But unfortunately, there has been very little work on measuring the contribution of spending on ICT to economic growth of Bangladesh. The paper by Shinkai and Hossain (2011), based on a survey of 202 firms of various sizes, analyses productivity and performance of the IT sector in Bangladesh. The authors argued that e-governance activities contributed to total productivity of the firms that were more than five years old. Realizing the importance of working on this issue, our current study will try to shed light on the status of well-recognized ICT indicators for Bangladesh in comparison to SAARC countries as well as to examine whether investment in ICT brings greater economic growth for the country.

### 3. Current Status of ICT Sector in Bangladesh

In Bangladesh, Information technology has become one of the highest priority sectors. The government has undertaken a number of initiatives to create a strong ICT sector. It's apparent from figure 2 as given below. Policies, programmes, projects and regulations are being designed in order to ensure access of all sections of the

population in all regions of the country to the new technology. Government, in collaboration with different national and international agencies, is also training up people to make them capable of utilizing ICT facilities. Due to the abolition of import tax and Value Added Tax (VAT) on computer hardware, software and accessories the cost of computers has significantly reduced at the retail outlets. The National ICT Policy-2009 aims at building an ICT-driven nation for capturing a share of the multi-billion dollar software export market and promoting application of ICT in every sphere of life. The use of Internet has considerably increased both in urban and rural areas. Understandably, the use of the ICT facilities is much higher in urban areas compared to rural areas. There has been rapid growth of use of Mobile phones between 2005 and 2010. While only 11.29% of households used mobile phones in 2005, more than 63% of households were found to use them in 2010 (Household Income and Expenditure Survey (HIES) 2010).



Allocation in ICT sector is gradually increasing.

Total allocation for ICT sector in FY 2006-07 was Tk. 872.5 crore. In FY 2014-15, this allocation has increased to Tk. 3939 crore.

Figure 2. Budget allocation for ICT sector (in Crore BDT)

Source: iBAS, Finance Division.

### 3.1 Snapshot of the Industry: Size, Composition and Market

As per Bangladesh Association of Software & Information Services (BASIS), there are around 800 registered software and ITES (IT Enabled Service) companies in Bangladesh along with an estimated five hundred plus unregistered small and home-based software and IT ventures doing business for both local and international markets. Approximately 30,000 professionals, majority IT and other graduates, are employed in the industry. The size of the IT market excluding telecom in Bangladesh is estimated to be US\$ 300 million in 2010 and 600 million in 2014 in total. The average yearly growth rate of these industries here has been over 40 per cent for recent five years, and this growth rate is expected to continue.

Local market still constitutes the major part of business of the software and IT service industry (63% of BASIS member companies are focused only in local market). Banking and other financial sectors (including capital market, Insurance, Leasing, and MFIs) are still at the center of attention for a large portion of IT companies. Sustainable demands for IT solutions come from both manufacturing and service industries. ICT applications are highly used in the banking and finance sector for its business function while moderately applied in the manufacturing sector. The main destinations of Bangladeshi software products are the USA, the UK, Canada, Australia, Denmark, Netherlands, Germany, India and Japan. In terms of export destinations, North America, mainly USA still dominates. The major strengths of the Bangladeshi ICT sector are educated workforce and cost advantage. As a developing market Bangladeshi ICT market suffers from under-development in infrastructure and power shortage.

BASIS officially inaugurated the Launching of “One Bangladesh” Campaign by giving a roadmap for the next five years with specific milestone, targets, appropriate detailed vision and plan to earn US \$ 1 billion from software/ITES export, to train and employ 1 million IT skilled professionals, to make internet available to 1 crore new users yearly and to contribute 1% in Gross Domestic Product (GDP) from software and IT sector by 2018 Under “One Bangladesh” campaign.

Table 1. Export trends in recent years

Fiscal year	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Export (in million USD)	4.2	7.9	12.68	27.01	26.08	24.09	32.91	35.36	45.31	70.81	101.63	134
Growth Rate	50%	88%	61%	113%	-3.44%	-4.83%	32.59%	7.44%	27.25%	56.28%	54.80%	34%

Source: BASIS.

Starting from a very low base, Software and IT-enabled services export has been showing impressive growth during the recent years. The export was 27.01 million US dollar in FY 2005-06 implying a growth rate of more than 113% over the previous year. In FY 2013-14, total export stands at US\$134 million. Bangladeshi Software and ITES providers have also been able to work with European partners in joint-venture projects.

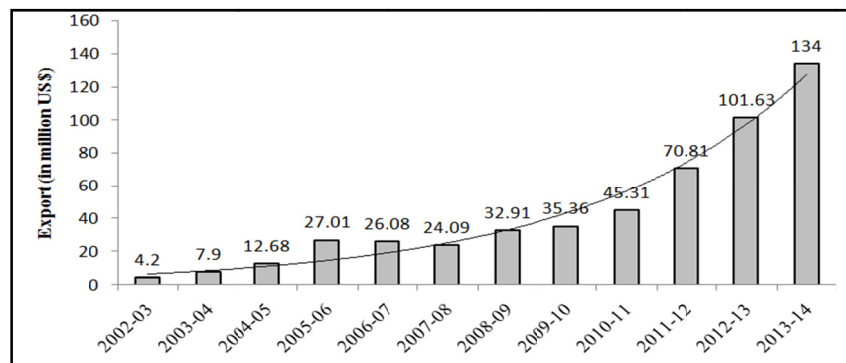


Figure 3. Software export volume in Bangladesh

### 3.2 Status of ICT Statistics in Bangladesh: A Comparison with SAARC Countries

It is widely recognized that South Asia has tremendous potential in the IT sector development because of availability of talented workforce at cheap wage rates. In Bangladesh, the IT sector has started growing, particularly after 2000, as a result of some favorable policies of the government. Still, in terms of the following ICT indicators, Bangladesh is lagging behind to other SAARC countries. The solid line represents the position of Bangladesh while the dotted lines represent the position of other SAARC countries.

• **Internet Users per 100 People:** The number of Internet subscribers in Bangladesh increased from 0.13 in 2001 to 6.5 in 2013 implying a 49% increase in internet users.

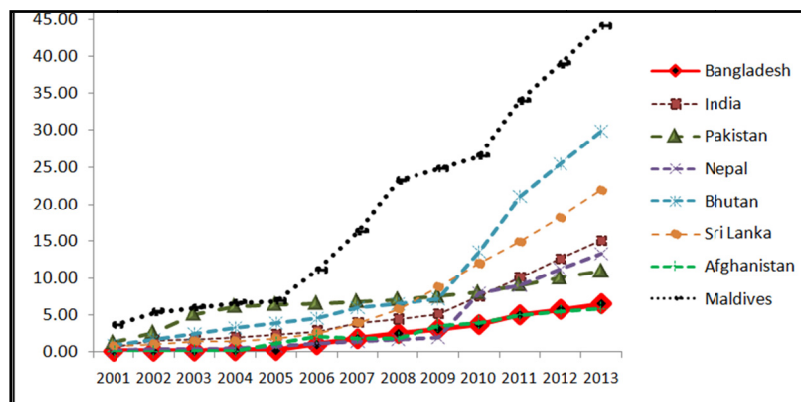
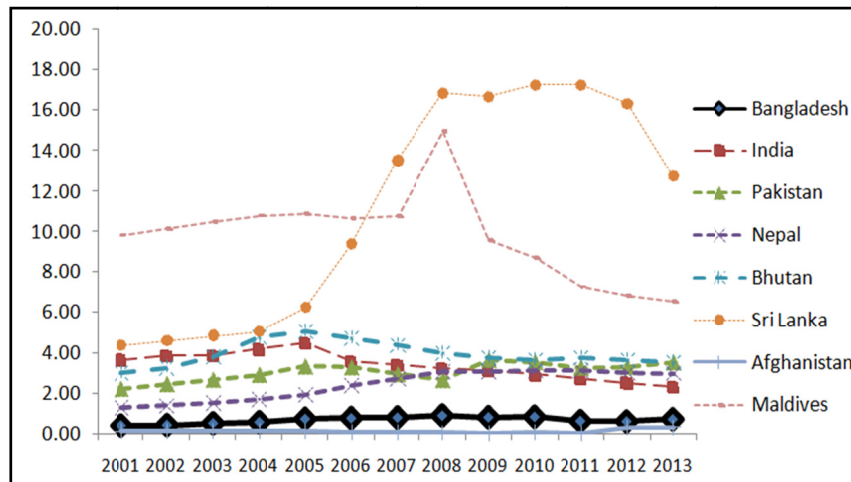


Figure 4. Internet users per 100 people in SAARC countries

Source: World Development Indicators, World Bank.

• **Telephone lines (per 100 people):** This indicator implies access to communication technology. Number of

telephone lines per 100 people is highest in Sri Lanka. Due to the widespread use of mobile phones, in most of the countries, this indicator is showing a declining trend.

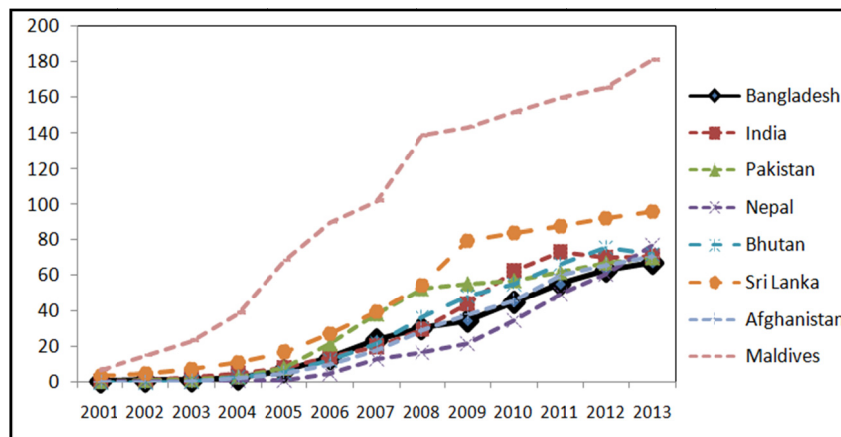


In Bangladesh, this statistic is 0.42 in 2001 and increased to 0.73 in 2013 and Number of telephone lines increased from 60,000 in 1975 to 1138946 in 2013.

Figure 5. Telephone lines per 100 people in SAARC countries

Source: World Development Indicators, World Bank.

• **Mobile cellular subscriptions (per 100 people):** another important ICT indicator is mobile cellular subscriptions (per 100 people) which represents ICT usage. Price of smart phones is decreasing day by day and gradually becoming more affordable. Telecom operators are offering various internet packages.



This indicator is highest in Maldives and second highest in Sri Lanka. In 2013, total mobile cellular subscriptions (per 100 people) increased to 10,50,51,000 from 5,20,000 in 2001.

Figure 6. Mobile cellular subscriptions per 100 People in SAARC countries

Source: World Development Indicators, World Bank.

• **Secure Internet servers (per 1 million people):** Secure servers are servers using encryption technology in Internet transactions. It represents ICT availability.



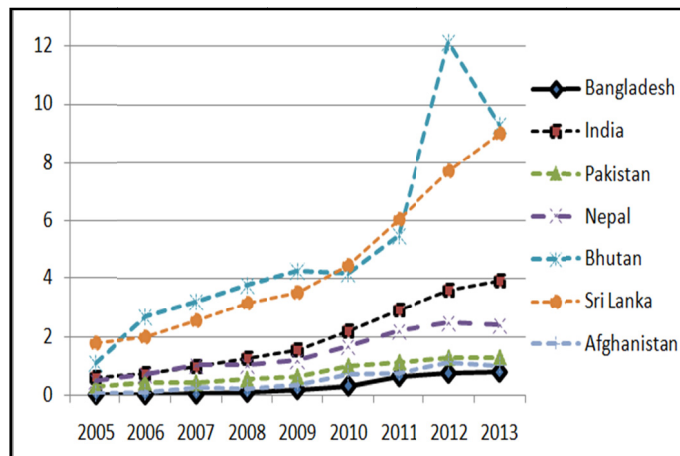


Figure 7. Secure Internet servers (per 1 million people) in SAARC countries

Source: World Development Indicators, World Bank.

In comparison to other SAARC countries, Bangladesh is mostly lagged behind in terms of this ICT availability indicator. Bhutan has been doing quite good.

In 2013, the number of secure internet servers was 120 in Bangladesh, 4889 in India, 30 in Afghanistan, 233 in Pakistan, 7 in Bhutan, 184 in Sri Lanka, 66 in Nepal and 30 in Maldives.

As demonstrated by the above figures, position of Bangladesh is far behind many neighboring countries in terms of providing and using ICT services. This is more apparent from the benchmarking indices of responsible international organizations like the United Nations, World Economic Forum, and International Telecommunication Union etc.

The World Economic Forum's *Networked Readiness Index (NRI)* indicates how much prepared a nation or community is to participate in and benefit from information and communication technology (ICT) developments. The NRI is a composite index that takes into account the environment for ICT offered by a country or community, the readiness of the country's key stakeholders (individuals, businesses, and governments) to use ICT, and the usage of ICT among these stakeholders.

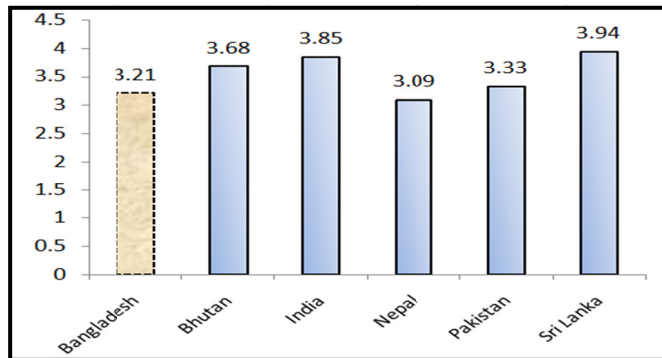
In 2013, Bangladesh scores 3.21 and ranked 114<sup>th</sup> out of 144 countries. In 2014 Bangladesh scores 3.2 and ranked 119<sup>th</sup> out of 148 countries.

Table 2. Comparative NRI index, 2014

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Rank	100	110	118	124	130	118	115	113	114	119
Score	-1.30	-1.11	2.55	2.65	2.7	3.01	3.19	3.2	3.22	3.2
Total Country	104	115	122	127	134	133	138	142	144	148

Source: Global Information Technology Report, World Economic Forum.

During 2010-2014, Bangladesh ranking improved to some extent. Though over time, Bangladesh is scoring higher value in terms of ICT readiness, comprehensive efforts should be made much more rigorously to improve its ranking compared to other countries.



NRI score isn't available for Maldives and Afghanistan. It's clear that Bangladesh is far lagged behind in ICT diffusion and usage. Its score in 2014 is lower than that of Bhutan, India, Pakistan and Sri Lanka. It means the country will have to go a far long way to exploit the opportunities offered by (ICT).

Figure 8. Comparative NRI score of Bangladesh and its neighboring countries

Source: Global Information Technology Report, World Economic Forum.

## 4. Methodology

### 4.1 Data and Variables

The data for this analysis were collected from secondary sources. Secondary data sources include newspaper, articles, internet etc. The firm level research only captures gains and losses of individual firms, not economy-wide effects or net gains to the economy. According to Cobb-Douglas production function, output is a function of capital, labor and technological progress. To assess the contribution of information technology to output, we begin by positing a production function that relates GDP with IT capital, IT usage, non-IT capital and labor over the period 1997-2013.

There is lack of reliable aggregate data on total investment or expenditure in IT sector in Bangladesh. So, import of ICT is used as a proxy for IT investment and number of internet subscribers is used as a proxy for ICT usage. Total labor employed is used as a proxy for human capital. Investment in non-IT capital is calculated by deducting import of ICT from gross capital formation. Data on these variables are collected from World Development Indicators (WDI), World Bank.

### 4.2 The Empirical Model

A linear regression has been conducted to measure the effects of IT investment and adoption on economic growth. The model specification is as follows:

$$Y = \alpha_0 + \beta_1 K + \beta_2 ICTK + \beta_3 ICTUSE + \beta_4 L + \varepsilon \dots \dots \dots (1)$$

Where Y is gross domestic product, K is non-ICT capital, L is total employment, ICTK is imports of ICT, ICTUSE is number of internet users and  $\varepsilon$  is residual, which captures the variation in Y not explained by these variables. The variables are transformed into natural logarithms.

$$\ln Y = \alpha_0 + \beta_1 \ln K + \beta_2 \ln ICTK + \beta_3 \ln ICTUSE + \beta_4 \ln L + \varepsilon \dots \dots \dots (2)$$

### 4.3 Empirical Result Analysis

In regression analysis, ICT capital is found to positively affect the GDP or output though the result isn't statistically significant. It's found that, if investment in ICT capital increases by \$1, GDP will increase by \$0.528. Use of ICT shows a positive and statistically significant relationship with GDP. If number of internet user increase by 1 person, GDP is expected to increase by \$0.015. There is positive and statistically significant association between non-ICT capital and output. GDP will increase by \$0.94 when investment in non-ICT capital is increased by \$1. However, contrary to expectation, a negative relationship is found between labor and output. However, this association is not found significant.



Table 3. Results of regression analysis

	Coefficients	P-value
Intercept	4.876753	0.282164
Ln ICTK	0.5283	0.774173
Ln ICTUSE	0.014992	0.008766
Ln K	0.939412	0.000000
Ln L	-0.118639	0.677524

Our regression analysis couldn't find significant relationship between ICT investment and economic growth, GDP. This may be due to the fact that IT investment constitutes a small share in GDP (less than 1% in Bangladesh). Besides that, the time series data (1997-2013) used is quite shorter than needed to yield a good analysis result and to smooth out the effects of the business cycle. So, based on the quantitative analysis, it is evident that IT investment in conjunction with investments in supporting infrastructure has a positive impact on productivity and economic growth.

### 5. Policy Implications and Concluding Remarks

It's obvious that investment in information and communication technology can help boost productivity growth and overall economic performance. But, most importantly, sustainable competitive advantages cannot be achieved by simply investing in ICT alone. Complementary human and organizational resources such as a flexible culture, skilled workforce, the integration of ICT and the firm's strategy are crucial to make it work. Skilled employees facilitate more effective integration of ICT in the planning process of the business. So, attention of government and organizations should be focused to complementary resources and technological skill development. This includes training IT professionals, investing in specialized information infrastructure, such as high-speed Internet backbones and satellite uplinks to get access to the most advanced global information networks.

Effective national strategies should be implemented for promoting use and production of ICT and developing national capabilities. Gurbaxani (1992) has estimated that every 1% drop in price in IT products leads to 1.5% increase in their demand. So, initiatives should be taken to reduce the price of IT products to increase their usage. Besides that, to increase export of IT goods and services to other countries initiatives should be taken to increase proper exposure of Bangladeshi IT companies. Another crucial fact is that to foster the growth of software and services companies, financial assistance and support need to be made easily available so that they don't fail in spite of having good people and technology. Governments should patronize partnerships between local IT firms and multinationals by offering incentives so that domestic IT firms can develop skill and knowledge to grow and compete globally.

Our analysis does not find a significant contribution of IT to economic growth (as represented by GDP). It does not mean that we should shy away from IT investments. It is natural that diffusion and organizational adaptation with new technologies will require time before potential benefits are realized. Bangladesh needs widespread diffusion and use of new technology at all spheres of life today. Overall picture of the Bangladeshi ICT industry looks very promising and it has the potential to become one of the major contributors in the economic development of the country. Bangladesh has been advancing fast overcoming all the obstacles in the ICT sector. To make the Digital Bangladesh Vision 2021 meaningful, Bangladesh needs an infusion of resources, leadership and ICT centered development from both Public and Private sector.

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