ICTs and Productivity for Socio-economic Growth

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Keywords: ICTs, e-service, productivity-function, socio-economic, growth, infrastructure.

List of Abbreviations

GDP	Gross Domestic Production
ICTs	Information Communication Technologies
LDC	Least Developed Country
OECD	Organization for Economic Cooperation and Development
UN	United Nations
WB	The World Bank

Abstract

Government of Bangladesh has set the mission of "Digital Bangladesh" with the philosophy of effective and constructive utilization of modern information communication technologies in policy formulation and in development programmes implementation activities with various dimensions. "Digital Bangladesh" significantly includes all classes of people and does not differentiate people in terms of technology. Moreover, the mission poses a vision of an efficient, transparent and accountable state by transforming the people into knowledge based society, to establish a pro-poor people driven effective government is also the dream of Bangladesh for ultimate socio-economic development of the people.

In this respect, all the world leaders and UN organization come to an end discussion that the ICTs sector such as ICT industries and ICTs orientated service sectors can be the most significant actor to reduce poverty from the world. These sectors have the potentiality to create a new field of the job market both direct and indirect income generation. This innovative job market will change the livelihood approach of the poor in the developing countries. Moreover, the use of ICTs as a tool for intervening e-services throughout the government and private sectors can change the scenario of total facts of the service delivery to the people and the innovative reforms in the policy formulation and implementation states. These acts of ICTs can enhance the socio-economic development of the poor.

ICTs and e-service[2] must be not the principal mechanism rather can be the catalyst or an enabler to the sustainable socio-economic development. The foremost concerns in this framework are policy reform, infrastructure development and capacity and capability enhancement of the government and the citizen as well for perfect openness, effective accessibility, steadiness, and affordability in the field of service delivery.

The direct co-relation of ICTs intervention in the economy is shown by a very simple equitation. This is the very famous and mostly used Cobb-Douglas equation of productivity. Besides this, we may find some results of previous studies that showed the positive impact of ICTs in the firm level and in the whole macroeconomic situations.

1.1 Infrastructure development to use ICTs and e-service effectively

ICT is embedded in networks and services that networks can be gather and disseminate various public and private information in the national and international spaces for establishing knowledge based society to enhance economic growths and social development, as well. There is a significant discrepancy between e-governance in developed and developing countries in the accessibility of ICTs infrastructure. It is known that developing countries have a relatively poor ICT infrastructures use in the public sector. This infrastructural limitation makes the hindrance of the citizens` easy access to the network but also barred the effective dissemination of information from and to the government. Hudson discusses the potential ICTs can contribute to the poverty reduction of the state, but there must be other factors and also need to finance in other types of infrastructural development such as the roads, highways, waterways, railways, even the energy and water supply structure to enhance the development process along with the intervention of the

[2] The World Bank Report-2006 defined "e-service" as the service delivery to people by means of electronic medium. Basically the service by the use of ICTs devices(Radio, TV, Internet or Mobile devices) that poses the correlation of both way interaction of both the recipient and the provider. It intervened in the governance for efficient, effective and transparent public service delivery to people, improved interactions with business and industry, citizen empowerment through access to information, or more efficient government management. The resulting benefits can be less corruption, increased transparency, greater convenience, revenue growth, and/or cost reductions. http://web.worldbank.org/7

ICTs, (Hudson, 2001). Policy maker in the governments and development organizations should focus on both conventional and current ICTs infrastructural development to overcome the social and economic disadvantages as well as poverty eradication, (Ssewanyana, 2007). Cecchini & Scott suggested that obligation of infrastructural improvement is not the only requirement for the easy and cost effective access to the ICTs but, the capabilities and the efficiency of institutes should execute ICTs based programs to give the potentiality of ICTs for the disadvantaged group of the society.

One of the significant prospects of the economic activities is defined by the term productivity. It is the edge of the wealth of a firm and for a country as well. Productivity may be positive or negative. When an economic project has taken ultimate result depends upon its productivity that indicates the future of the project. The ratio of the production means the ratio of the produced output of a mechanism or economic activities and the production input measures productivity. It shows the actual efficiency of the production procedures. In case of the national productivity of the economic activities, a positive productivity indicates the growth rising, more income that means the purchasing power of the people and spending money for up gradation of livelihood approaches. Moreover, it indicates that the people as well as the nation can afford more for their socio-economic development such as quality health, housing, food, and education and socio-economic measures.

Technology that effects positively the factors of production such as land, labour capital, materials and energy and reduces the risks of production are defined the productivity. Improving technologies and this case ICTs are one of the most potential productivity of the 21st century. ICTs have the potentiality to reduce different risks of production factors and can enhance the productivity and economic growth as well. Economic growth can be defined with the combination of productivity and augment of GDP[3], (Kretschmer T., 2012).

Stiroh econometrically analyzed the impact of ICTs on productivity. He showed the addition of unchanging factors responsible for the estimation of the productivity by using ICTs, (Stiroh,2005). Moreover, some other researchers stated that the consequence of investment in ICT sector is mentionable but the total effectiveness depends upon other factors such as other resources for the production, market environment and also upon the economic circumstances such as macro and microeconomic situations, (Melville et al. 2004). Generation to generation the world is growing up with a significant economic growth. The productivity of the newer generation is the key secrets of the economic growth as the new generation is more productive than the old one. Likewise the developed country is much richer than the developing countries as the economy of the former is more productive than the latter.

[3] OECD Digital Economy Papers No. 195 Information and Communication Technologies and Productivity Growth, 2012

1.2 ICTs` Potentiality accounting

The technique of growth accounting is the basis of the significant document by Robert Solow on technical change and the aggregate production function that stated in 1957. Some other studies analyze the paper, (Barro, 1999, Aghion and Howitt, 2007). In this respect the OECD in 2003 stated that the growth accounting exercises with the modern technologies can donate a significant result of the economic growths by the output with an input. The productivity factors in the field of industrial sectors are being distinguished properly to measure ICT and non-ICT capital based productivity (OECD, 2003). There are many other scholars who worked on the growth accounting into a well-tested approach to measure the ICTs involvement that indicates the correlation between economic growth and productivity (Jorgenson et al., 2005b; Inklaar et al., 2005; Inklaar et al., 2008; van Ark et al., 2003).

In order to show a resultant index for the impact of technologies especially ICTs this index indicates the function of inputs such as capital, labour, time and technologies that implied for production. These factors should be measured perfectly to get appropriate results. To get a practical growth accounting equation Cobb-Douglas[4] gave an appropriate function. This function is based on the ICTs and non ICTs input factors and a residual.

1.3 Inputs and Outputs: The Production Function

The ultimate economic factors of any economy is the output of the production activities from some of the inputs mainly the capital or investments, labour and services and raw materials.

There is a general function to correlate the inputs and the output, which is known as the production function that stated by Cobb-Douglas with a simple equation as follows:

$Y = A F (K, N)$…….. (1)

Y- Stands for output which also called real GNP.

K- Goes for the physical capital such as investment, plant and equipment, etc. and

N- Showed the labour includes the number of the worker and the hour of working.

A- Indicated the term productivity.

Thus, the equation shows that the output is the function of capital and labour productivity. Here the productivity can be defined as the level of output from the input. Higher productivity means the output might be higher from the same inputs. This change of the production factors is which rise the productivity mainly defined as the technological advancement. These technologies enhance the capability of the labour

[4] **Cobb–Douglas production function** is a particular functional form of the production function, widely used to represent the technological relationship between the amounts of two or more inputs, particularly physical capital and labour, and the amount of output that can be produced by those inputs. The Cobb-Douglas form was developed and tested against statistical evidence by Charles Cobb and Paul Douglas during 1927–1947.

or develop the capacity of the machineries or the service could be developed by use modern technologies. In this study the technology concerned the ICTs mainly.

However, other than the inputs there are some factors, which may influence productivity, such as:

(i) Technological advancement and intervention of innovative technologies-ICTs, renewable energy and modern equipments, advance life support mechanism and medicine, and so on,

(ii) Skilled and capable labour forces,

(iii) Communication infrastructures: roads and railways, waterways and airways, and so on.

(iv) Environment and weather, and

(v) The economic and legal policies of a country are also considerable factors to overall productivity.

1.4 The Output Elasticity of ICT Investment

To find the output elasticity of ICTs investment the productivity function (Equiation-1) can be stated as following on firm level find the impact of ICTs on productivity in most simple way:

Y_x □ □ □ F (ICT$_x$, NICT$_x$, L$_x$)…….. (2)

Here firm i have the value of output Y. This firm has the input factors of labor (L), ICT capital (ICT) and non-ICT capital NICT).

If this equation is presented as the simple Cobb-Douglas function and the constant □ x's are differ from one to another firm, then one can re-write the equation (2) as

Y_x □ □A×□ICT$_x$ ×□NICT$_x$ ×□L$_x$…….. (3)

By the natural logarithms, the equation can be derived as follows:

LogYx= LogA+ □1 log ICT$_x$+ □2 log NICT$_x$+□3 log L$_x$…… (4)

If the value of Y, ICT, NICT and L at any given time is given then the value of productivity A and the constant can be found. Here A stands for technology level and are elasticities of Y with respect to x (x = ICT, NICT, L).

Now if the 1 stands as the elasticity of production (value added) of the of ICT capital and if 1 1, then it might be found that one-percent raise in ICT capital would raise in output by more than one percent. This situation of an economy is significantly showed the positive impact of ICT investment for overall economic growth.

So for the value of 1 > x (x = 2, 3), that might be show the more effective productivity increase ICT capital to the non-ICT capital and labour for accelerating the improvement of growth.

1.5 The Impact of ICT on Labour Intensity and Labour Productivity

From the derivation and simple explanation of the Cobb-Douglas equation or productivity function, it is clear that the technological up gradation especially the ICTs intervention might enhance the capacity of the firm or the productivity in some direct or indirect ways. Direct ways of the capacity may be in terms of cost effectiveness, capacity improvement of labour capability, and also cut of labour prices. Cost of the input may be lower by the intervention of ICTs. Moreover, ICTs reduce the cost of communication and service side of the firm. It also has an impact on the service and investment provision. ICTs also have some changeover effect on employment corresponding to the investment on it. It is thought that investment and thus advancement in the ICTs sectors enhance efficiency and capacity of the labour and on the other hand reduces the intensity of the labour, but consequently ICTs spread other types of direct and indirect job in the market. In both cases productivity increases significantly. In all respect the potentiality of ICTs investment can bring much better productivity than other capitals

1.6 ICTs Investment and Economic Growth

In developed and developing countries ICT is today's most potential mechanism for economic growth and a mother source of employment growth. But it's also enriching communities, society, and contributing to improved quality of life. These stated the evidences of the impact of ICTs in the economic and social livelihood of the people all over the world, especially in the OECD countries as they contributes larger investment in ICTs sectors for overall growth (Schreyer, et al., 2003). The large number of existing studies and findings has triggered a number of reviews as summarized in Table 1.1

Table-1.1: Findings of some previous studies of ICT capital and productivity.

Study	Method	Results
Brynjolfsson and Yang, (1996)	Written survey based on over 150 studies from 1980s to 1990s.	Describe and showed some of the controversial outcome of the studies on the impact of ICTs on productivity. Further they showed that such outcomes are because of inappropriate information and analytical methods.
Brynjolfsson and Hitt, (2000)	Literature survey.	The impact of the ICTs is dependent on the corresponding institutional investment.
Baily, (2012)	It's a research base on case study calculate average growth accounting and also the structural change.	This study found that the productivity growth in the 1990s is not only due to IT is potential, and other causes were free trade and globalization.
Dedrick *et al.* (2003)	Written survey on 19 firm level and 15 country level studies from 1987 to 2002.	The productivity through ICTs investment at firm level showed a significant growth as the investment is a complementary.
Melville *et al.* (2004)	Develop a model of IT business value added on resource based view to review the literature.	Investment in the ICTs has potential impact on the growth but it depends upon the level of complementary resources, competitive climate and general macroeconomic environment. On the other hand, better result may found where there is a harmonization between the technical and human ICT resources.
Stiroh, (2005)	Meta-analysis (20 studies from 1994-2002).	Study characteristics explain about 35% of the saturation in the ICT elasticities. Median elasticity at 0.046.
Draca *et al.* (2006)	Survey micro and macro literature.	Macro studies meanwhile show evidence of ICT impact. In micro studies the effect is larger than the neo-classical contribution would expect with an organisational harmonization.
Holt and Jamison, (2009)	Literature survey on broadband studies.	Broadband has positive impact, but cannot be measured with any precision.

On the other hand, the contribution of ICT investment and labour productivity can be found by reviewing some studies on the United States and the European Union. The outcomes are showed in Table 1.2. The contribution of ICT was the lowest in Europe before 1995 at only 17% of productivity growth. There was a peak contribution over 70% in the United States in between 1995-2000.

Table-1.2: ICT contribution to labour productivity form growth accounting.

Year	EU in %	Source	USA in %	Source
1990-1995	17%	van Ark *et al.* (2002)	36%	Jorgenson (2001)
1995-2000	42%	van Ark *et al.* (2002)	73%	Jorgenson *et al.* (2008), Oliner *et al.* (2007)
2000-2005	45%	van Ark and Inklaar, (2005)	43%	Jorgenson *et al.* (2008), Oliner *et al.* (2007)
2003-2007	31%	European Commission, (2010)		

From the table it can be stated that the US`s productivity slowdown in pre-1995 and the productivity growth was behind European levels. On the other hand, in period from 1995-2000, the US`s showed high productivity growth due to large investment in ICT. IT capital represents 1.1 percentage points of the 4.8% output growth during 1996-1999 and the TFP growth was 40% in IT producing sectors, (Oliner *et al.*, 1994).

Although Jorgenson (2005) recognized the role of ICT with an assumptions that ICT was accounted for 60% of the labour productivity growth rate. In addition, after 2000 ICT investment and productivity slowed, but remained strong compared to the pre-1995 period. Reduced TFP growth in ICT producing industries was partly offset by a rise of TFP in IT using service sectors, (Jorgenson, 2007). Some other studies summarized that due to continuous investment in ICT there was sustainable growth in the US (Gordon, 2003; Oliner *et al.*, 2007). On the other hand, since 1995 in the EU invested small level in ICTs and that caused a low level of productivity. This caused a differential with the US and that increased through the 2000s (van Ark and Inklaar, 2005). In this respect The World Bank publication stated that the impact of ICT investment for growth is profound because it creates opportunities across all segments of the economy and society. Private investors transferred approximately USD 100 billion to governments in developing countries from 1997 to 2008. The ICT sector generates annual revenues equivalent to around four per cent of gross domestic product. When indirect and downstream benefits are included, the impact on GDP growth could exceed 5% in some countries. For every 10% increase in high-speed Internet connections, the increase in economic growth developing countries is even higher, at 1.4%[5].38 The World Bank. (2010). However, Kretschmer, T. (2012) stated that the effect of ICTs on productivity is not only significant and positive, but also continuously show an upward trend over time; however, low performers cannot increase productivity through only ICT investment rather there is a need of harmonization in complementary organizational investments.

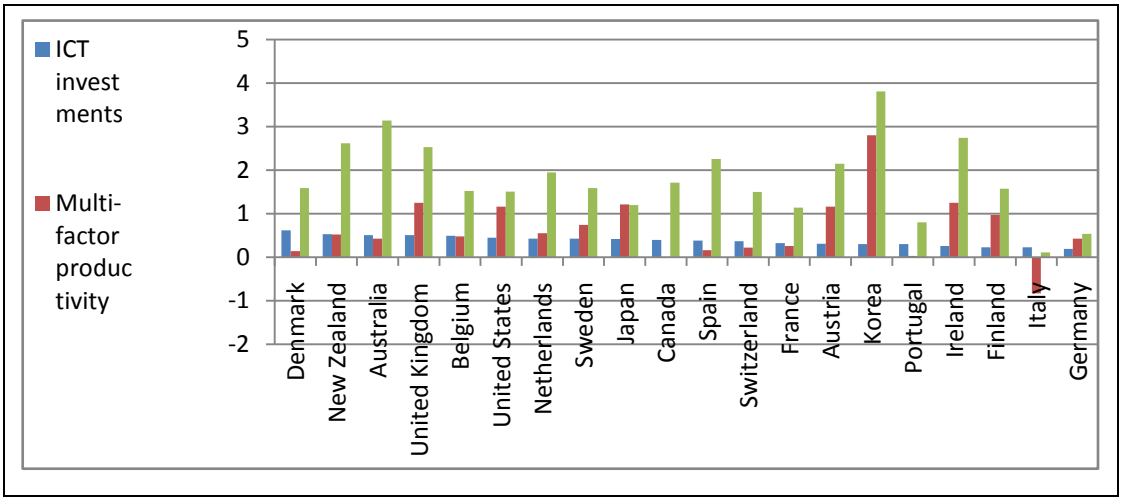
[5] The World Bank. (2010). Information and Communication Technologies for Development. *Issue Brief.* Washington D.C.

It should be noted that investment in ICTs are not straight meaning of productivity. There should be something more to change and convert investment in some other manner. In this respect following table and graph stated by the OECD[6] as key indicator of the scenario and ultimate impact of investment in ICTs sector upon the total productivity and GDP as well.

Table-1.3: Contributions of ICT investment to GDP growth, 2000-09. Annual average growth (%).

Investment Country wise	ICT investments	Multi-factor productivity	GDP growth
Denmark	0.62	0.14	1.59
New Zealand	0.53	0.52	2.62
Australia	0.51	0.43	3.14
United Kingdom	0.51	1.25	2.53
Belgium	0.49	0.48	1.52
United States	0.45	1.16	1.51
Netherlands	0.43	0.55	1.95
Sweden	0.43	0.74	1.59
Japan	0.42	1.21	1.2
Canada	0.4	0.01	1.71
Spain	0.38	0.16	2.26
Switzerland	0.37	0.22	1.5
France	0.32	0.26	1.14
Austria	0.31	1.16	2.15
Korea	0.3	2.8	3.81
Portugal	0.3	0.03	0.8
Ireland	0.26	1.25	2.74
Finland	0.23	0.97	1.57
Italy	0.23	-0.83	0.11
Germany	0.19	0.43	0.54

[6] OECD (2011), *The Future of the Internet economy. A statistical profile. June 2011 update*, OECD, Paris. [http://www.oecd.org/]



Notes: Estimates are based on cost shares and hedonic prices.

Sources: OECD Productivity Database, June 2011.

These data table and graph stated as total productivity table of some of developed countries of different regions of the world. Here in most of the countries (except Italy), total productivity factor is increased with an increase in investment in ICT sector. So in that course, in most of the countries have a positive growth of GDP. This is notable that all the data of ICTs investment and its positive impacts are found from developed countries. This is because of the ICTs investments in the developing countries are very recent and the impact study are not very available yet.

1.7 Remarks

From the above discussion it can be assume that there is significant impact on productivity and growth of ICTs investment. The impact of ICTs in developed and developing countries are not at the same level. The impact in developed countries are very high than in developing countries. The potentiality of ICTs in both developed and developing countries and estimated the productivity and GDP growth by the input factors of ICT and non-ICT capital on the basis of the Cobb-Douglas productivity function.

One scholar Pohjola stated by the result of the study, who studied 39 different countries both developed and developing countries to find the correlation of ICTs in the field of GDP growth and productivity function. The study also suggested that an earlier period in 1980-1995, the impact of ICTs on human capital are not strong in both developed and developing countries, but another analysis of 23 OECD countries there found a strong evidence of positive impact of ICTs on growth, (Pohjola, 2000). The cause of the projection of lagging behind of the impact of ICTs in developing countries may explain by the matter that in developing countries investment in ICTs intervention is not enough and the capability of the

human capital are not sufficiently advanced as those are in developed countries. This may due to the "digital divide" consequences in the developing countries[7].

In addition, there are some good examples in some OECD countries about the impact of ICTs in the service sectors. It is found that the contribution of ICTs in service sector is much greater than other sector such as firm level manufacturing and trade. The major aspects of the ICTs are the communication and service delivery those become easy and enhance the capacity of the organization to those activities. But there are still some difficulties in the developing countries for establishing the actual and effective ICTs intervention though the governments are investing more and more to build the ICTs infrastructure.

[7] Information Technology and Economic Growth: A Cross-Country Analysis; UNU/WIDER Working paper No 173.

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