EFFECT OF INFORMATION AND COMMUNICATIONS TECHNOLOGY ON DEVELOPMENT

By

Hyangsuk SEONG

THESIS

Submitted to

KDI School of Public Policy and Management

in partial fulfillment of the requirements

for the degree of

MASTER OF PUBLIC POLICY IN ECONOMIC DEVELOPMENT

2012

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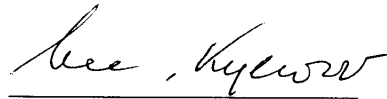# EFFECT OF INFORMATION AND COMMUNICATIONS TECHNOLOGY ON DEVELOPMENT

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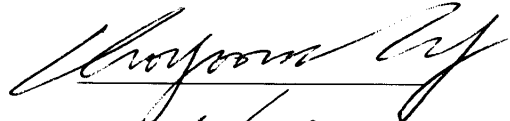in partial fulfillment of the requirements

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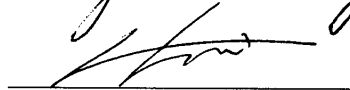MASTER OF PUBLIC POLICY IN ECONOMIC DEVELOPMENT

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ABSTRACT

EFFECT OF INFORMATION AND COMMUNICATIONS TECHNOLOGY ON DEVELOPMENT

By

Hyangsuk SEONG

The effect of information and communications technology (ICT) on development of countries has been studied qualitatively or with case studies of a specific country or a community but it is still controversial if the ICT contributes to the development. Therefore, this paper studies quantitatively the effect of ICT on development of countries with macroeconomic data, i.e. GDP per capita and human development index (HDI) in a function of macroeconomic variables including the ICT indicators in the UN Millennium Development Goals (MDGs) with regression analysis. The analysis shows that the ICT among the macroeconomic variables contributes most strongly to GDP per capita and HDI of the countries. Therefore, governments of developing countries are recommended to invest the ICT for both economic and human development of the countries.

The effect of ICT on economic growth of countries is also studied with the annual growth of GDP per capita in a function of macroeconomic variables including the annual growth of ICT. This study shows the positive contribution of the growth of ICT to the economic growth of the countries but the goodness of the fit (R^2) of the annual growth of GDP per capita is much lower than that of GDP per capita and HDI, which may imply that the ICT explains the development of a country better than the economic growth of the country.

Based on this study, the recommendations to UN or a government of a country for the era beyond the UN Millennium Development Goals (after 2015) are as follows;

1) Provide and monitor quantitative targets of ICT indicators because the ICT plays significant roles on development of a country. It is noted that the current MDG has the ICT indicators under the Goal 8 but does not have any quantitative target to be achieved by 2015.

2) Introduce HDI as an indicator, which reflects the quality of life of a country, in addition to the simple poverty reduction (Goal 1) to halve the proportion of people whose income is less than one dollar a day between 1990 and 2015.

3) Introduce different quantitative targets of the HDI and the ICT indicators based on the developmental stages of countries, e.g. least developed countries, developing countries, landlocked countries etc.

4) Create a one-to-one partnership of a donor country and a recipient country for development projects of the aid recipient country such as ODA and monitor the progress of their projects regularly in UN to facilitate development of the recipient countries effectively and efficiently.

Dedicated to my family

ACKNOWLEDGEMENTS

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1. INTRODUCTION

This paper studies the effect of the information and communications technology (ICT) on the development of a country with GDP per capita and HDI, which are often used to distinguish if a country is developed, developing or least developed. The ICT's contribution to the economic growth of countries is also studied. Recognizing that the ICT is not the only factor to contribute to development or growth of a country, other macroeconomic elements are included as independent variables.

The most studies of the effect of ICT on development of countries have been done qualitatively or with case studies of a specific country or community. The effect of ICT on development is studied quantitatively in this paper with macroeconomic data including the ICT data with GDP per capita and Human Development Index (HDI)[1] as measures of the development of economies. The annual growth of GDP per capita is also analyzed to see if the ICT contributes to economic growth of countries in the world. This macro-level economic analysis makes it possible to control other factors that may have similar impacts on development or growth of a country and also sheds light on developing countries where empirical evidence is lacking as a cross-country analysis (Qiang, Rossoto and Kimura 2009).

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[1] The HDI is a synthetic product of the UNDP, has been published annually since 1990 and is a comparative measure of life expectancy, literacy, education, and standards of living of a country, taken as a synonym of the older terms of the standard of living or quality of life, which was devised by Mahbub ul Haq, followed by Amartya Sen in 1990. The HDI intends to capture a country's achievements in longevity, knowledge and standard of living through various indices (UNDP, 2012).
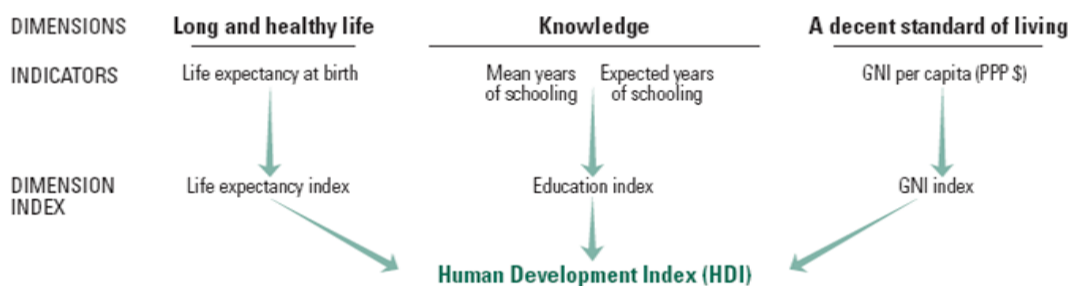
Source: Human Development Report 2011

In 2000, UN established the 8 Millennium Development Goals (MDGs) to eradicate extreme poverty, hunger, literacy and disease on the Earth by 2015; eradicate extreme poverty and hunger (Goal 1), achieve universal primary education (Goal 2), promote gender equality and empower women (Goal 3), reduce child mortality (Goal 4), improve maternal health (Goal 5), combat HIV/AIDS, malaria and other diseases (Goal 6), ensure environmental sustainability (Goal 7) and develop a global partnership for development (Goal 8). The progress of the MDGs is measured through 21 targets and 60 official indicators.
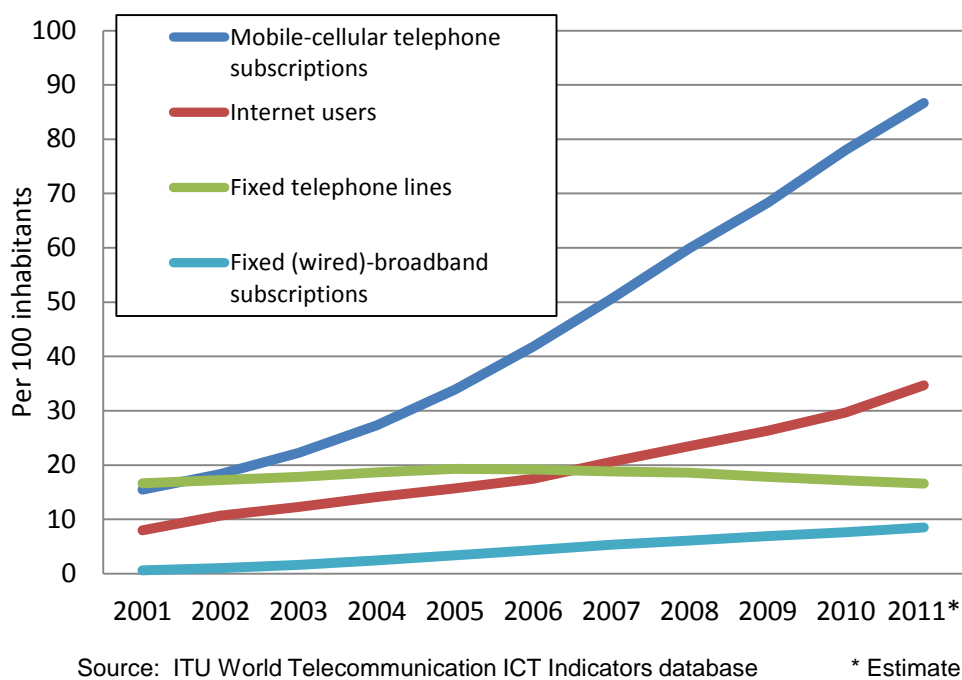
Figure 1: Global ICT developments in 2001-2011

The ICTs (indicators 8.14, 8.15 and 8.16 of MDG) is a part of the Goal 8 and has been growing rapidly in the world (UN 2011). By the end of 2010, the number of mobile cellular subscriptions had grown to 5.3 billion and its penetration levels had reached 76 % (UN 2011). Many developed countries are reaching saturation levels in mobile cellular subscriptions with an average penetration level of 116 % (UN 2011). Mobile penetration in the developing world had reached 68 % by 2010 and in the least developed countries (LDCs) 30 %, compared with only 1 % of fixed telephone line penetration (UN 2011). More than 2 billion

people in the world were also using the Internet, so almost one in three people were online in 2010 (UN 2011).

The ICT is recognized as one of enablers to achieve the MDGs (Bernardia and Chiara 2011), which has been able to induce social and economic development in terms of health care, education, employment, agriculture, trade, etc (Franklin 2007). However, the ICT indicators in Goal 8 do not have a target to be achieved by 2015 and the evidences about the ICT's contribution to the development are not always seen (Heeks 2010); the ICT in developing countries or communities may not sustain (Avgerou 2008), they may fail to enhance capabilities (Zheng and Walsham 2008) and so on. There is also skepticism on if scarce resources should be used on ICT expenditure when there are so many competing priorities and the infrastructure for the effective and efficient utilization of the ICT is often not good in developing countries (Mpogile et al. 2008, Thompson and Walsham 2010). As the ICT involves more than the mere deployment of technology and the development or economic growth with the ICT is not straightforward, the detailed analysis of the ICT contribution to an economy is required.

This section will be followed by the literature review on the effect of ICT and other macroeconomic factors on development or economic growth of countries, hypothesis of the study, methodology to analyze the contribution of macroeconomic factors to development and economic growth, data analysis, conclusion and recommendations to UN or a government.

2.   REVIEW OF LITERATURE

There is a great deal of literature that studies the contribution of ICT to achieve the MDGs, economic growth or human development. The most studies are qualitative analysis or case studies on a specific field of a specific country, which are briefly described in this section as a

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basis for the quantitative macroeconomic study of the effect of ICT on the development and the economic growth. It is noted that ICT alone does not make contributions to development or growth of countries. Therefore, the studies on the effect of other macroeconomic data on development and growth of economies are also reviewed, i.e. capital formation, trade, education, health and employment which are considered together with ICT in this paper (Kukeli 2012, UN 2011).

"Good practice paper on ICT for economic growth and poverty reduction" by OECD (2005) gives an overview of cross-cutting applications of ICT as tools but not goals and links the use of ICT to development cooperation. It provides many positive results of projects on the use to development in developing countries; the impact of phones on rural areas in Mozambique and Laos PDR, the phones have been effectively used by Grameen to empower women in small businesses, e-Justice program in South-Africa to support fundamental reforms necessary to establish a more fair, accessible and efficient system of justice, a health information system in Albania and so on (OECD 2005). There is also a general framework for describing poverty reduction through the application of ICTs, development strategy, an information plan and a technology plan: the e-Primer on ICT for poverty alleviation published by the United Nations Development Program's Asia-Pacific Development Information Program (UNDP-APDIP 2004). Under the right circumstances, the ICT has been shown to be capable of inducing social and economic development, however, much of the evidence in support of the use of ICTs for alleviating poverty remains anecdotal, and initiatives are proceeding with little reference to each other (Harris 2004). This e-primer reviews contemporary initiatives at a field level and synthesizes the learning opportunities that they provide. It serves as a practical guide for field implementers by offering a deeper understanding of how these have been applied in a range of instances (Harris 2004).

Franklin (2007) reviews the Trinidad and Tobago National ICT Plan and assesses it in terms of its capability to enable development and poverty reduction since the Government of Trinidad and Tobago in its Medium Term Policy Outlook for 2004-2006 identified the achievement of developed nation status by the year 2020 as the principal developmental goal of the country. The National ICT Plan of Trinidad and Tobago as one of the strategies for achieving this goal with the recognition that investment in new ICTs at the national level will make little sense unless it can benefit a significant proportion of poor people and be affordable to them (Franklin 2007). It concludes that the application of ICTs to development should begin with a developmental strategy (Franklin 2007). Thompson and Walsham (2010) also argue the necessity to expand the research agenda on the use of ICT in African countries to include a stronger strategic developmental focus than is evident in much of the literature to date. They conclude with a call for information society researchers working on Africa to involve in debate on national and international policy from an ICT perspective and to engage with other research communities in doing this, notably with those concerned with the field of African development (Thompson and Walsham 2010). Bernardia and Chiara (2011) address one aspect of the relationship between ICT and MDGs by highlighting implications for a more effective usage of ICT in monitoring HIV/AIDS initiatives in Kenya and their integration into local contexts. The ambiguity of coordination mechanisms at the policy implementation level can have negative effects on the effective usage of information technology in the monitoring of MDGs (Biesma *et al.* 2009, Bernardia and Chiara 2011). In the context of monitoring and evaluation, information technology can contribute to turn global policy into desired local practices only if aid coordination and the emphasis on local needs are released from an unclear mandate and are focused more on the real priorities of the national context in which they need to be realized (Bernardia and Chiara 2011). Especially, in a sector such as health care in Kenya, where aid is highly fragmented and volatile, the

strengthening and computerization of health information systems to track responses to diseases must turn into a concrete solution (OECD 2005).

Kivunikea, Ekenberga, Danielsona and Tusubira (2011) address that applied Sen's capability approach to explore how individuals in rural communities in Uganda perceived the importance of ICT toward their quality of life (QoL) and how this perception influenced ICT adoption. They find that ICT uptake and use toward improved the QoL is still limited while perception is inclined to social benefits. As a similar concept of the QoL, human development index (HDI) was originally defined as 'a process of enlarging people's choices' that enables them 'to lead a long and healthy life, to acquire knowledge and to have access to resources needed for a decent standard of living' (UNDP 1990). Ranis *et al.* (2006) show that HDI explains more about a country's performance on human development than per-capita income when one adopts a broader definition of human development. A few authors including Ranis *et al.* have proposed alternative indices to address some of the index's shortcomings (Sagar 1998). However, of those proposed alternatives to the HDI, few have produced alternatives covering so many countries, and that no development index (other than, perhaps, Gross Domestic Product per capita) has been used so extensively or effectively as the HDI. Whereas the HDI of UNDP for 2009 enumerates 182 economies and the coverage of the HDI for 2010 dropped to 169 countries, there has been the study about the HDI that has resulted in an extending of its geographical coverage: David Hastings (2011), of the United Nations Economic and Social Commission for Asia and the Pacific, published a report geographically extending the HDI to more than 230 economies. However, the HDI has been criticized: a redundant measure that adds little to the value of the individual measures composing it (Cahill 2005); a means to provide legitimacy to arbitrary weightings of a few aspects of social development; a number producing a relative ranking which is useless for inter-temporal comparisons and difficult to compare a country's progress or regression since the

HDI for a country in a given year depends on the levels of, e.g., life expectancy or GDP per capita of other countries in that year (McGillivray 1991, Cahill 2005).

Qiang, Rossotto and Kimura (2009) use an endogenous growth model (Barro 1991) to test the impact of broadband penetration on the average growth rate of GDP per capita between 1980 and 2006 for 120 countries with the independent variables of GDP per capita in 1980, average ratio of investment to GDP between 1980 and 2006, primary school enrollment rate in 1980, average penetration of broadband and other telecommunications services between 1980 and 2006. They find that the broadband benefits are major and robust for developed and developing countries. However, their studies (Qiang, Rossoto and Kimura 2009) seem to be a bit early to draw such conclusions since the broadband service was far from being implemented in 1980 and broadband penetration in the world was just 4.3% in the year 2006. The ICT is not the only factor to make contributions to development or growth of an economy, therefore, other variables related to economic growth may be useful to consider such as trade, foreign investment, education and innovation as Qiang, Rossotto and Kimura (2009) pointed out.

In addition to the ICT (the indicators 8.14, 8.15 and 8.16 of MDG), the worldwide development project of Millennium Development Goals (MDGs) monitors annual growth rate of GDP per capita employed (indicator 1.4), employment-to-population ratio (indicator 1.5), several indicators related to education (Goal 2) and health (Goal 5), trade capacity (indicator 8.9), etc. There are some studies related to these factors on development of economies (Kukeli 2012, Davies and Quinlivan 2006, Nelson 2007, UN 2011). For example, the theory of trade may be marked with the theory of comparative advantage as delineated by both Ralph Torrens in 1808 and 1815 and by David Ricardo in 1821 (Davies and Quinlivan 2006). Davies and Quinlivan (2006) examine the impact of trade on countries' social developments as measured by the Human Development Index and find that increases in trade

are positively associated with future increases in social welfare as well as GDP per capita. Capital formation is also viewed as a chief factor affecting growth, welfare, and economic development in countries wanting to strengthen their market led economic infrastructure: the capital formation not only increases labor productivity but also contributes to economic growth and technological advancement of the country (Kukeli 2012). However, other literature provides paradoxical evidence about the role of capital formation in influencing the economic growth of a nation (Ghali and Al-Mutawa 1999, Mishra 2010).

Since the establishment of MDG, there are many studies on development or economic growth of an economy (OECD 2005, Franklin 2007, UN 2011, Qiang, Rossotto and Kimura 2009), however, results and conclusions on the effect of these factors on development or growth of an economy are not clear. Moreover, most studies are limited to case studies, qualitative approach or only a few factors are considered. Therefore, in this paper, GDP per capita, HDI and growth of GDP per capita are separately studied with the function of capital formation, trade, education, health, employment and ICT in the world, developing countries and developed countries. The results of HDI are also compared with those of GDP per capita to see if the HDI is a redundant measure that adds little to the value of the GDP per capita (McGillivray 1991, Cahill 2005). For the developing countries which receive official development assistance (ODA), the effect of ODA on development or economic growth of the developing countries is also studied with "net ODA received" as an additional independent parameter.

3. HYPOTHESIS

This paper considers 3 dependent variables and maximum 7 independent variables; GDP per capita, HDI and growth of GDP per capita are the 3 dependent variables, which are used separately in the Regression analysis. The independent variables in addition to ICT variables

are gross capital formation, trade, education, health, employment and ODA. The ODA is an independent variable only for developing economies. Different set of only some of these variables have been used in studies of development or growth of economies as seen in the previous section of the review of literature.

Based on the literature reviews and the fact that the utilization of ICT continues to increase as countries' economies are advanced, hypothesis of this study are as follows;

1. The effect of ICT is positively significant on development and growth of an economy; i.e., ICT contributes positively to the GDP per capita. ICT contributes positively to HDI and ICT contributes positively to the growth of GDP per capita.

2. Other each independent variable of gross capital formation, trade, education, health and employment also contributes positively to the each dependent variable of GDP per capita, HDI and growth of GDP per capita.

3. ODA contributes positively to development and growth of developing countries.

4. HDI of a country explains the quality of life of the country, which is more than just GDP per capita of the country.

4. METHODOLOGY AND DATA

The regression is used to analyze the effect of ICT on development of countries with GDP per capita and human development index of a country and economic growth of a country with annual % growth of GDP per capita as dependent variables. Independent variables are gross capital formation, trade, ODA, education, health, female employment ratio and ICT variables. The female employment ratio is chosen since it is expected that if a female has a job, the income of her household would be increased. Then, female empowerment could be realized through financial power so eventually human development including gender equality could be achieved. As Amartya Sen stated, nothing is as important as the participation and

leadership of women, for the advancement of economic development (Buskens and Webb, 2008).

Definitions of the variables are below except the HDI already given in the footnote 1 of this paper. After the description of methodology of this study, details about the data of all the variables are followed (See also Annex 1).

variables	Definition (source: World Bank DB)
GDP per capita, PPP (constant 2005 international $)	GDP per capita based on purchasing power parity (PPP). Data are in constant 2005 international dollars. GDP per capita is gross domestic product divided by midyear population. PPP GDP is gross domestic product converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GDP as the U.S. dollar has in the United States. GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.
GDP per capita growth (annual %)	Annual percentage growth rate of GDP per capita based on constant local currency.
Gross capital formation (% of GDP)	Gross capital formation (formerly gross domestic investment) consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories. Fixed assets include land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. Inventories are stocks of goods held by firms to meet temporary or unexpected fluctuations in production or sales, and "work in progress." According to the 1993 SNA[2], net acquisitions of valuables are also considered capital formation.
trade (% of GDP)	Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product.

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[2] The 1993 SNA (1993 System of National Accounts) is a comprehensive, consistent and flexible set of macroeconomic accounts to meet the needs of government and private-sector analysts, policy-makers, and decisions-takers. It was prepared jointly by the International Monetary Fund, the European Union, the Organization for Economic Co-operation and Development, the United Nations, and the World Bank. These five organizations constitute the Inter-Secretariat Working Group on National Accounts (ISWGNA), that has been mandated by the Statistical Commission of the United Nations to oversee international coordination in the development of national accounts.(http://www.imf.org/external/pubs/ft/sna/default.htm)

Net ODA received (% of GNI)	Net official development assistance (ODA) consists of disbursements of loans made on concessional terms (net of repayments of principal) and grants by official agencies of the members of the Development Assistance Committee (DAC), by multilateral institutions, and by non-DAC countries to promote economic development and welfare in countries and territories terms (net of repayments of principal) and grants by official agencies of the members of the DAC, by multilateral institutions, and by non-DAC countries to promote economic development and welfare in countries and territories in the DAC list of ODA recipients. It includes loans with a grant element of at least 25 % (calculated at a rate of discount of 10 %).
Public spending on education (% of GDP)	Public expenditure on education consists of current and capital public expenditure on education which includes government spending on educational institutions (both public and private), education administration as well as subsidies for private entities (students/households and other privates entities).
Health expenditure (% of GDP)	Total health expenditure is the sum of public and private health expenditure. It covers the provision of health services (preventive and curative), family planning activities, nutrition activities, and emergency aid designated for health but does not include provision of water and sanitation.
Female employment ratio	Female employment to population ratio is the proportion of a country's female population that is employed. Ages 15 and older are generally considered the working-age population.
Internet users (per 100 people)	Internet users are people with access to the worldwide network.
Mobile cellular subscription (per 100 people)	Mobile cellular telephone subscriptions are subscriptions to a public mobile telephone service using cellular technology, which provide access to the public switched telephone network. Post-paid and prepaid subscriptions are included.
Fixed telephone line (per 100 people)	Telephone lines are fixed telephone lines that connect a subscriber's terminal equipment to the public switched telephone network and that have a port on a telephone exchange. Integrated services digital network channels and fixed wireless subscribers are included.
Fixed broadband Internet subscribers (per 100 people)	Fixed broadband Internet subscribers are the number of broadband subscribers with a digital subscriber line, cable modem, or other high-speed technology.

Firstly, the GDP per capita is studied as follows;

$$GDPPC = a_0 + a_1*x_1 + a_2*x_2 + a_3*x_3 + a_4*x_4 + a_5*x_5 + a_6*x_6 + a_7*x_7 \qquad (1)$$

where

GDPPC: GDP per capita, PPP the constant 2005 international $

a0: intercept, constant term

a1, a2, a3, a4, a5, a6 and a7: coefficient of each independent variable below

x1: gross capital formation (% of GDP).

x2: trade (% of GDP).

x3: net ODA received (% of GNI) for developing economies only.

x4: public spending on education (% of GDP).

x5: health expenditure (% of GDP).

x6: female employment to population ratio.

x7: ICT variable. The following 6 models are considered separately;

model 1) internet users per 100 people

model 2) mobile cellular subscription per 100 people

model 3) fixed telephone line users per 100 people

model 4) fixed broadband internet subscribers per 100 people

model 5) sum of the ICT variables in models 1), 2), 3) and 4)

model 6) simultaneous input of all the ICT variables in models 1), 2), 3) and 4).

For the model 5), the equation for GDPPC is as follows;

$$GDPPC = a0+a1*x1+a2*x2+a3*x3+a4*x4+a5*x5+a6*x6+\mathbf{a7*(x71+x72+x73+x74)} \qquad (1\text{-}1)$$

where

x71: internet users per 100 people

x72: mobile cellular subscription per 100 people

x73: fixed telephone line users per 100 people

x74: fixed broadband internet subscribers per 100 people.

For the model 6), the equation is given below;

$$GDPPC=a0+a1*x1+a2*x2+a3*x3+a4*x4+a5*x5+a6*x6$$

$$+ \mathbf{a71*x71+a72*x72+a73*x73+a74*x74} \qquad (1\text{-}2)$$

where

a71, a72, a73 and a74: coefficient of each ICT variable (x71, x72, x73 and x74) described under the equation (1-1).

Secondly, the HDI of a country is used as a separate dependent variable instead of GDP per capita to analyze the contribution of the ICT to the development of the country.

$$\text{HDI} = b0+b1*x1+b2*x2+b3*x3+b4*x4+b5*x5+b6*x6+b7*x7 \tag{2}$$

where

HDI: human development index of a country in a given year

b0: intercept, constant term

b1, b2, b3, b4, b5, b6 and b7: coefficient of each independent variable introduced in the equation (1). The 6 models of the ICT variable are also considered for the HDI.

In order to see if the ICT variables contribute to economic growth of a country, the growth of GDP per capita is considered as a dependent variable. Since the growth of GDP per capita is taken as the dependent variable, the growths of ICT variables are also used as independent variables.

$$\boldsymbol{\Delta\text{GDPPC}} = c0+c1*x1+c2*x2+c3*x3+c4*x4+c5*x5+c6*x6+c7*\boldsymbol{\Delta x7} \tag{3}$$

where

ΔGDPPC: annual % growth of GDP per capita of a country.

$\Delta x7(t)$: annual % growth of ICT variables of a country $(= (\ln(x7(t))-\ln(x7(t-1)))*100)$. The 6 models of the growth of the ICT variable are also considered for the growth of GDP per capita.

GDP per capita, annual growth of GDP per capita and all the independent variables are collected from the World Bank database and human development index from UNDP databank. The variables of "sum of the ICT" and "annual % growth of the ICT" are

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calculated from the data of the ICT from the World Band database. The considered time period is the year 1990 – 2010. The starting year of 1990 is chosen since it is the reference year that MDGs are monitored. The 163 countries' data are obtained. Data of some variables are not available for some countries in some time period of 1990-2010; HDI is published every 5 years until 2005 therefore it is available only for 9 years, i.e. the year 1990, 1995, 2000 and 2005-2010. "Net ODA received" is available for some developing countries for some different time period. Data of the public education spending are the least available. Among the ICT variables, the fixed broadband networks have been implemented rather recently; in many developed countries, the fixed broadband data are available from the year 2000 and developing countries from the year 2005. Therefore, the available data of the fixed broadband subscribers are not many. The master sample statistics of each variable are shown in the Table 1. Depending on a dependent variable and a model, involved data set can be varied and respective sample statistics is given in Annex 2 with its analysis result.

Table 1: Master sample statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
HDI	1357	0.63	0.18	0.19	0.94
GDP per capita, PPP(year 2005 $)	3298	10767	12964	101	74164
GDP per capita growth (annual %)	3336	1.96	6.11	-50.29	92.586
Gross capital formation(% of GDP)	3250	22.53	8.51	-0.69	113.6
Trade (% of GDP)	3307	82.8	47.1	0.00	460.5
Net ODA received (% of GNI)	2425	7.63	11.74	-0.73	181.01
Education spending (% of GDP)	1295	4.63	1.95	0.00	16.06
Health expenditure(% of GDP)	2596	6.09	2.43	0.00	19.31
Female employment ratio (%)	3220	46.94	16.48	5.40	88.20
Internet users (%)	2881	12.99	21.03	0.00	95.63
Mobile cellular subscriptions (%)	3402	26.86	38.96	0.00	187.86
Fixed telephone lines (%)	3402	16.94	18.53	0.01	74.69
Fixed broadband subscribers (%)	1729	4.06	7.84	0.00	38.10
Sum of the ICT	3413	56.68	73.16	0.00	320.21

Annual % growth of internet users	2509	47.16	55.24	-44.28	585.38
Annual % growth of mobile cellular	2747	44.08	45.40	-128.72	434.61
Annual % growth of telephone	3239	4.31	12.96	-139.87	233.91
Annual % growth of broadband	1154	55.16	62.75	-171.28	460.45
Annual % growth of the sum of ICT	3242	17.64	18.61	-118.73	322.63

For GDP per capita, HDI and growth of GDP per capita with each set of independent variable, the number of countries involved could be different in each regression analysis depending on the availability of the data of the involved variables.

5. ANAYLSIS RESULTS

The GDP per capita, HDI and annual % growth of GDP per capita are separately analyzed in the function of gross capital formation, trade, education spending, health expenditure, female employment ratio and ICTs with linear regression of SPSS. For each dependent variable of GDP per capita, HDI and annual % growth of GDP per capita, 3 cases are considered; Case i) all the countries regardless of the developmental stage of a country, Case ii) economies which receive ODA (developing economies) and Case iii) economies without ODA (developed economies).

For the countries which received ODA (Case ii)), two sub-cases are analyzed; Case ii-1) considers the additional independent variable of "net ODA received" to see if there is some effect of the ODA on development of a developing country. Case ii-2) does not include the "net ODA received" as an independent variable, i.e. the same set of variables for the Cases i) and iii), to see how the same set of independent variables contribute to each dependent variable depending on the group of countries. Therefore, precisely speaking, 4 cases are considered.

For a dependent variable, each case analyzes 6 models of the ICT variables together with other independent variables of capital formation, trade, education, health and female employment ratio; 4 cases in each dependent variable, therefore, 24 analysis scenarios. Since the 3 dependent variables are considered in this study, total 72 scenarios are analyzed.

Table 2: Skeleton of 24 analysis scenarios for a dependent variable

A dependent variable	Independent variables					
	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
	Gross capital formation					
	Trade					
	Public education spending					
	Health expenditure					
	Female employment ratio					
Case	Internet users	Mobile cellular	Fixed telephone	Fixed broadband	Sum of the ICT	All the ICT
i) All the countries						
ii-1) Developing countries with " net ODA received" as an independent variable						
ii-2) Developing countries						
iii) Developed countries						

5.1. GDP per capita

The results of regression with GDP per capita as the dependent variable are shown in Table 3 for the Case i) of all countries. The standardized coefficients of the independent variables are given with t-value in parenthesis. The symbol ***, ** and * means significant at 1% level, 5% level and 10% level, respectively. The constant term in the expression of the standardized coefficients does not have any number but has t-value with significant level when it is significant. It is noted that the number of observations are different in each Model because the data availability of the ICT variables is not always same in a country particularly in early period of observations.

Since all the independent variables are in the unit of %, if a coefficient of an independent variable is bigger than that of other independent variable, it can be understood that the

independent variable with bigger coefficient contributes to the dependent variable more than the other independent variables with smaller coefficients.

Model 1) studies the effect of independent variables of capital formation, trade, education spending, health expenditure, female employment ratio and internet users as the ICT variable on the dependent variable of GDP per capita (GDPPC); the standardized coefficients of each independent variable are -0.030(-1.583), 0.057***(2.838), -0.058***(-2.834), 0.070***(3.087), -0.118***(-6.437) and 0.746***(33.991), respectively as shown in the Table 3. It is noted that the coefficient of the ICT variable (internet users) is the biggest. Model 2) is the same as Model 1) except that ICT variable is mobile cellular subscription per 100 people and Model 3) is with the ICT variable of fixed telephone line per 100 people, and so on.

Table 3: Regression results of GDP per capita for Case i) of all the countries

Dependent variable GDPPC	Standardized coefficients (t-value)					
	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Constant	*** (6.007)	(-0.455)	*** (3.150)	*** (3.021)	*** (3.948)	*** (5.636)
Capital formation (% of GDP)	-0.030 (-1.583)	-0.047** (-2.144)	-0.042** (2.429)	-0.024 (-0.952)	-0.052*** (-2.851)	-0.066*** (-3.849)
Trade (% of GDP)	0.057*** (2.838)	0.071*** (3.089)	0.083*** (4.637)	0.127*** (4.870)	0.032* (1.686)	0.049*** (2.687)
Education spending (% of GDP)	-0.058*** (-2.834)	-0.013 (-0.571)	-0.064*** (-3.498)	-0.042 (-1.560)	-0.047** (-2.445)	-0.087*** (-4.675)
Health expenditure (% of GDP)	0.070*** (3.087)	0.223*** (9.026)	-0.060*** (-2.786)	0.240*** (8.050)	0.038* (1.754)	-0.087*** (-3.750)
Female employment ratio (%)	-0.118*** (-6.437)	-0.048** (-2.293)	0.004 (0.217)	-0.128*** (-5.223)	-0.054*** (-3.078)	-0.027 (-1.557)
Internet users (%)	**0.746*** (33.991)**					**0.385*** (7.962)**
Mobile cellular subscription (%)		**0.568*** (24.227)**			**0.787*** (37.482)**	**0.094*** (3.412)**
Fixed telephone (%)			**0.867*** (41.594)**			**0.579*** (19.929)**
Fixed broadband internet (%)				**0.501*** (18.039)**		**-0.070** (-2.007)**
No. of observation	1200	1217	1218	997	1219	980
Adjusted R^2	0.604	0.476	0.677	0.418	0.637	0.733

Regression results for Case ii-1), Case ii-2) and Case iii) are given in the Annex 2 of this paper. The analysis of standardized coefficients of the independent variables are followed in the order of ICT, female employment ratio, health expenditure, education spending, trade and gross capital formation with comparison of results of the 4Ccases.

Firstly, Table 4 shows that the ICT variables contribute to GDP per capita strongly; almost all the coefficients of the ICT variables are significant at 1% level and the biggest positive among independent variables in each Model as seen in the Table 3 and Annex 2. This finding supports the hypothesis 1: the positive contribution of the ICT variable to dependent variable.

Table 4: ICT variables in GDP per capita

Dependent variable GDPPC		Standardized coefficients (t-value)					
		Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Case i)	Internet users	0.746*** (33.991)				0.787*** (37.482)	0.385*** (7.962)
	Mobile cellular subscription		0.568*** (24.227)				0.094*** (3.412)
	Fixed telephone			0.867*** (41.594)			0.579*** (19.929)
	Fixed broadband				0.501*** (18.039)		-0.070** (-2.007)
Case ii-1)	Internet users	0.422*** (14.534)				0.455*** (15.600)	0.083 (1.512)
	Mobile cellular subscription		0.293*** (9.782)				0.071* (1.872)
	Fixed telephone lines			0.641*** (22.880)			0.530*** (13.209)
	Fixed broadband				0.392*** (12.311)		0.058 (1.317)
Case ii-2)	Internet users	0.488*** (17.014)				0.525*** (18.592)	0.091* (1.653)
	Mobile cellular subscription		0.365*** (12.118)				0.087** (2.276)
	Fixed telephone lines			0.695*** (26.298)			0.561*** (14.301)
	Fixed broadband				0.443*** (13.645)		0.047 (1.053)
Case iii)	Internet users	0.389*** (7.380)				0.396*** (8.075)	0.426*** (4.695)
	Mobile cellular subscription		0.269*** (5.959)				0.186*** (3.108)
	Fixed telephone lines			0.381*** (6.442)			0.440*** (7.807)
	Fixed broadband				0.202*** (3.949)		-0.184** (-2.427)

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The goodness of the fit (R^2) in Table 5 and the coefficients of the ICT variables in Table 4 are Case i) > Case ii) > Case iii) in each model. It means that the ICT contributes to GDP per capita most strongly in the world, less in developing countries and then least in developed countries.

Table 5: Adjusted R^2 of GDP per capita

	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Case i)	0.604	0.476	0.677	0.418	0.637	0.733
Case ii-1)	0.475	0.398	0.595	0.451	0.485	0.607
Case ii-2)	0.436	0.338	0.582	0.399	0.454	0.601
Case iii)	0.265	0.233	0.243	0.218	0.282	0.401

Table 6: Female employment ratio in GDP per capita

	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Case i)	-0.289*** (-10.103)	-0.296*** (-9.780)	-0.149*** (-5.771)	-0.328*** (-9.978)	-0.266*** (-9.465)	-0.184*** (-6.207)
Case ii-1)	-0.289*** (-10.103)	-0.296*** (-9.780)	-0.149*** (-5.771)	-0.328*** (-9.978)	-0.266*** (-9.465)	-0.184*** (-6.207)
Case ii-2)	-0.362*** (-12.962)	-0.388*** (-12.977)	-0.179*** (-7.009)	-0.415*** (-12.883)	-0.327*** (-11.862)	-0.204*** (-6.958)
Case iii)	0.185*** (3.323)	0.349*** (6.731)	0.276*** (5.221)	0.314*** (5.522)	0.257*** (4.984)	0.109* (1.865)

Secondly, the female employment ratio is significant but negative in the Cases i) and ii) while the hypothesis 2 expects the positive contribution of the independent variable to GDP per capita. In order to understand this finding, data of MDG Report 2011 is reviewed; the data of the indicator 1.5 "Employment-to-population ratio" and the indicator 3.2 "Share of women in wage employment in the non-agricultural sector" in MDG Report 2011 of UN. It is noted that developing countries have generally labor-intensive jobs such as agricultural sector, where high female employment ratio may not always imply high GDP per capita. Employment-to-population ratio of the Indicator 1.5 for all sectors in Table 7 is higher in developing countries and even higher in least developed countries than developed countries while female employment ratio in non-agricultural sector is higher in developed countries than developing countries as in the data of the indicator 3.2 in Table 8.

Table 7: Employment-to population ratio (indicator 1.5)

(a) Total

	Employment-to-population ratio, percentage			
	1991	2000	2009	2010[p]
World	62.2	61.5	61.2	61.1
Developing Regions	64.3	63.2	62.7	62.7
Northern Africa	43.4	43.1	45.8	45.9
Sub-Saharan Africa	62.6	62.6	64.3	64.4
Latin America and the Caribbean	56.4	58.1	60.6	60.7
Eastern Asia	74.4	73.9	70.3	70.2
Southern Asia	58.5	56.9	58.3	58.5
South-Eastern Asia	68.3	67.1	65.9	65.8
Western Asia	48.0	45.3	43.6	43.5
Oceania	65.9	66.3	66.4	66.1
Caucasus and Central Asia	57.4	54.9	59.1	59.8
Developed Regions	56.6	55.8	55.4	54.8
Least Developed Countries (LDCs)	70.2	68.5	69.1	69.1
Landlocked Developing Countries (LLDCs)	67.4	67.1	69.5	69.7
Small Island Developing States (SIDS)	55.2	56.7	57.9	57.7

[p] Preliminary data. Source: MDG Report 2011

(b) Men, women and youth

	Employment-to-population ratio, percentage, 2010[p]		
	Men	Women	Youth
World	72.9	49.2	44.3
Developing Regions	75.8	49.4	45.3
Northern Africa	69.8	22.3	28.5
Sub-Saharan Africa	74.1	54.9	47.4
Latin America and the Caribbean	74.6	47.5	44.3
Eastern Asia	75.9	64.3	54.5
Southern Asia	78.5	37.4	42.7
South-Eastern Asia	77.5	54.5	44.2
Western Asia	66.1	18.9	24.2
Oceania	70.2	62.0	50.7
Caucasus and Central Asia	66.3	53.9	39.4
Developed Regions	61.5	48.5	38.1
Least Developed Countries (LDCs)	78.9	59.5	54.9
Landlocked Developing Countries (LLDCs)	77.6	62.2	57.0
Small Island Developing States (SIDS)	69.3	46.5	41.5

[p] Preliminary data.

Table 8: Share of women in wage employment in the non-agricultural sector (indicator 3.2)

	Percentage of employees in non-agricultural wage employment who are women			
	1990	2000	2005	2009
World	35.0	37.5	38.4	39.6
Developing Regions	28.8	31.7	32.6	33.8
Northern Africa	19.0	18.8	18.6	18.8
Sub-Saharan Africa	23.5	28.1	30.2	32.6
Latin America and the Caribbean	36.4	40.4	41.5	43.0
Eastern Asia	38.1	39.7	40.9	41.7
Eastern Asia excluding China	40.1	42.3	44.0	44.8
Southern Asia	13.3	17.1	18.1	19.4
Southern Asia excluding India	14.6	18.4	18.0	19.0
South-Eastern Asia	34.6	36.9	36.8	37.6
Western Asia	14.9	16.8	17.5	18.7
Oceania	33.3	35.5	35.2	36.2
Caucasus and Central Asia	43.8	44.2	45.3	45.2
Developed Regions	44.3	46.2	47.1	48.3

Source: MDG Report 2011

Our results in the Table 6 support this observation. In the Case iii) i.e. for developed economies, the coefficients of the female employment ratio are positive to the GDP per capita in regression analysis. For the developed countries which mostly do not have labor-intensive agricultural sector, the female employment would mean to contribute positively to income of a family, eventually GDP per capita of the country.

Table 9: Health expenditure in GDP per capita

	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Case i)	0.070*** (3.087)	0.223*** (9.026)	-0.060*** (-2.786)	0.240*** (8.050)	0.038* (1.754)	-0.087*** (-3.750)
Case ii-1)	0.059** (2.053)	0.109*** (3.652)	-0.064** (-2.437)	0.068** (2.049)	0.042 (1.480)	-0.090*** (-2.968)
Case ii-2)	0.000 (0.006)	0.048 (1.590)	-0.107*** (-4.238)	0.004 (0.107)	-0.014 (-0.483)	-0.119*** (-4.113)
Case iii)	0.010 (0.179)	0.092* (1.704)	-0.045 (-0.744)	0.079 (1.359)	-0.011 (-0.199)	-0.157*** (-2.673)

Thirdly, the health expenditure contributes positively in some cases, which is consistent with the hypothesis 2. For developing countries, the investment to health sector could cure ill people suffering from diseases e.g. malaria, HIV/AIDS *etc.* who can go back to work within a year since this study examines the effect of independent variables on the dependent variable in the same year. Therefore, it could have direct impact of the recovery of labor force of the developing countries. However, for developed countries of Case iii), the health expenditure would not play much role on GDP per capita in the same year since the health expenditure in the developed countries would be rather focused on wellbeing, e.g. the combat with obesity, senile Alzheimer's disease and so on.

Table 10: Public spending on education in GDP per capita

	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Case i)	-0.058*** (-2.834)	-0.013 (-0.571)	-0.064*** (-3.498)	-0.042 (-1.560)	-0.047** (-2.445)	-0.087*** (-4.675)
Case ii-1)	-0.070** (-2.402)	-0.064** (-2.058)	-0.013 (-0.518)	-0.044 (-1.291)	-0.062** (-2.171)	-0.001 (-0.037)
Case ii-2)	-0.068** (-2.239)	-0.062* (-1.897)	-0.007 (-0.280)	-0.035 (-0.970)	-0.060** (-2.021)	0.004 (0.132)
Case iii)	-0.317*** (-5.834)	-0.333*** (-6.040)	-0.373*** (-6.753)	-0.373*** (-6.378)	-0.339*** (-6.341)	-0.387*** (-7.432)

Fourthly, the public spending on education contributes to GDP per capita negatively, which is different from the hypothesis 2 of this paper. It is probably due to that this study analyzes the effect of education spending in a year on the GDP per capita in the same year. The hypothesis would be turned out to be true if we consider enough period of time to see the effect of education, not within a year effect. Generally, it takes some time to observe the

effect of the investment to education on GDP per capita in a country. Therefore, the public spending on education would show positive contribution to the income (GDP per capita) of the country in some years later with time series methodology (Harvey 1981).

Fifthly, the trade contributes positive to GDP per capita in most scenarios as shown in Table 11 when they are significant. This is consistent with the hypothesis 2 of this paper.

Table 11: Trade (% of GDP) in GDP per capita

	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Case i)	0.057*** (2.838)	0.071*** (3.089)	0.083*** (4.637)	0.127*** (4.870)	0.032* (1.686)	0.049*** (2.687)
Case ii-1)	0.070** (2.365)	0.110*** (3.518)	0.038 (1.450)	0.083*** (2.459)	0.076*** (2.608)	0.023 (0.771)
Case ii-2)	0.049 (1.594)	0.087*** (2.651)	0.021 (0.821)	0.061* (1.730)	0.055* (1.831)	0.012 (0.406)
Case iii)	0.068 (1.410)	0.070 (1.415)	0.136*** (2.879)	0.129*** (2.548)	0.039 (0.823)	0.047 (1.024)

Lastly, the gross capital formation in Table 12 contributes negatively to GDP per capita in developed countries and is insignificant in developing countries. The gross capital of a country is spent in building infrastructure such as roads, bridges, airports, railways, a new planned city, which take time to contribute to the income of a country. Therefore, invest to construct infrastructure in a year could contribute negatively to GDP per capita of the country in the same year. This is different from the hypothesis 2 of this paper but the hypothesis would be true if we consider time delay effect of invest on GDP per capita, not the same year effect.

Table 12: Gross capital formation (% of GDP) in GDP per capita

	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Case i)	-0.030 (-1.583)	-0.047** (-2.144)	-0.042** (2.429)	-0.024 (-0.952)	-0.052*** (-2.851)	-0.066*** (-3.849)
Case ii-1)	0.028 (1.017)	0.014 (0.492)	-0.007 (-0.306)	0.028 (0.883)	-0.003 (-0.110)	-0.029 (-1.050)
Case ii-2)	0.025 (0.865)	0.009 (0.299)	-0.010 (-0.413)	0.015 (0.458)	-0.008 (-0.285)	-0.038 (-1.385)
Case iii)	-0.281*** (-6.129)	-0.279*** (-5.972)	-0.235*** (-5.034)	-0.307*** (-6.222)	-0.272*** (-6.024)	-0.258*** (-5.897)

5.2. Human Development Index (HDI)

Regression results of Case i), Case ii-1), Case ii-2) and Case iii) for human development index are in the Annex 2 of this paper. The standardized coefficients of ICT variables, female employment ratio, health expenditure, education spending, trade and gross capital formation are analyzed with comparison of results of 4 Cases for HDI.

Table 6: ICT variables in HDI

Dependent variable HDI		Standardized coefficients (t-value)					
		Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Case i)	Internet users	0.751*** (28.772)				0.801*** (33.991)	0.373*** (7.164)
	Mobile cellular subscription		0.605*** (21.329)				0.216*** (7.935)
	Fixed telephone			0.834*** (34.643)			0.535*** (17.296)
	Fixed broadband				0.646*** (19.847)		-0.156*** (-3.566)
Case ii-1)	Internet users	0.431*** (11.991)				0.507*** (14.474)	0.169*** (2.824)
	Mobile cellular subscription		0.380*** (10.447)				0.214*** (5.267)
	Fixed telephone lines			0.599*** (16.458)			0.501*** (9.511)
	Fixed broadband				0.390*** (10.086)		-0.140** (-2.367)
Case ii-2)	Internet users	0.517*** (13.908)				0.594*** (16.951)	0.187*** (3.010)
	Mobile cellular subscription		0.466*** (12.271)				0.242*** (5.774)
	Fixed telephone lines			0.688*** (19.344)			0.572*** (10.854)
	Fixed broadband				0.469*** (11.427)		-0.171** (-2.798)
Case iii)	Internet users	0.556*** (10.341)				0.496*** (9.482)	0.531*** (6.091)
	Mobile cellular subscription		0.235*** (4.439)				0.032 (0.597)
	Fixed telephone lines			0.353*** (5.208)			0.404*** (7.057)
	Fixed broadband				0.444*** (7.417)		0.012 (0.143)

Firstly, the ICT variables also contribute to HDI most strongly among independent variables, i.e., almost all the coefficients of the ICT variables are significant at 1% level and the biggest positive in each model, which is consistent with the hypothesis 1.

The adjusted R^2 of HDI in Table 14 is comparable in all the Cases while that of GDP per capita, in particular, is very low for developed countries in Table 5. The adjusted R^2 of HDI for each Case is also bigger than that of GDP per capita, which may imply that HDI is better to explain development of a country than GDP per capita. This is consistent with the hypothesis 4: HDI explains more than GDP per capita of a country.

Table 74: Adjusted R^2 of HDI

	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Case i)	0.727	0.633	0.783	0.625	0.777	0.852
Case ii-1)	0.626	0.598	0.698	0.601	0.666	0.735
Case ii-2)	0.563	0.523	0.665	0.518	0.620	0.714
Case iii)	0.607	0.452	0.470	0.544	0.584	0.679

Secondly, the female employment ratio in Table 15 is significant but negative in the Cases i) and ii) while it is positive in the Case iii) of developed countries. This finding is consistent with that in GDP per capita. In developed countries which mostly do not have labor-intensive sector, the female employment would explain empowerment of women in economic and social activities in their countries, so eventually human development.

Table 85: Female employment ratio in HDI

	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Case i)	-0.289*** (-13.115)	-0.211*** (-8.179)	-0.190*** (-9.544)	-0.329*** (-11.987)	-0.219*** (-10.958)	-0.179*** (-9.751)
Case ii-1)	-0.317*** (-9.063)	-0.320*** (-8.945)	-0.190*** (-5.837)	-0.355*** (-9.213)	-0.281*** (-8.533)	-0.188*** (-5.424)
Case ii-2)	-0.392*** (-10.800)	-0.403*** (-10.758)	-0.225*** (-6.644)	-0.445*** (-10.973)	-0.338*** (-9.927)	-0.208*** (-5.829)
Case iii)	-0.077 (1.402)	0.318*** (5.233)	0.213*** (3.490)	0.223*** (3.693)	0.196*** (3.661)	-0.001 (-0.018)

Thirdly, the health expenditures are significant and positive like the hypothesis 2 in developed countries (Case iii)) while they are less significant in developing countries (Case ii)) shown in Table 16. Health expenditure in developing countries would not only cure patient but also build infrastructure of health sector such as hospitals and medical schools. It would take some time to spread the effect of investment to health sector on development of

developing countries. However, developed countries would show the effect of health expenditure to human development more quickly, e.g. taking care of the elderly by social workers because it is expected that the developed countries have already had infrastructures of health sector. The health expenditure in HDI fits better than that in GDP per capita in Table 9, therefore, the hypothesis 4 is accepted.

Table 96: Health expenditure in HDI

	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Case i)	0.076*** (2.682)	0.258*** (8.352)	-0.018 (-0.673)	0.155*** (4.274)	0.054** (2.093)	-0.011 (-0.461)
Case ii-1)	0.140*** (3.664)	0.201*** (5.185)	0.027 (0.749)	0.159*** (3.624)	0.116*** (3.219)	0.037 (0.957)
Case ii-2)	0.032 (0.838)	0.096** (2.405)	-0.068** (-1.959)	0.036 (0.791)	0.020 (0.572)	-0.040 (-1.095)
Case iii)	0.292*** (4.941)	0.474*** (7.192)	0.334*** (4.663)	0.310*** (4.733)	0.306*** (5.041)	0.130** (2.151)

Fourthly, the public spending on education is mostly insignificant different from the hypothesis 2. It can be understood because it takes some time to show the effect of the education spending on human development of a country. However, in this study, the effect of the education spending on HDI is analyzed in the same year. Due to the limitation of the analysis within the same year, even negative contribution of the public spending on education to the HDI of the developing countries in the same year could occur as shown in the Case ii) in Table 17.

Table 10: Public spending on education in HDI

	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Case i)	-0.020 (-0.835)	0.010 (0.333)	0.000 (0.021)	-0.014 (-0.442)	0.010 (0.440)	0.015 (0.778)
Case ii-1)	-0.108*** (-2.947)	-0.098*** (-2.546)	-0.036 (-1.070)	-0.073* (-1.737)	-0.073** (-2.109)	-0.035 (-0.988)
Case ii-2)	-0.067* (-1.708)	-0.049 (-1.199)	0.004 (0.119)	-0.011 (-0.248)	-0.033 (-0.902)	0.002 (0.053)
Case iii)	0.002 (0.028)	-0.011 (-0.161)	-0.048 (-0.725)	-0.091 (-1.448)	-0.044 (-0.761)	-0.062 (-1.136)

Lastly, the trade and gross capital formation are insignificant to HDI of developed countries while they mostly contribute positively to HDI of developing countries as shown in Tables 18 and 19 because developing countries are easier to improve their societies than developed countries with small inputs within a short period, i.e. easy to catch up developed countries.

Table 118: Trade (% of GDP) in HDI

	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Case i)	0.020 (0.840)	0.052* (1.889)	0.047** (2.276)	0.075*** (2.580)	-0.003 (-0.129)	-0.029 (-1.513)
Case ii-1)	0.094*** (2.624)	0.135*** (3.683)	0.081*** (2.511)	0.111*** (2.792)	0.095*** (2.835)	0.012 (0.359)
Case ii-2)	0.037 (0.976)	0.077** (1.969)	0.035 (1.060)	0.046 (1.086)	0.044 (1.267)	-0.030 (-0.894)
Case iii)	-0.038 (-0.761)	0.012 (0.202)	0.043 (0.764)	-0.008 (-0.149)	-0.058 (-1.134)	-0.062 (-1.328)

Table 129: Gross capital formation (% of GDP) in HDI

	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Case i)	0.080*** (3.555)	0.059** (2.268)	0.052*** (2.566)	0.100*** (3.587)	0.049** (2.405)	0.025 (1.401)
Case ii-1)	0.139*** (4.173)	0.123*** (3.529)	0.069** (2.239)	0.155*** (4.168)	0.093*** (2.899)	0.036 (1.117)
Case ii-2)	0.118*** (3.265)	0.095*** (2.515)	0.042 (1.302)	0.124*** (3.050)	0.066** (1.949)	0.005 (0.140)
Case iii)	-0.024 (-0.511)	-0.018 (-0.329)	0.001 (0.025)	-0.021 (-0.403)	-0.007 (-0.153)	0.010 (0.218)

5.3. Growth of GDP per capita

Regression results of Case i), Case ii-1), Case ii-2) and Case iii) for annual % growth of GDP per capita are in the Annex 2 of this paper. The results of variables of ICT, female employment ratio, health expenditure, education spending, trade and gross capital formation are analyzed with comparison of all the results for annual % growth of GDP per capita.

Table 20 shows that the most ICT growth variables in Case iii) of developed countries contribute positively to the annual growth of GDP per capita with high t-value while those in

Cases ii) of developing countries are insignificant or significant with low t-value. This may imply that ICT does not contribute the growth of developing countries.

Table 2013: Growth of ICT variables in annual % growth of GDP per capita

Dependent variable GDPPC growth		Standardized coefficients (t-value)					
		Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Case i)	Annual % growth of internet users	-0.073*** (-2.553)				0.092*** (3.261)	-0.019 (-0.495)
	Annual % growth of mobile cellular subscription		0.096*** (3.388)				0.273*** (6.644)
	Annual % growth of fixed telephone			0.045* (1.653)			0.014 (0.395)
	Annual % growth of fixed broadband				0.170*** (4.650)		0.092** (2.417)
Case ii-1)	Annual % growth of internet users	-0.130*** (-3.853)				0.047 (1.380)	-0.032 (-0.626)
	Annual % growth of mobile cellular subscription		0.033 (0.969)				0.215*** (3.968)
	Annual % growth of fixed telephone			0.017 (0.509)			-0.032 (-0.629)
	Annual % growth of fixed broadband				0.124*** (2.474)		0.074 (1.404)
Case ii-2)	Annual % growth of internet users	-0.130*** (-3.874)				0.042 (1.260)	-0.036 (-0.706)
	Annual % growth of mobile cellular subscription		0.031 (0.938)				0.206*** (3.937)
	Annual % growth of fixed telephone			0.017 (0.504)			-0.032 (-0.633)
	Annual % growth of fixed broadband				0.124*** (2.468)		0.078 (1.495)
Case iii)	Annual % growth of internet users	0.185*** (3.797)				0.359*** (7.639)	-0.025 (-0.445)
	Annual % growth of mobile cellular subscription		0.343*** (7.419)				0.373*** (5.863)
	Annual % growth of fixed telephone			0.169*** (3.656)			0.094** (1.938)
	Annual % growth of fixed broadband				0.234*** (4.502)		0.025 (0.407)

Table 21 shows that R^2 with annual % growth of GDP per capita is very low compared with that of GDP per capita in Table 5 and HDI in Table 14. Therefore, the methodology used in this study may not explain economic growth of countries well while it explains the development of countries pretty well. However, this would be mainly due to the limitation of data analysis, i.e. the effect of the independent variables on the dependent variable in the

same year because the observation of economic growth of a country within a year would be too ambitious. Table 21 shows that the R^2 with annual % growth of GDP per capita of Case iii) of developed countries fits a little better than that of Cases i) or ii).

Table 214: Adjusted R^2 of annual % growth of GDP per capita

	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Case i)	0.106	0.128	0.111	0.133	0.117	0.179
Case ii-1)	0.139	0.149	0.135	0.121	0.135	0.147
Case ii-2)	0.140	0.150	0.135	0.124	0.136	0.148
Case iii)	0.141	0.217	0.138	0.199	0.223	0.289

The female employment ratios are insignificant to the annual growth of GDP per capita while the female employment ratios are significant negatively for developing countries and positively for developed countries in GDP per capita and HDI.

Table 22: Female employment ratio in annual % growth of GDP per capita

	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Case i)	0.035 (1.269)	0.055** (1.998)	0.042 (1.540)	0.083** (2.271)	0.029 (1.043)	0.051 (1.395)
Case ii-1)	0.027 (0.741)	0.047 (1.287)	0.034 (0.931)	0.059 (0.986)	0.027 (0.751)	0.056 (0.937)
Case ii-2)	0.026 (0.773)	0.043 (1.277)	0.025 (0.743)	0.067 (1.329)	0.016 (0.478)	0.037 (0.715)
Case iii)	0.044 (0.775)	0.032 (0.601)	0.007 (0.121)	0.033 (0.532)	0.060 (1.138)	0.042 (0.707)

Health expenditure in Table 23 is insignificant or significant with low t-value.

Table 153: Health expenditure in annual % growth of GDP per capita

	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Case i)	-0.044 (-1.394)	-0.011 (-0.346)	-0.025 (-0.841)	-0.089** (-2.081)	-0.009 (-0.286)	0.002 (0.053)
Case ii-1)	0.039 (1.070)	0.066* (1.826)	0.066* (1.873)	0.079 (1.466)	0.068** (1.930)	0.107** (1.963)
Case ii-2)	0.038 (1.084)	0.064* (1.813)	0.061* (1.777)	0.081 (1.500)	0.062* (1.791)	0.102* (1.897)
Case iii)	-0.152*** (-2.659)	-0.100* (-1.816)	-0.179*** (-3.181)	-0.142** (-2.173)	-0.077 (-1.382)	-0.076 (-1.196)

Public spending on education in Table 24 contributes negatively to the annual growth of GDP per capita in most cases since the public spending on education would be just expenditure without contributing to the growth of GDP per capita of the country in the same year, which take some time to show its effects on the economic growth of a country. However, Case iii) of developed countries shows positive contribution to the annual growth of GDP per capita significant at 5 % or 10 % level, which is difficult to understand why the public spending on education contributes positively to the growth of GDP per capita of the country in the same year.

Table 164: Public spending on education in annual % growth of GDP per capita

	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Case i)	-0.114*** (-3.744)	-0.124*** (-4.101)	-0.121*** (-4.034)	-0.095** (-2.302)	-0.116*** (-3.879)	-0.097** (-2.370)
Case ii-1)	-0.188*** (-5.062)	-0.202*** (-5.451)	-0.194*** (-5.308)	-0.278*** (-4.968)	-0.191*** (-5.230)	-0.281*** (-4.990)
Case ii-2)	-0.187*** (-5.068)	-0.201*** (-5.448)	-0.193*** (-5.285)	-0.277*** (-4.974)	-0.190*** (-5.199)	-0.285*** (-5.089)
Case iii)	0.103* (1.748)	0.131** (2.342)	0.115** (1.957)	0.157** (2.353)	0.097** (1.749)	0.164*** (2.575)

Table 25 shows that trade contributes positively to the annual growth of GDP per capita only for Case ii) of developing countries. Case iii) of developed countries is insignificant, which leads to Case i) insignificant, too.

It is reminded that trade also contributes to GDP per capita and HDI of developing countries positively while it contributes less significantly and is insignificant of developed countries. This would imply that trade indeed contribute to the development and economic growth of developing countries.

Table 175: Trade (% of GDP) in annual % growth of GDP per capita

	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Case i)	0.033 (1.110)	0.040 (1.362)	0.038 (1.295)	-0.020 (-0.535)	0.043 (1.484)	0.017 (0.453)
Case ii-1)	0.118*** (3.168)	0.126*** (3.383)	0.124*** (3.383)	0.128** (2.396)	0.125*** (3.394)	0.136*** (2.534)
Case ii-2)	0.118*** (3.172)	0.125*** (3.375)	0.123*** (3.344)	0.127** (2.389)	0.122*** (3.331)	0.137*** (2.555)
Case iii)	-0.063 (-1.236)	-0.036 (-0.752)	-0.076 (-1.496)	-0.051 (-0.892)	-0.041 (-0.856)	-0.045 (-0.841)

It is interesting to see in Table 26 that gross capital formation contributes positively to the annual growth of GDP per capita for all cases with high t-values, which would explain economic growth of a country best and support the hypothesis 2. However, the gross capital formation is insignificant to GDP per capita in developing countries, contributes negatively to GDP per capita in developed countries and positively to HDI in only developing countries as seen in previous sections. It needs further study to understand these results each other. Time series analysis with averaged data over some period might give different results.

Table 186: Gross capital formation (% of GDP) in annual % growth of GDP per capita

	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Case i)	0.287*** (9.971)	0.312*** (11.020)	0.294*** (10.400)	0.250*** (6.664)	0.297*** (10.524)	0.242*** (6.568)
Case ii-1)	0.289*** (8.138)	0.320*** (9.083)	0.303*** (8.671)	0.213*** (4.106)	0.303*** (8.695)	0.202*** (3.927)
Case ii-2)	0.289*** (8.143)	0.320*** (9.097)	0.304*** (8.684)	0.215*** (4.203)	0.304*** (8.710)	0.197*** (3.879)
Case iii)	0.302*** (6.052)	0.324*** (6.848)	0.306*** (6.172)	0.367*** (6.579)	0.294*** (6.232)	0.380*** (7.169)

5.4. Effect of ODA on GDP per capita, HDI and Growth of GDP per capita

In this study, the countries of Cases ii-1) and ii-2) are chosen as developing countries since they receive ODA according to the database of World Bank. Case ii-1) considers the "net ODA received" as an independent variable in addition to the independent variables in Cases i), ii-2) and iii). In this section, the results of Case ii-1) for the 3 dependent variables are

compared focusing on the effect of ODA on the development or economic growth of a country to see if the hypothesis 3 is accepted, i.e. the positive effect of the ODA on development or economic growth of a developing country.

Table 197: Net ODA received in 3 dependent variables

Dependent variable	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
GDPPC	-0.228*** (-7.622)	-0.278*** (-8.870)	-0.138*** (-5.143)	-0.256*** (-7.566)	-0.206*** (-6.928)	-0.095*** (-3.126)
HDI	-0.295*** (-7.950)	-0.317*** (-8.365)	-0.222*** (-6.525)	-0.332*** (-8.054)	-0.255*** (-7.223)	-0.179*** (-5.006)
Growth of GDPPC	-0.002 (-0.063)	-0.010 (-0.261)	-0.024 (-0.658)	0.014 (0.234)	-0.033 (-0.902)	-0.040 (-0.634)

The negative coefficient of the ODA to GDP per capita or HDI in Table 27 should not be interpreted that the developing country which received ODA worsens its development, which seem to be different from the hypothesis 3. They rather explain that as GDP per capita or HDI is increased in the developing country, the received ODA of the country is reduced, which may imply appropriate ODA policy in the world.

The effect of ODA on economic growth of a county is insignificant maybe due to the limitation of the analysis of data in the same year, However, the insignificant coefficients of the ODA in the annual % growth of GDP per capita would mean that the ODA is not granted based on the annual growth rate of GDP per capita of a developing country.

5.5   LIMITATIONS OF THIS STUDY

As it mentioned in previous sections, this study has fundamental limitation. i.e., all the independent variables are expected to contribute to each dependent variable in the same year. This would be unreasonable expectation because for example, spending on education will generally affect GDP per capita, HDI or growth of GDP per capita some years later. There is a Korean saying "Education is a plan which spans a hundred years." Therefore, an average figure of each variable over a five or ten years period would be more appropriate to analyze

than the figure of each year. Time series methodology would be desirable to apply, too. However, data over such a period are not sufficiently available, so data of each year are analyzed.

It is found that the ICT makes contribution to development or economic growth of an economy. However, the development of the ICT is also affected by the development or economic growth of the economy. In reality, the higher the GDP per capita of a country, the higher is the use of the ICT. Therefore, the relation between ICT and development or economic growth is two-way traffic, not a one-way traffic. However, this paper studies one way relationship from ICT to development or economic growth. Therefore, in the future studies, the two-way model should be utilized with time delay effect of independent variables on dependent variable.

6. CONCLUSIONS AND RECOMMENDATIONS

Development and economic growth of countries are studied with GDP per capita, HDI and annual growth of GDP per capita in the function of ICT, female employment ratio, health expenditure, education spending, trade and gross capital formation.

The ICT variables strongly contribute to GDP per capita of a country. The strong contribution of ICT variables to development is also found in the analysis of human development index with higher goodness of the fit (R^2) than that in GDP per capita, i.e., the ICT contributes positively to the development of a country. The annual growth of ICT also contributes positively to the annual % growth of GDP per capita with much lower R^2 than that of GDP per capita or HDI. Therefore, the ICT variables would explain development a lot better than economic growth of a country.

The negative contribution of the female employment ratio to both GDP per capita and HDI is found in developing countries due to labor-intensive sector while positive contribution in developed countries due to non-labor intensive sector.

The positive coefficients of health expenditure in GDP per capita of the developing countries can be understood that the investment to health sector in a year could recover labor force of the developing countries within the same year, e.g. the cure of people suffering HIV/AIDS and malaria *etc*. It is found that health expenditure contributes more significantly to HDI than GDP per capita, which improves human development of a country.

Education spending is negative to GDP per capita and annual growth of GDP per capita and insignificant to HDI, which can be understood by the fact that education on development and economic growth take some time to show its effect.

Trade contributes positively to both development (GDP per capita and HDI) and economic growth of developing countries.

Gross capital formation contributes negatively to GDP per capita of developed countries, positively to HDI of developing countries and positively to annual % growth of GDP per capita of both developing and developed countries, which would need further study with time series methodology.

According to the MDG Reports, it is still a long way to go in empowering women, promoting sustainable development, protecting the most vulnerable from natural disasters and so on, which requires a post-2015 development framework. It is also noted that contrast to other MDGs, the Goal 8 (develop a global partnership for development) doesn't have quantitative target to monitor its progress. For example, the Target 8.F (in cooperation with the private sector, make available benefits of new technologies, especially information and communications) has indicators of

the ICT variables such as internet users per 100 population, cellular subscribers per 100 population and broadband users per 100 populations, which are monitored every year but there is no specific target of the indicator to be achieved by the year 2015. Therefore, the era beyond the MDG should have quantitative targets of the indicators related to the ICT variables because it is found that the ICT plays significant roles on GDP per capita and HDI. It is recommended that governments should invest ICT because the ICT contributes positively to both development and economic growth of their countries.

It is also recommended to introduce HDI as a target to monitor the quality of life of a country, not just the goal of simple poverty reduction of current MDG 1 since men cannot live by bread alone. The quantitative targets of HDI and ICT variables of developing countries should be different, depending on the stage of development of the countries. For example, the least developed countries would set their goals to be achieved by 2020 or 2025 as the average value of HDI and ICT variables of landlocked developing countries in 2010, the landlocked developing countries' goals to be achieved by 2020 or 2025 are those of small island developing countries in 2010, the small island developing countries' goals are those of developed countries in 2010 similarly.

Lastly, in order to facilitate the achievement of goals beyond MDG further, it is recommended that UN create a one-to-one partnership of the most developed country with the least developed country, the second most developed country with the second least developed country, and so on. In order to do this, we may use rank of each country such as HDI or GDP per capita of countries. The participating countries are recommended to submit a progress report on their projects to UN regularly e.g. every 5 years, which provides that the partner countries work together efficiently and effectively to complete the projects with more responsibilities. Regular peer review is also recommended to monitor the progress of their projects in order to facilitate development of the recipient countries.

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ANNEXES

Annex 1

Source of Data

Variable	Source	URL
HDI	UNDP	http://hdrstats.undp.org/en/tables/
GDP per capita, PPP(year 2005 $)	World Bank	http://databank.worldbank.org/ddp/home.do or http://databank.worldbank.org/databank/download/WDIandGDF_excel.zip
GDP per capita growth (annual %)		
Gross capital formation(% of GDP)		
Trade (% of GDP)		
Net ODA received (% of GNI)		
Education spending (% of GDP)		
Health expenditure(% of GDP)		
Female employment ratio (%)		
Internet users (%)		
Mobile cellular subscriptions (%)		
Fixed telephone lines (%)		
Fixed broadband subscribers (%)		

Annex 2

Description statistics and results of Regression

1. GDP per capita

Case i) All countries

Dependent variable GDPPC	Sample statistics (standard deviation)					
	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
GDPPC	12766.85 (13246.60)	12714.56 (13219.33)	12704.14 (13218.87)	14059.43 (13603.96)	12694.75 (13217.52)	14153.995 (13628.85)
Capital formation (% of GDP)	22.46 (7.19)	22.57 (7.29)	22.56 (7.29)	22.83 (6.60)	22.55 (7.30)	22.80 (6.60)
Trade (% of GDP)	85.07 (44.37)	85.62 (44.74)	85.58 (44.74)	86.50 (45.31)	85.57 (44.72)	85.97 (44.91)
Education spending (% of GDP)	4.56 (1.81)	4.57 (1.81)	4.57 (1.82)	4.68 (1.76)	4.57 (1.81)	4.66 (1.76)
Health expenditure (% of GDP)	6.44 (2.41)	6.42 (2.39)	6.43 (2.41)	6.62 (2.43)	6.44 (2.41)	6.62 (2.42)
Female employment ratio (%)	48.06 (15.16)	47.93 (15.14)	47.95 (15.15)	47.83 (14.69)	47.96 (15.14)	47.89 (14.71)
Internet users	20.07 (24.39)					23.73 (25.29)
Mobile cellular subscription		44.07 (40.91)			89.21 (83.65)	52.26 (40.67)
Fixed telephone lines			21.68 (20.04)			23.92 (20.43)
Fixed broadband internet				4.62 (8.26)		4.69 (8.31)
No. of observation	1200	1217	1218	997	1219	980

Dependent variable GDPPC	Standardized coefficients (t-value)					
	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Constant	*** (6.007)	(-0.455)	*** (3.150)	*** (3.021)	*** (3.948)	*** (5.636)
Capital formation (% of GDP)	-0.030 (-1.583)	-0.047** (-2.144)	-0.042** (2.429)	-0.024 (-0.952)	-0.052*** (-2.851)	-0.066*** (-3.849)
Trade (% of GDP)	0.057*** (2.838)	0.071*** (3.089)	0.083*** (4.637)	0.127*** (4.870)	0.032* (1.686)	0.049*** (2.687)
Education spending (% of GDP)	-0.058*** (-2.834)	-0.013 (-0.571)	-0.064*** (-3.498)	-0.042 (-1.560)	-0.047** (-2.445)	-0.087*** (-4.675)

Health expenditure (% of GDP)	0.070*** (3.087)	0.223*** (9.026)	-0.060*** (-2.786)	0.240*** (8.050)	0.038* (1.754)	-0.087*** (-3.750)
Female employment ratio (%)	-0.118*** (-6.437)	-0.048** (-2.293)	0.004 (0.217)	- 0.128*** (-5.223)	-0.054*** (-3.078)	-0.027 (-1.557)
Internet users	**0.746*** (33.991)**					**0.385*** (7.962)**
Mobile cellular subscription		**0.568*** (24.227)**			**0.787*** (37.482)**	**0.094*** (3.412)**
Fixed telephone			**0.867*** (41.594)**			**0.579*** (19.929)**
Fixed broadband internet				**0.501*** (18.039)**		**-0.070** (-2.007)**
Adjusted R²	0.604	0.476	0.677	0.418	0.637	0.733

***: significant at 1% level, **: significant at 5% level, *: significant at 10% level

< Observation of the results >

- Trade, ICT variables > 0

- Gross capital formation, Public education spending, Female employment ratio < 0

- Health expenditure > 0 in most cases

Case ii) Countries which received ODA: developing economies

Note: Case ii-1) and Case ii-2) have the same sample statistics for each model.

Dependent variable GDPPC	**Sample statistics** (standard deviation)					
	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
GDPPC	5125.39 (4858.22)	5106.38 (4825.19)	5100.00 (4825.42)	5433.39 (4888.00)	5095.18 (4824.32)	5477.35 (4921.51)
Capital formation (% of GDP)	22.21 (8.25)	22.36 (8.38)	22.34 (8.38)	22.73 (7.64)	22.34 (8.38)	22.70 (7.65)
Trade (% of GDP)	80.28 (39.62)	81.30 (40.42)	81.24 (40.41)	81.91 (39.89)	81.24 (40.39)	80.80 (38.91)
Net ODA received (% of GNI)	6.13 (9.81)	6.09 (9.68)	6.16 (9.76)	5.78 (10.34)	6.16 (9.76)	5.63 (10.28)
Education spending (% of GDP)	4.23 (1.93)	4.25 (1.93)	4.25 (1.93)	4.34 (1.88)	4.24 (1.93)	4.31 (1.87)
Health expenditure (% of GDP)	5.68 (2.09)	5.65 (2.04)	5.67 (2.09)	5.74 (2.05)	5.67 (2.08)	5.72 (2.01)

Female employment ratio (%)	48.12 (17.78)	47.91 (17.75)	47.95 (17.76)	47.68 (17.62)	47.95 (17.75)	47.81 (17.66)
Internet users	7.51 (10.67)					9.33 (11.52)
Mobile cellular subscription		25.94 (30.45)			43.89 (47.05)	32.43 (31.74)
Fixed telephone lines			9.98 (10.66)			10.79 (11.04)
Fixed broadband internet				0.89 (2.26)		0.91 (2.28)
No. of observation	783	796	797	609	798	596

ii-1) Net ODA received is additionally considered as an independent variable

Dependent variable GDPPC	Standardized coefficients (t-value)					
	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Constant	*** (9.969)	*** (8.839)	*** (8.625)	*** (9.323)	*** (9.564)	*** (8.368)
Capital formation (% of GDP)	0.028 (1.017)	0.014 (0.492)	-0.007 (-0.306)	0.028 (0.883)	-0.003 (-0.110)	-0.029 (-1.050)
Trade (% of GDP)	0.070** (2.365)	0.110*** (3.518)	0.038 (1.450)	0.083*** (2.459)	0.076*** (2.608)	0.023 (0.771)
Net ODA received (% of GNI)	-0.228*** (-7.622)	-0.278*** (-8.870)	-0.138*** (-5.143)	-0.256*** (-7.566)	-0.206*** (-6.928)	-0.095*** (-3.126)
Education spending (% of GDP)	-0.070** (-2.402)	-0.064** (-2.058)	-0.013 (-0.518)	-0.044 (-1.291)	-0.062** (-2.171)	-0.001 (-0.037)
Health expenditure (% of GDP)	0.059** (2.053)	0.109*** (3.652)	-0.064** (-2.437)	0.068** (2.049)	0.042 (1.480)	-0.090*** (-2.968)
Female employment ratio (%)	-0.289*** (-10.103)	-0.296*** (-9.780)	-0.149*** (-5.771)	-0.328*** (-9.978)	-0.266*** (-9.465)	-0.184*** (-6.207)
Internet users	**0.422*** (14.534)**					**0.083 (1.512)**
Mobile cellular subscription		**0.293*** (9.782)**			**0.455*** (15.600)**	**0.071* (1.872)**
Fixed telephone lines			**0.641*** (22.880)**			**0.530*** (13.209)**
Fixed broadband internet				**0.392*** (12.311)**		**0.058 (1.317)**
Adjusted R^2	0.475	0.398	0.595	0.451	0.485	0.607

***: significant at 1% level, **: significant at 5% level, *: significant at 10% level

< Observation of the results>

- Trade, ICT variables > 0

- Net ODA received, Female employment ratio < 0

- Public education spending < 0 when they are significant

- Health expenditure: case by case

- Gross capital formation: insignificant

ii-2) Net ODA received is NOT considered as the independent variable: the same set of independent variables in Cases i) and iii)

Dependent variable GDPPC	Standardized coefficients (t-value)					
	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Constant	*** (11.251)	*** (10.030)	*** (9.256)	*** (10.928)	*** (10.611)	*** (8.893)
Capital formation (% of GDP)	0.025 (0.865)	0.009 (0.299)	-0.010 (-0.413)	0.015 (0.458)	-0.008 (-0.285)	-0.038 (-1.385)
Trade (% of GDP)	0.049 (1.594)	0.087*** (2.651)	0.021 (0.821)	0.061* (1.730)	0.055* (1.831)	0.012 (0.406)
Education spending (% of GDP)	-0.068** (-2.239)	-0.062* (-1.897)	-0.007 (-0.280)	-0.035 (-0.970)	-0.060** (-2.021)	0.004 (0.132)
Health expenditure (% of GDP)	0.000 (0.006)	0.048 (1.590)	-0.107*** (-4.238)	0.004 (0.107)	-0.014 (-0.483)	-0.119*** (-4.113)
Female employment ratio (%)	-0.362*** (-12.962)	-0.388*** (-12.977)	-0.179*** (-7.009)	-0.415*** (-12.883)	-0.327*** (-11.862)	-0.204*** (-6.958)
Internet users	**0.488*** (17.014)**					**0.091* (1.653)**
Mobile cellular subscription		**0.365*** (12.118)**				**0.087** (2.276)**
Fixed telephone lines			**0.695*** (26.298)**		**0.525*** (18.592)**	**0.561*** (14.301)**
Fixed broadband internet subscribers				**0.443*** (13.645)**		**0.047 (1.053)**
No. of observation	783	796	797	609	798	596
Adjusted R^2	0.436	0.338	0.582	0.399	0.454	0.601

***: significant at 1% level, **: significant at 5% level, *: significant at 10% level

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<Observation of the results>

- ICT variables > 0, Trade > 0 when they are significant

- Female employment ratio < 0

- Gross capital formation: insignificant

- Public education spending, Health expenditure < 0 when they are significant

Case iii) Countries without receiving ODA: developed economies

Dependent variable GDPPC	Sample statistics (standard deviation)					
	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
GDPPC	27708.41 (11641.14)	27735.34 (11602.63)	27735.34 (11602.63)	27888.97 (11537.50)	27735.34 (11602.63)	27861.42 (11578.74)
Capital formation (% of GDP)	23.00 (4.56)	23.02 (4.55)	23.02 (4.55)	23.00 (4.53)	23.02 (4.55)	22.98 (4.54)
Trade (% of GDP)	93.79 (51.47)	93.38 (51.50)	93.38 (51.50)	93.44 (52.21)	93.38 (51.50)	93.87 (52.19)
Education spending (% of GDP)	5.19 (1.39)	5.19 (1.39)	5.19 (1.39)	5.21 (1.40)	5.19 (1.39)	5.21 (1.40)
Health expenditure (% of GDP)	7.93 (2.33)	7.94 (2.32)	7.94 (2.32)	8.03 (2.33)	7.94 (2.32)	8.03 (2.34)
Female employment ratio (%)	48.06 (8.25)	48.09 (8.22)	48.09 (8.22)	48.08 (8.29)	48.09 (8.22)	48.05 (8.31)
Internet users	44.81 (24.78)				179.36 (65.52)	46.53 (24.33)
Mobile cellular subscription		80.44 (34.22)				83.77 (32.59)
Fixed telephone lines			44.51 (13.61)			44.58 (13.71)
Fixed broadband internet				10.61 (10.55)		10.67 (10.57)
No. of observation	406	409	409	383	409	380

Dependent variable GDPPC	Standardized coefficients (t-value)					
	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Constant	*** (7.607)	*** (4.919)	*** (5.189)	*** (6.685)	*** (6.363)	*** (5.794)
Capital formation (% of GDP)	-0.281*** (-6.129)	-0.279*** (-5.972)	-0.235*** (-5.034)	-0.307*** (-6.222)	-0.272*** (-6.024)	-0.258*** (-5.897)
Trade (% of GDP)	0.068 (1.410)	0.070 (1.415)	0.136*** (2.879)	0.129*** (2.548)	0.039 (0.823)	0.047 (1.024)
Education spending (% of GDP)	-0.317*** (-5.834)	-0.333*** (-6.040)	-0.373*** (-6.753)	-0.373*** (-6.378)	-0.339*** (-6.341)	-0.387*** (-7.432)
Health expenditure (% of GDP)	0.010 (0.179)	0.092* (1.704)	-0.045 (-0.744)	0.079 (1.359)	-0.011 (-0.199)	-0.157*** (-2.673)
Female employment ratio (%)	0.185*** (3.323)	0.349*** (6.731)	0.276*** (5.221)	0.314*** (5.522)	0.257*** (4.984)	0.109* (1.865)
Internet users	**0.389*** (7.380)**					**0.426*** (4.695)**
Mobile cellular subscription		**0.269*** (5.959)**			**0.396*** (8.075)**	**0.186*** (3.108)**
Fixed telephone lines			**0.381*** (6.442)**			**0.440*** (7.807)**
Fixed broadband internet subscribers				**0.202*** (3.949)**		**-0.184** (-2.427)**
Adjusted R^2	0.265	0.233	0.243	0.218	0.282	0.401

***: significant at 1% level, **: significant at 5% level, *: significant at 10% level

<Observation of the results >

- Gross capital formation, Public education spending < 0

- Female employment ratio, ICT variables > 0

- Trade > 0 when they are significant

- Health expenditure : case by case

2. Human development Index (HDI)

Case i) All countries

Dependent variable HDI	Sample statistics (standard deviation)					
	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
HDI	0.67 (0.18)	0.67 (0.18)	0.67 (0.18)	0.69 (0.17)	0.67 (0.18)	0.69 (0.17)
Capital formation (% of GDP)	23.04 (6.86)	23.07 (6.88)	23.07 (6.88)	23.47 (6.53)	23.06 (6.88)	23.45 (6.50)
Trade (% of GDP)	87.62 (47.23)	87.78 (47.48)	87.74 (47.50)	88.28 (47.89)	87.73 (47.46)	88.10 (47.69)
Education spending (% of GDP)	4.73 (1.91)	4.73 (1.92)	4.73 (1.92)	4.82 (1.86)	4.73 (1.92)	4.82 (1.86)
Health expenditure (% of GDP)	6.65 (2.56)	6.61 (2.54)	6.63 (2.57)	6.78 (2.55)	6.63 (2.56)	6.79 (2.53)
Female employment ratio (%)	49.02 (15.00)	48.88 (15.11)	48.91 (15.12)	48.61 (14.83)	48.91 (15.11)	48.63 (14.77)
Internet users	26.94 (27.38)				116.59 (89.85)	30.19 (27.59)
Mobile cellular subscription		62.00 (42.84)				69.57 (40.36)
Fixed telephone lines			21.71 (19.24)			23.54 (19.50)
Fixed broadband internet				7.33 (10.09)		7.43 (10.13)
No. of observation	585	591	591	517	592	510

Dependent variable HDI	Standardized coefficients (t-value)					
	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Constant	*** (25.097)	*** (16.481)	*** (26.424)	*** (20.397)	*** (25.325)	*** (27.081)
Capital formation (% of GDP)	0.080*** (3.555)	0.059** (2.268)	0.052*** (2.566)	0.100*** (3.587)	0.049** (2.405)	0.025 (1.401)
Trade (% of GDP)	0.020 (0.840)	0.052* (1.889)	0.047** (2.276)	0.075*** (2.580)	-0.003 (-0.129)	-0.029 (-1.513)
Education spending (% of GDP)	-0.020 (-0.835)	0.010 (0.333)	0.000 (0.021)	-0.014 (-0.442)	0.010 (0.440)	0.015 (0.778)
Health expenditure (% of GDP)	0.076*** (2.682)	0.258*** (8.352)	-0.018 (-0.673)	0.155*** (4.274)	0.054** (2.093)	-0.011 (-0.461)
Female employment ratio (%)	-0.289*** (-13.115)	-0.211*** (-8.179)	-0.190*** (-9.544)	-0.329*** (-11.987)	-0.219*** (-10.958)	-0.179*** (-9.751)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Internet users	**0.751***** **(28.772)**					**0.373***** **(7.164)**
Mobile cellular subscription		**0.605***** **(21.329)**			**0.801***** **(33.991)**	**0.216***** **(7.935)**
Fixed telephone lines			**0.834***** **(34.643)**			**0.535***** **(17.296)**
Fixed broadband internet				**0.646***** **(19.847)**		**-0.156***** **(-3.566)**
Adjusted R^2	0.727	0.633	0.783	0.625	0.777	0.852

***: significant at 1% level, **: significant at 5% level, *: significant at 10% level

<Observation of the results>

- Gross capital formation, Trade, Health expenditure, ICT variables > 0

- Female employment ratio < 0

- Public education spending is insignificant to HDI

Case ii) Countries which received ODA : developing economies

Dependent variable HDI	Sample statistics (standard deviation)					
	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
HDI	0.57 (0.15)	0.57 (0.14)	0.57 (0.14)	0.58 (0.14)	0.57 (0.14)	0.58 (0.14)
Capital formation (% of GDP)	22.84 (7.66)	22.93 (7.67)	22.94 (7.66)	23.55 (7.73)	22.91 (7.66)	23.47 (7.26)
Trade (% of GDP)	80.57 (37.91)	81.15 (38.46)	81.10 (38.47)	80.99 (37.14)	81.09 (38.42)	80.26 (36.56)
Net ODA received (% of GNI)	5.77 (11.39)	5.70 (11.28)	5.75 (11.34)	5.43 (11.96	5.76 (11.32)	5.34 (11.97)
Education spending (% of GDP)	4.47 (2.03)	4.49 (2.04)	4.49 (2.04)	4.56 (1.96)	4.48 (2.03)	4.54 (1.97)
Health expenditure (% of GDP)	5.87 (2.26)	5.83 (2.21)	5.86 (2.25)	5.94 (2.19)	5.86 (2.25)	5.91 (2.15)
Female employment ratio (%)	49.15 (17.74)	48.87 (17.83)	48.91 (17.85)	48.46 (17.80)	48.91 (17.82)	48.57 (17.80)
Internet users	10.95 (12.69)				64.39 (53.53)	12.73 (13.18)
Mobile cellular subscription		42.13 (34.66)				49.00 (33.59)

Fixed telephone lines			10.36 (10.50)			11.10 (10.82)
Fixed broadband internet				1.52 (2.87)		1.55 (2.89)
No. of observation	374	379	379	314	380	308

ii-1) Net ODA received is additionally considered as an independent variable

Dependent variable HDI	Standardized coefficients (t-value)					
	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Constant	*** (20.319)	*** (18.539)	*** (21.722)	*** (18.973)	*** (20.673)	*** (20.201)
Capital formation (% of GDP)	0.139*** (4.173)	0.123*** (3.529)	0.069** (2.239)	0.155*** (4.168)	0.093*** (2.899)	0.036 (1.117)
Trade (% of GDP)	0.094*** (2.624)	0.135*** (3.683)	0.081*** (2.511)	0.111*** (2.792)	0.095*** (2.835)	0.012 (0.359)
Net ODA received (% of GNI)	-0.295*** (-7.950)	-0.317*** (-8.365)	-0.222*** (-6.525)	-0.332*** (-8.054)	-0.255*** (-7.223)	-0.179*** (-5.006)
Education spending (% of GDP)	-0.108*** (-2.947)	-0.098*** (-2.546)	-0.036 (-1.070)	-0.073* (-1.737)	-0.073** (-2.109)	-0.035 (-0.988)
Health expenditure (% of GDP)	0.140*** (3.664)	0.201*** (5.185)	0.027 (0.749)	0.159*** (3.624)	0.116*** (3.219)	0.037 (0.957)
Female employment ratio (%)	-0.317*** (-9.063)	-0.320*** (-8.945)	-0.190*** (-5.837)	-0.355*** (-9.213)	-0.281*** (-8.533)	-0.188*** (-5.424)
Internet users	**0.431*** (11.991)**					**0.169*** (2.824)**
Mobile cellular subscription		**0.380*** (10.447)**			**0.507*** (14.474)**	**0.214*** (5.267)**
Fixed telephone lines			**0.599*** (16.458)**			**0.501*** (9.511)**
Fixed broadband internet				**0.390*** (10.086)**		**-0.140** (-2.367)**
Adjusted R^2	0.626	0.598	0.698	0.601	0.666	0.735

***: significant at 1% level, **: significant at 5% level, *: significant at 10% level

<Observation of the results>

- Gross capital formation, Trade, Health expenditure, ICT variables > 0

- Net ODA received, Public education spending, Female employment ratio < 0

ii-2) Net ODA received is NOT considered as an independent variable: the same set of independent variables in Cases i) and iii)

Dependent variable HDI	Standardized coefficients (t-value)					
	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Constant	*** (21.193)	*** (19.078)	*** (22.437)	*** (20.072)	*** (21.325)	*** (20.787)
Capital formation (% of GDP)	0.118*** (3.265)	0.095*** (2.515)	0.042 (1.302)	0.124*** (3.050)	0.066** (1.949)	0.005 (0.140)
Trade (% of GDP)	0.037 (0.976)	0.077** (1.969)	0.035 (1.060)	0.046 (1.086)	0.044 (1.267)	-0.030 (-0.894)
Education spending (% of GDP)	-0.067* (-1.708)	-0.049 (-1.199)	0.004 (0.119)	-0.011 (-0.248)	-0.033 (-0.902)	0.002 (0.053)
Health expenditure (% of GDP)	0.032 (0.838)	0.096** (2.405)	-0.068** (-1.959)	0.036 (0.791)	0.020 (0.572)	-0.040 (-1.095)
Female employment ratio (%)	-0.392*** (-10.800)	-0.403*** (-10.758)	-0.225*** (-6.644)	-0.445*** (-10.973)	-0.338*** (-9.927)	-0.208*** (-5.829)
Internet users	**0.517*** (13.908)**					**0.187*** (3.010)**
Mobile cellular subscription		**0.466*** (12.271)**			**0.594*** (16.951)**	**0.242*** (5.774)**
Fixed telephone lines			**0.688*** (19.344)**			**0.572*** (10.854)**
Fixed broadband internet				**0.469*** (11.427)**		**-0.171** (-2.798)**
Adjusted R^2	0.563	0.523	0.665	0.518	0.620	0.714

***: significant at 1% level, **: significant at 5% level, *: significant at 10% level

<Observation of the results>

- Gross capital formation, ICT variables > 0

- Female employment ratio < 0

- Trade, Public education spending, Health expenditure are mostly insignificant

Case iii) Countries without receiving ODA: developed economies

Dependent variable HDI	Sample statistics (standard deviation)					
	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
HDI	0.85 (0.05)	0.85 (0.05)	0.85 (0.05)	0.85 (0.05)	0.85 (0.05)	0.85 (0.05)
Capital formation (% of GDP)	23.52 (5.03)	23.52 (5.03)	23.52 (5.03)	23.52 (5.02)	23.52 (5.03)	23.52 (5.02)
Trade (% of GDP)	100.61 (58.41)	100.61 (58.41)	100.61 (58.41)	100.70 (58.93)	100.61 (58.41)	100.70 (58.93)
Education spending (% of GDP)	5.12 (1.39)	5.12 (1.39)	5.12 (1.39)	5.16 (1.39)	5.12 (1.39)	5.16 (1.39)
Health expenditure (% of GDP)	8.02 (2.48)	8.02 (2.48)	8.02 (2.48)	8.09 (2.47)	8.02 (2.48)	8.09 (2.47)
Female employment ratio (%)	48.88 (8.22)	48.88 (8.22)	48.88 (8.22)	48.79 (8.30)	48.88 (8.22)	48.79 (8.30)
Internet users	55.93 (22.66)					57.21 (21.72)
Mobile cellular subscription		99.31 (29.16)			213.78 (56.00)	101.87 (26.15)
Fixed telephone lines			42.61 (13.26)			42.83 (13.28)
Fixed broadband internet				16.57 (10.55)		16.57 (10.55)
No. of observation	208	208	208	200	208	200

Dependent variable HDI	Standardized coefficients (t-value)					
	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Constant	*** (36.920)	*** (26.590)	*** (30.582)	*** (34.616)	*** (33.429)	*** (31.863)
Capital formation (% of GDP)	-0.024 (-0.511)	-0.018 (-0.329)	0.001 (0.025)	-0.021 (-0.403)	-0.007 (-0.153)	0.010 (0.218)
Trade (% of GDP)	-0.038 (-0.761)	0.012 (0.202)	0.043 (0.764)	-0.008 (-0.149)	-0.058 (-1.134)	-0.062 (-1.328)
Education spending (% of GDP)	0.002 (0.028)	-0.011 (-0.161)	-0.048 (-0.725)	-0.091 (-1.448)	-0.044 (-0.761)	-0.062 (-1.136)
Health expenditure (% of GDP)	0.292*** (4.941)	0.474*** (7.192)	0.334*** (4.663)	0.310*** (4.733)	0.306*** (5.041)	0.130** (2.151)
Female employment ratio (%)	-0.077 (1.402)	0.318*** (5.233)	0.213*** (3.490)	0.223*** (3.693)	0.196*** (3.661)	-0.001 (-0.018)
Internet users	**0.556*** (10.341)**				**0.496*** (9.482)**	**0.531*** (6.091)**

Mobile cellular subscription		**0.235*** (4.439)**				**0.032 (0.597)**
Fixed telephone lines			**0.353*** (5.208)**			**0.404*** (7.057)**
Fixed broadband internet				**0.444*** (7.417)**		**0.012 (0.143)**
Adjusted R^2	0.607	0.452	0.470	0.544	0.584	0.679

***: significant at 1% level, **: significant at 5% level, *: significant at 10% level

<Observation of the results>

- Health expenditure, Female employment ratio, ICT variables > 0

- Gross capital formation, Trade, Public education spending are mostly insignificant.

3. Growth of GDP per capita

Case i) All countries

Dependent variable GDPPC growth	Sample statistics (standard deviation)					
	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
GDPPC growth	2.74 (4.69)	2.85 (4.70)	2.80 (4.67)	2.86 (4.25)	2.80 (4.73)	2.81 (4.24)
Capital formation (% of GDP)	22.34 (7.24)	22.41 (7.23)	22.42 (7.36)	23.33 (5.91)	22.43 (7.35)	23.26 (5.89)
Trade (% of GDP)	84.49 (44.44)	85.14 (45.15)	84.78 (44.91)	86.76 (45.67)	84.82 (44.90)	86.73 (45.75)
Education spending (% of GDP)	4.62 (1.90)	4.63 (1.91)	4.62 (1.91)	4.84 (1.65)	4.62 (1.91)	4.83 (1.67)
Health expenditure (% of GDP)	6.47 (2.42)	6.45 (2.39)	6.45 (2.42)	6.95 (2.48)	6.43 (2.40)	6.96 (2.48)
Female employment ratio (%)	48.01 (15.10)	47.76 (14.98)	47.93 (15.13)	47.11 (13.60)	47.91 (15.12)	47.07 (13.56
Annual % growth of internet users	35.28 (40.01)					19.83 (21.31
Annual % growth of mobile cellular subscription		36.46 (37.92)			20.97 (18.50)	21.81 (20.30
Annual % growth of fixed telephone lines			2.60 (12.05)			0.96 (12.27
Annual % growth of fixed broadband internet subscribers				61.20 (65.42)		60.88 (65.54
No. of observation	1199	1206	1231	677	1231	664

Dependent variable GDPPC growth	Standardized coefficients (t-value)					
	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Constant	(-0.105)	** (-2.235)	(-0.967)	(-0.795)	* (-1.755)	** (-2.333)
Capital formation (% of GDP)	0.287*** (9.971)	0.312*** (11.020)	0.294*** (10.400)	0.250*** (6.664)	0.297*** (10.524)	0.242*** (6.568)
Trade (% of GDP)	0.033 (1.110)	0.040 (1.362)	0.038 (1.295)	-0.020 (-0.535)	0.043 (1.484)	0.017 (0.453)
Education spending (% of GDP)	-0.114*** (-3.744)	-0.124*** (-4.101)	-0.121*** (-4.034)	-0.095** (-2.302)	-0.116*** (-3.879)	-0.097** (-2.370)
Health expenditure (% of GDP)	-0.044 (-1.394)	-0.011 (-0.346)	-0.025 (-0.841)	-0.089** (-2.081)	-0.009 (-0.286)	0.002 (0.053)

	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Female employment ratio (%)	0.035 (1.269)	0.055** (1.998)	0.042 (1.540)	0.083** (2.271)	0.029 (1.043)	0.051 (1.395)
Annual % growth of internet users	**-0.073*** (-2.553)**					**-0.019 (-0.495)**
Annual % growth of mobile cellular subscription		**0.096*** (3.388)**			**0.092*** (3.261)**	**0.273*** (6.644)**
Annual % growth of fixed telephone lines			**0.045* (1.653)**			**0.014 (0.395)**
Annual % growth of fixed broadband internet subscribers				**0.170*** (4.650)**		**0.092** (2.417)**
No. of observation	1199	1206	1231	677	1231	664
Adjusted R^2	0.106	0.128	0.111	0.133	0.117	0.179

***: significant at 1% level, **: significant at 5% level, *: significant at 10% level

<Observation of the results>

- Gross capital formation > 0, trade : insignificant

- Public education spending < 0, ICT variables > 0

- Health expenditure < 0, Female employment ratio > 0 when they are significant

Case ii) Countries which received ODA : developing economies

Dependent variable GDPPC growth	Sample statistics (standard deviation)					
	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
GDPPC growth	2.94 (5.07)	3.06 (5.07)	2.99 (5.02)	3.65 (4.23)	2.98 (5.10)	3.60 (4.23)
Capital formation (% of GDP)	22.04 (8.29)	22.16 (8.29)	22.19 (8.43)	23.66 (6.69)	22.20 (8.43)	23.56 (6.67)
Trade (% of GDP)	79.53 (39.76)	81.00 (40.87)	80.58 (40.55)	79.87 (35.32)	80.65 (40.54)	79.28 (35.19)
Net ODA received (% of GNI)	6.02 (9.79)	5.61 (9.33)	6.07 (9.73)	3.87 (5.40)	6.01 (9.64)	3.83 (5.36)
Education spending (% of GDP)	4.29 (2.02)	4.32 (2.03)	4.32 (2.03)	4.44 (1.66)	4.32 (2.03)	4.42 (1.67)
Health expenditure (% of GDP)	5.71 (2.10)	5.68 (2.03)	5.70 (2.09)	5.93 (1.98)	5.68 (2.05)	5.93 (1.98)
Female employment ratio (%)	48.02 (17.72)	47.53 (17.57)	47.80 (17.69)	45.85 (16.89)	47.77 (17.67)	45.82 (16.83)

	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Annual % growth of internet users	43.26 (43.67)					25.12 (23.77)
Annual % growth of mobile cellular subscription		45.33 (41.64)			26.01 (20.19)	31.04 (21.44)
Annual % growth of fixed telephone lines			4.47 (14.11)			3.60 (15.81)
Annual % growth of fixed broadband internet subscribers				65.83 (68.99)		65.76 (69.15)
No. of observation	783	782	807	362	807	354

ii-1) Net ODA received is additionally considered as an independent variable

Dependent variable GDPPC growth	Standardized coefficients (t-value)					
	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Constant	(-0.390)	** (-2.113)	* (-1.629)	(0.116)	* (-1.916)	(-0.634)
Capital formation (% of GDP)	0.289*** (8.138)	0.320*** (9.083)	0.303*** (8.671)	0.213*** (4.106)	0.303*** (8.695)	0.202*** (3.927)
Trade (% of GDP)	0.118*** (3.168)	0.126*** (3.383)	0.124*** (3.383)	0.128** (2.396)	0.125*** (3.394)	0.136*** (2.534)
Net ODA received (% of GNI)	-0.002 (-0.063)	-0.010 (-0.261)	-0.024 (-0.658)	0.014 (0.234)	-0.033 (-0.902)	-0.040 (-0.634)
Education spending (% of GDP)	-0.188*** (-5.062)	-0.202*** (-5.451)	-0.194*** (-5.308)	-0.278*** (-4.968)	-0.191*** (-5.230)	-0.281*** (-4.990)
Health expenditure (% of GDP)	0.039 (1.070)	0.066* (1.826)	0.066* (1.873)	0.079 (1.466)	0.068** (1.930)	0.107** (1.963)
Female employment ratio (%)	0.027 (0.741)	0.047 (1.287)	0.034 (0.931)	0.059 (0.986)	0.027 (0.751)	0.056 (0.937)
Annual % growth of internet users	**-0.130*** (-3.853)**					**-0.032 (-0.626)**
Annual % growth of mobile cellular subscription		**0.033 (0.969)**			**0.047 (1.380)**	**0.215*** (3.968)**
Annual % growth of fixed telephone lines			**0.017 (0.509)**			**-0.032 (-0.629)**
Annual % growth of fixed broadband internet subscribers				**0.124*** (2.474)**		**0.074 (1.404)**
Adjusted R^2	0.139	0.149	0.135	0.121	0.135	0.147

***: significant at 1% level, **: significant at 5% level, *: significant at 10% level

<Observation of the results>

- Gross capital formation, Trade, Health expenditure > 0

- Public education spending < 0

- Net ODA received, Female employment ratio, ICT variables are mostly insignificant.

ii-2) Net ODA received is NOT considered as an independent variable: the same set of independent variables in Cases i) and iii)

Dependent variable GDPPC growth	Standardized coefficients (t-value)					
	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Constant	(-0.386)	** (-2.107)	(-1.536)	(0.048)	* (-1.773)	(-0.437)
Capital formation (% of GDP)	0.289*** (8.143)	0.320*** (9.097)	0.304*** (8.684)	0.215*** (4.203)	0.304*** (8.710)	0.197*** (3.879)
Trade (% of GDP)	0.118*** (3.172)	0.125*** (3.375)	0.123*** (3.344)	0.127** (2.389)	0.122*** (3.331)	0.137*** (2.555)
Education spending (% of GDP)	-0.187*** (-5.068)	-0.201*** (-5.448)	-0.193*** (-5.285)	-0.277*** (-4.974)	-0.190*** (-5.199)	-0.285*** (-5.089)
Health expenditure (% of GDP)	0.038 (1.084)	0.064* (1.813)	0.061* (1.777)	0.081 (1.500)	0.062* (1.791)	0.102* (1.897)
Female employment ratio (%)	0.026 (0.773)	0.043 (1.277)	0.025 (0.743)	0.067 (1.329)	0.016 (0.478)	0.037 (0.715)
Annual % growth of internet users	**-0.130*** (-3.874)**					**-0.036 (-0.706)**
Annual % growth of mobile cellular subscription		**0.031 (0.938)**			**0.042 (1.260)**	**0.206*** (3.937)**
Annual % growth of fixed telephone			**0.017 (0.504)**			**-0.032 (-0.633)**
Annual % growth of fixed broadband internet subscribers				**0.124*** (2.468)**		**0.078 (1.495)**
No. of observation	783	782	807	362	807	354
Adjusted R^2	0.140	0.150	0.135	0.124	0.136	0.148

***: significant at 1% level, **: significant at 5% level, *: significant at 10% level

<Observation of the results>

- Gross capital formation, Trade, Health expenditure > 0

- Public education spending < 0

- Female employment ratio, ICT variables are mostly insignificant.

Case iii) Countries without receiving ODA: developed economies

Dependent variable GDPPC growth	Sample statistics (standard deviation)					
	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
GDPPC growth	2.28 (3.80)	2.28 (3.79)	2.28 (3.79)	1.91 (4.06)	2.28 (3.79)	1.91 (4.09)
Capital formation (% of GDP)	22.99 (4.57)	23.02 (4.56)	23.02 (4.56)	23.02 (4.76)	23.02 (4.56)	22.98 (4.77)
Trade (% of GDP)	93.71 (51.34)	93.17 (51.38)	93.17 (51.38)	94.89 (54.21)	93.17 (51.38)	95.61 (54.18)
Education spending (% of GDP)	5.20 (1.39)	5.19 (1.39)	5.19 (1.39)	5.24 (1.40)	5.19 (1.39)	5.25 (1.41)
Health expenditure (% of GDP)	7.94 (2.33)	7.94 (2.32)	7.94 (2.32)	8.12 (2.46)	7.94 (2.32)	8.12 (2.48)
Female employment ratio (%)	48.05 (8.26)	48.09 (8.23)	48.09 (8.23)	48.60 (8.16)	48.09 (8.23)	48.54 (8.20)
Annual % growth of internet users	19.29 (20.40)					13.81 (16.19)
Annual % growth of mobile cellular subscription		18.42 (19.92)			11.25 (8.82)	10.99 (11.76)
Annual % growth of fixed telephone lines			-1.19 (4.74)			-2.09 (4.50)
Annual % growth of fixed broadband internet subscribers				55.67 (60.60)		55.50 (60.94)
No. of observation	404	408	408	312	408	308

Dependent variable GDPPC growth	Standardized coefficients (t-value)					
	Model 1)	Model 2)	Model 3)	Model 4)	Model 5)	Model 6)
Constant	*** (-2.518)	*** (-3.854)	(-1.490)	*** (-3.752)	*** (-4.077)	*** (-4.792)
Capital formation (% of GDP)	0.302*** (6.052)	0.324*** (6.848)	0.306*** (6.172)	0.367*** (6.579)	0.294*** (6.232)	0.380*** (7.169)
Trade (% of GDP)	-0.063 (-1.236)	-0.036 (-0.752)	-0.076 (-1.496)	-0.051 (-0.892)	-0.041 (-0.856)	-0.045 (-0.841)
Education spending (% of GDP)	0.103* (1.748)	0.131** (2.342)	0.115** (1.957)	0.157** (2.353)	0.097** (1.749)	0.164*** (2.575)
Health expenditure (% of GDP)	-0.152*** (-2.659)	-0.100* (-1.816)	-0.179*** (-3.181)	-0.142** (-2.173)	-0.077 (-1.382)	-0.076 (-1.196)
Female employment ratio (%)	0.044 (0.775)	0.032 (0.601)	0.007 (0.121)	0.033 (0.532)	0.060 (1.138)	0.042 (0.707)
Annual % growth of internet users	**0.185*** (3.797)**				**0.359*** (7.639)**	**-0.025 (-0.445)**

Annual % growth of mobile cellular subscription		**0.343*** (7.419)**				**0.373*** (5.863)**
Annual % growth of fixed telephone lines			**0.169*** (3.656)**			**0.094** (1.938)**
Annual % growth of fixed broadband internet subscribers				**0.234*** (4.502)**		**0.025 (0.407)**
Adjusted R^2	0.141	0.217	0.138	0.199	0.223	0.289

***: significant at 1% level, **: significant at 5% level, *: significant at 10% level

<Observation of the results>

- Gross capital formation, Public education spending, ICT variables > 0

- Health expenditure < 0

- Trade and Female employment ratio are insignificant.