Strategic Considerations for Development of the ICT Industry in Korea: Exploratory Research Using Input-Output Analysis

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Abstract

This study compares the economic impacts among ICT sectors and derives strategic considerations for development of the ICT industry in Korea. Prior to analysis, this study classified ICT industry into four sectors: ICT equipment, components, service, and SW/system. This study conducted Input-Output Analysis on the four ICT sectors. An Input–Output Analysis is a quantitative economic technique that represents the direct and indirect interdependencies between different industries of a national economy. Features of each ICT sector were observed in the results. Within the ICT equipment sector, production is decreasing, import dependence is increasing, and employment size is very low, relative to the overall ICT industry. The component sector accounts for the over half of the output and value added of the ICT industry, but domestic production has recently declined. The subsector experienced decreasing production and increasing imports relative to the other ICT subsectors. In the service sector, output is small but its production and employment impact is very high. The fourth sector, ICT SW/system, has very low impact on production but high impact on employment. These features suggest two strategies to develop the ICT industry in Korea. First, the ICT component and service sectors should be promoted to stimulate growth of the national economy. Second, to encourage employment growth, policies should promote the ICT SW/system and service sectors.

Keywords
ICT, ICT industry, Input-Output Analysis, ICT industry classification

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1. INTRODUCTION

Korea is a country with internationally advanced Information and Communication Technology (ICT). According to the ICT Development Index (IDI) published by the International Telecommunication Union (ITU) in 2015, Korea ranked first. The manufacturing capacity of ICT products such as smart phones and semiconductors is the highest in the world. The wired and wireless internet environment also precedes other countries.

But, today the outlook for the Korean ICT industry are not as good as it had been. Rivals and the most developed countries such as the U.S. and Japan have been growing significantly in ICT convergence. China is emerging as a strong player. European countries also maintain high competitiveness. As a result, the international competitiveness of the Korean ICT industry has weakened. ICT products as a share of total exports fell to 30% in 2014 from 39% in 2000. The growth rate of the ICT industry decreased during the same period.

Nevertheless, the ICT industry is still the most important field for the Korea economy. Because of the shortage of natural resources and the high cost of labor, a manufacturing centered economy is hard to maintain. In contrast, the ICT industry, which consists of technologies and ideas, can serve as a growth engine for Korea.

The government needs to promote the ICT industry, but government budget constraints make it impossible to promote all ICT sectors equally. Thus, in a strategic aspect, it is important to select the more important ICT industry sectors and to promote them intensively. However, there are not enough studies that explain which ICT sectors play important role. Instead, most studies have described the effects of entire the ICT industry on the national economy. For example, Colecchia and Schreyer (2002) compares the impact of ICT capital accumulation on output growth in Australia, Canada, Finland, France, Germany, Italy, Japan, the United Kingdom, and the United States. Koutroumpis (2009) investigates how broadband penetration affects economic growth based on 22 OECD countries' data collected for the period 2002–2007. Etro (2009) analyzes the economic impact of the gradual introduction of cloud-computing using the endogenous market structures approach to macroeconomics.

In this situation, the most urgent task is to identify which ICT sector plays the most important role in the national economy. In addition to this, the objectives of this study are to compare the economic impacts and to select strategically important ICT sectors. More detailed objectives are as follows. First, to classify the ICT industry. Based on the previous classifications, this study categorizes the Korea ICT industry into several ICT sectors. Second, investigating each ICT sector’s economic impact on national economy. The methodology is *Input-Output Analysis*. It can analyze each ICT sector’s impact on the total production, value-added, and employment of national economy. The time period of analysis is from 2010 to 2013.

2. CLASSIFYING ICT INDUSTRY INTO SECTORS

2.1. ICT Industry Category

ICT industry categories vary across different sources, so we classify these into the four ICT sectors used in this paper: ICT equipment, components, service, and SW/system. This section describes and categorizes the various terms used by international organizations and the Korean public sector.

2.1.1. UN ISIC

The United Nations (UN) publishes *International Standard Industrial Classification of All Economic Activities* (ISIC). The most recent version, that is Rev. 4, was officially released on 11 August 2008 (UN, 2008). Its main purpose is to provide a set of categories that can be used for the collection and reporting of ICT statistics. The ICT industry category of UN ISIC Rev. 4 is composed of two parts. The first is ICT manufacturing in Section C: *Manufacturing*. This includes the manufacture of computer, electronic and optical products. The second is ICT service in Section J: *Information and Communication*. Programming and broadcasting activities, telecommunications, and information service activities are in this section. Industries in each category are as follows.

TABLE 1. ICT Industry Category of UN ISIC

Section	Division	Industry
Section C: Manufacturing	Manufacture of computer, electronic and optical products	• Manufacture of electronic components and boards • Manufacture of computers and peripheral equipment • Manufacture of communication equipment • Manufacture of consumer electronics • Manufacture of measuring, testing, navigating and control equipment; watches and clocks • Manufacture of irradiation, electro-medical and electrotherapeutic equipment • Manufacture of optical instruments and photographic equipment • Manufacture of magnetic and optical media
Section J: Information and Communicatiaon	Publishing activities	• Software publishing
	Programming and broadcasting activities	• Radio broadcasting • Television programming and broadcasting activities
	Telecommunications	• Wired telecommunications activities • Wireless telecommunications activities • Satellite telecommunications activities • Other telecommunications activities
	Computer programming, consultancy and related activities	• Computer programming, consultancy and related activities
	Information service activities	• Data processing, hosting and related activities; web portals • Other information service activities

Source: UN (2008)

2.1.2. OECD ICT Industry Classification

OECD *ICT Industry Classification* presents the definition of ICT products developed by the Working Party on Indicators for the Information Society (WPIIS) Classifications Expert Group (OECD, 2009). The OECD classification is composed of broad level categories. The definition is a subset of the Central Product Classification (CPC) developed by the United Nations Statistical Division (UNSD). The broad level categories and industries belonging to each category are shown in TABLE 2 below.

TABLE 2. OECD ICT Industry Classification

Broad Level Category	Industry
Computers and Peripheral Equipment	• Personal digital assistants and similar computers • Input peripherals (keyboard, joystick, mouse) • Laser printers used with data processing machines • Monitors and projectors
Communication Equipment	• Television cameras • Telephones for cellular networks or for other wireless networks
Consumer Electronic Equipment	• Video game consoles • Digital cameras • Sound recording or reproducing apparatus
Miscellaneous ICT Components and Goods	• Sound, video, network and similar cards for automatic data processing machines • Printed circuits • Electronic integrated circuits
Manufacturing Services for ICT Equipment	• Electronic component and board manufacturing services • Computer and peripheral equipment manufacturing services • Communication equipment manufacturing services
Business and Productivity Software and Licensing Services	• Operating systems, packaged • Network software, packaged • Database management software, packaged
Information Technology Consultancy and Services	• Business process management services • IT consulting services • Website hosting services
Telecommunications Services	• Fixed telephony services – access and use • Mobile telecommunications services – access and use • Data transmission services
Leasing or Rental Services for ICT Equipment	• Leasing or rental services concerning computers without operator • Leasing or rental services concerning telecommunications equipment without operator
Other ICT Services	• Engineering services for telecommunications and broadcasting projects • Maintenance and repair services of computers and peripheral equipment

Source: OECD (2009)

2.1.3. ICT Production Statistics of Korea

The Korea Association for ICT Promotion (KAIT) and the Korea Electronics Association (KEA) conduct the *Information and Communication Technology Survey* annually. Based on the result of the survey, they publish *ICT Production Statistics* (KAIT & KEA, 2015). The ICT industry categories of this are as follows.

TABLE 3. Category of ICT Production Statistics of Korea

Broad Level Category	Industry (Mid-level Category)	
Information, Telecommunication and Broadcasting Service	• Wired telecom • Wireless telecom • Wired/Wireless telecom resale and intermediary service • Value added communication service	Telecommunication service
	• Terrestrial broadcasting service • Pay broadcasting service • Program production/providing • Other broadcasting service	Broadcasting service
	• IPTV service • Wired and wireless contents service	Broadcasting-telecommunication Convergence service
Information, Telecommunication and Broadcasting Equipment	• Communication equipment • Broadcasting equipment • Information system • Electronic components • Information and telecommunication applied apparatus and instruments	
Software and Digital Contents	• Package software • IT(Information Technology) services • Digital contents development/production services	

Source: KAIT and KEA (2015)

2.1.4. ICT Statistics of Korea

KEA and the Ministry of Science, ICT and Future Planning (MSIP) publish *ICT Statistics of Korea* annually (MSIP & KEA, 2015). There are a couple of purposes for these statistics. One is to comprehend the structure and distribution of the ICT sector and the current status of its management. Another is to compile statistics for the comparison of the industry in Korea and abroad. These statistics are based on the Korea Standard Industrial Classification (KSIC). KSIC divides the ICT industry into two broad level categories: ICT manufacturing and ICT Service Activities. Industries that belong to the two categories are as follows.

TABLE 4. Category of ICT Statistics of Korea

Broad level Category	Mid-level Category	Micro-level Category	Industry
ICT Manufacturing	Manufacture of electronic components, computer, radio, television and communication equipment and apparatuses	Manufacture of semiconductor	• Manufacture of electronic integrated circuits • Manufacture of diodes, transistors and similar semi-conductor devices
		Manufacture of electronic components	• Manufacture of liquid crystal flat display boards • Manufacture of printed circuit boards • Other related industries
		Manufacture of computer and peripheral equipment	• Manufacture of computer • Manufacture of computer monitor • Other related industries
		Manufacture of telecommunication and broadcasting apparatuses	• Manufacture of line telecommunication apparatuses • Manufacture of mobile phone • Other related industries
		Manufacture of electronic video and audio equipment	• Manufacture of television • Manufacture of video and other audio equipment • Other related industries
		Manufacture of magnetic and optical medium	• Manufacture of magnetic and optical medium
ICT Service Activities	Goods related services	ICT wholesale	• Wholesale of computers, computer peripheral equipment and software • Other related industries
		ICT renting	• Renting of computers and office equipment • Other related industries
	Intangible nature services	Telecommunications	• Wired telecommunications • Wireless telecommunications, satellite telecommunications • Other related industries
		ICT computer programming system Integration management services	• System software development and supply • Application software development and supply • Computer programming services • Computer system integration consultancy and establishment services • Other related industries
		ICT information service activities	• Data processing • Hosting and related service activities
		ICT maintenance and repair services	• Maintenance and repair services of computers and office machinery • Maintenance and repair services of communication machinery

Source: MSIP and KEA (2015)

2.2. Classifying ICT Industry Sector

The ICT industry sector classification in this paper is based on *UN ISIC Rev. 4, OECD ICT Industry Classification, ICT Production Statistics of Korea* and *ICT Statistics of Korea*. It is consists of four areas. The first is ICT equipment (called "equipment"), which includes information equipment, audio and video communications equipment. The second is ICT components and accessories (called, "component"), which includes semiconductors and related devices, other electric components and accessories. The third is ICT Services (called, "service"), which includes information and communications services, and broadcasting service. The fourth is SW and ICT System (called, "SW/system"), which includes software, ICT system, and computer related services.

TABLE 5. ICT Industry Sector Classification

Sector	Division	Other Classification			
		UN *ISIC*	OECD *ICT Industry Classification*	KAIT/ KEA *ICT Production Statistics of Korea*	KEA/ MSIP *ICT Statistics of Korea*
ICT Equipment (equipment)	• Information equipment • Audio, video and communications equipment	• Manufacture of computer, electronic and optical products	• Computers and peripheral equipment • Communication equipment • Consumer electronic equipment • Manufacturing services for ICT equipment • Leasing or rental services for ICT equipment	• Communication equipment • Broadcasting equipment • Information system • Information and telecommunication applied apparatus and instruments	• Manufacture of computer and peripheral equipment • Manufacture of telecommunication and broadcasting apparatuses • Manufacture of electronic video and audio equipment • Manufacture of magnetic and optical medium • ICT wholesale • ICT renting
ICT Components and Accessories (component)	• Semiconductors and related devices • Other electric components and accessories		• Miscellaneous ICT components and goods	• Electronic components	• Manufacture of semiconductor • Manufacture of electronic components
ICT Services (service)	• Information and communications services	• Information service activities • Telecommunications	• Telecommunications services • Other ICT services	• Telecommunication service • Broadcasting service • Broadcasting-telecommunication convergence service	• Telecommunications • ICT information service activities
	• Broadcasting service	• Programming and broadcasting activities			
SW and ICT System (SW/system)	• SW, ICT system, computer related services	• Publishing activities • Computer programming consultancy and related activities	• Business and productivity software and licensing services • Information technology consultancy and services	• Package software • IT (information technology) services	• ICT computer programming system integration management services • ICT maintenance and repair services

3. INPUT-OUTPUT ANALYSIS

3.1. Definition

A national economy consists of intricately connected industries. Various materials from several industries are used directly or indirectly to produce goods or services. Goods and services are consumed by consumers or intermediately input into the production process. In this situation, Input-Output Analysis is a methodology that shows the interdependence between industries quantitatively, generated directly or indirectly in the process of buying and selling goods and services (Miller & Blair, 2009; OECD, 2015).

Input-Output Analysis is useful for measuring and comparing economic impact between industries. For example, Kang, and Cho (2013) show that the emotional ICT industries have had a large impact on Korean economy. The total production from emotional ICT industry accumulated 206 trillion KRW over the last 5 years. Moreover, the total value added from both emotional ICT industry and its convergence industry from 2011 to 2015 is an estimated total 118 trillion KRW. The employment in both emotional ICT and its convergence industry over 5 years is an estimated total 2.1 million people. Lee and Kwak (2012) analyze the software industry's impact in the national economy, using input-output analysis. They find that an increase of 1 KRW in the software industry induced 0.534 KRW in total production.

3.2. Input-Output Table

Input-Output Tables describe the sale and purchase relationships within national economy (Bank of Korea, 2015; OECD, 2015). This table can either show flows of final and intermediate goods and services defined according to industry outputs or according to product outputs. Each column of the Input-Output Table shows the monetary value of inputs to each sector. Input is classified as an intermediate input and value added. Intermediate input is the material purchased from other industries for the production of the industry. Value added is the primary input factor such as labor and capital.

Each row represents the value of each sector's production. Output (produced goods and service) is classified as intermediate demand and final expenditure. Final expenditure is composed of private consumption, government consumption, private fixed capital formation, government fixed capital formation and so on. Subtracting imports from the sum of intermediate demand and final expenditure is total output.

TABLE 6. Input-Output Table

			OUTPUT						
			Intermediate Demand (*X*)				Final Expenditure (*Y*)	Import (*M*)	Total Output (*X*+*Y*-*M*)
			Sector 1	Sector 2	...	Sector n	Consumption and Gov. Expenditure		
INPUT	Intermediate Input (A)	Sector 1	X_{11}	X_{12}		X_{1n}	Y_1	M_1	X_1
		Sector 2	X_{21}	X_{22}		X_{2n}	Y_2	M_2	X_2
		....							
		Sector n	X_{n1}	X_{n2}		X_{nn}	Y_n	M_n	X_n
	Value Added (B)	Labor Compensation							
		Operating Profit							
		Other Value Added							
Total Input (A+B)									

Source: Bank of Korea (2015); OECD (2015)

Each observation of Input-Output Table can be transposed into equations as follows:

$$X_{11}+X_{12}+...+X_{1j}+...+X_{1n}+Y_1-M_1=X_1$$
$$X_{21}+X_{22}+...+X_{2j}+...+X_{2n}+Y_2-M_2=X_2$$
$$.....$$
$$X_{i1}+X_{i2}+...+X_{ij}+ ... +X_{in}+Y_i-M_i=X_i$$
$$.....$$
$$X_{n1}+X_{n2}+...+X_{nj}+...+X_{nn}+Y_n-M_n=X_n$$

X*ij* : input of *i* for production *j*, Xi : Total Output of *i* , Yi : Final Expenditure of *i* , Mi : Import of *i*

3.3. Inducement Coefficients

3.3.1. Production Inducement Coefficient

The *Production Inducement Coefficient* represents the direct and indirect output creation of total industries that are generated to meet additional 1 unit demand for a specific industry (Bank of Korea, 2015). Deriving the *Production Inducement Coefficient* starts form calculating *Input Coefficient*. The *Input Coefficient* refers to the volume of intermediate inputs that are required to produce one unit of total output. The Input-Output Table can be transposed using *Input Coefficient* as follows:

First, the observation X_{ij} (in TABLE 6) can be transposed as $X_{ij} = (X_{ij} / X_j) X_j$

Second, the Input-Output Table can be transposed as,

$$(X_{11} / X_1) X_1+(X_{12} / X_2) X_2+... (X_{1n} / X_n) X_n+Y_1-M_1=X_1$$
$$(X_{21} / X_1) X_1+(X_{22} / X_2) X_2+... (X_{2n} / X_n) X_n+Y_2-M_2=X_2$$
$$.....$$
$$(X_{n1} / X_1) X_1+(X_{n2} / X_2) X_2+... (X_{nn} / X_n) X_n+Y_n-M_n=X_n$$

Finally, using the *Input Coefficient* $a_{ij} = X_{ij} / X_j$, the Input-Output Table can be expressed as,

$$a_{11}X_1+a_{12}X_2+....+a_{1j}X_j+...+a_{1n}X_n+Y_1-M_1=X_1$$
$$a_{21}X_1+a_{22}X_2+....+a_{2j}X_j+...+a_{2n}X_n+Y_2-M_2=X_2$$
$$.....$$
$$a_{n1}X_1+a_{n2}X_2+....+a_{nj}X_j+...+a_{nn}X_n+Y_n-M_n=X_n$$

These equations also can be transposed matrix form as follows:

$$\begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{21} \\ \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ \dots \\ X_n \end{bmatrix} + \begin{bmatrix} Y_1 \\ Y_2 \\ \dots \\ Y_n \end{bmatrix} - \begin{bmatrix} M_1 \\ M_2 \\ \dots \\ M_n \end{bmatrix} = \begin{bmatrix} X_1 \\ X_2 \\ \dots \\ X_n \end{bmatrix}$$

And this matrix can be expressed as:

$$AX + Y - M = X$$

The matrix equation can be arranged for X. In that, $(I-A)^{-1}$ is called *Production Inducement Coefficient Matrix*. And $(I-A)^{-1}$ is also known as the *Leontief inverse* or the *total requirements matrix* (Miller & Blair, 2009).

$$AX + Y - M = X$$
$$X - AX = Y - M$$
$$(I - A)X = Y - M$$
$$X = (I - A)^{-1}(Y - M)$$

3.3.2. Value Added and Employment Inducement Coefficient

Value Added Inducement Coefficient represents the direct and indirect value added generated from all industries (national economy) that are caused to meet additional 1 unit demand for a specific industry (Bank of Korea, 2015).

The *Employment Inducement Coefficient* represents the direct and indirect employment generated for all industries that are caused to meet additional 1 billion KRW demand for a specific industry (Bank of Korea, 2015). Income labors are included in the category of employment, but self-employed or unpaid family workers are excluded.

4. ECONOMIC IMPACT ANALYSIS OF ICT INDUSTRY

4.1. Data

This study utilizes Input-Output Table of Korea published from the Bank of Korea (2012-2015). This study uses data from 2010 to 2013 because the Bank of Korea used the same criteria during this period. Prior to 2010, the methodology was different. The most recent version is *2013 Input-Output Table* published on December 2015. The ICT sector classification used to analyze economic impact of the ICT industry is shown in Table 5. The ICT industries included in each sector are as follows.

TABLE 7. ICT industry Sector and Industry

Sector	Division	Industry
Equipment	Information equipment	• Computer and peripheral equipment
	Audio, video and communications equipment	• Television • Electric household audio equipment • Other audio and visual equipment • Line telecommunication apparatuses • Wireless telecommunication apparatuses • Wireless communication systems and broadcasting apparatuses
Component	Semiconductors and related devices	• Semiconductor devices • Integrated circuits
	Other electric components and accessories	• Electron tubes • Digital display • Electric resistors and storage batteries • Electric coils, transformers • Printed circuit boards • Misc. electronic components
Service	Information and communications services	• Postal services • Telecommunications • High-speed network services • Value added communication • Information services
	Broadcasting service	• Terrestrial broadcasting • Broadcasting via cable, satellite
SW/system	SW, ICT system, computer related services	• Computer software development and supply • Computer related services

Source: Bank of Korea (2012; 2013; 2014)

4.2. Impact on Production and Import

The output of the ICT Industry for 2013 is 379,607,265 million KRW. This is an increase of 8.4% than 350,128,794 million KRW in 2010. The share of ICT industry output of Korea in 2013 is 10.8%. The output of ICT component subsector is 198,453,486 million KRW, which is 52.3% of the ICT industry and 5.7% of total industry. The annual output of ICT equipment, component and service sector shows a tendency to increase. But the proportion of the equipment, component, and service sectors as share of total industry decreased. In contrast, the proportion of SW/system sector slightly increased.

The Production Inducement Coefficient (domestic) of the ICT industry for 2013 is 1.788. This means the direct and indirect domestic productions created 1.788 units for an additional 1 unit demand on ICT industry. This value decreased from 1.845 in 2010 to 1.788 in 2013. The coefficient of ICT service subsector is 1.974, making it the highest. For the SW/system sector, its coefficient is the lowest at 1.622. Analyzing the trend, the coefficient of ICT equipment and ICT component are decreasing; for ICT services, it remained level; and it increased for SW/system.

The production inducement effect of the ICT industry is lower than total industry. For 2013, the Production Inducement Coefficient of the ICT industry is 1.788 when the total industry's coefficient is 1.918. However, the ICT service subsector had a higher coefficient at 1.974 than the overall industry average Production Inducement Coefficient. So, the ICT service sector has higher importance in terms of production inducement.

TABLE 8. ICT Industry Impact on Production

		2010	2011	2012	2013
Output (million KRW)	Total Industry	3,048,067,463	3,367,597,037	3,472,075,074	3,503,479,768
	ICT Industry	350,128,794	390,055,245	377,265,547	379,607,265
	- equipment	76,614,791	80,006,000	77,908,143	79,481,025
	- component	184,333,091	216,442,698	201,713,539	198,453,486
	- service	57,617,638	59,250,434	61,010,162	62,294,482
	- SW/system	31,563,274	34,356,113	36,633,703	39,378,272
Production Inducement Coefficient[1)]	Total Industry[2)]	1.900	1.910	1.907	1.918
	ICT Industry[3)]	1.845	1.809	1.813	1.788
	- equipment	1.989	1.927	1.972	1.876
	- component	1.829	1.732	1.721	1.678
	- service	1.970	1.990	1.991	1.974
	- SW/system	1.593	1.587	1.569	1.622

Note: 1) The coefficient only covers domestic product.
2) The coefficient of "Total Industry" is the arithmetic mean for all industries.
3) The coefficient of "ICT Industry" is the arithmetic mean for the four ICT industry sectors.

FIGURE 1. The Share of Total/ICT Industry of for Each ICT Ssector in Total/ICT Industry (%)

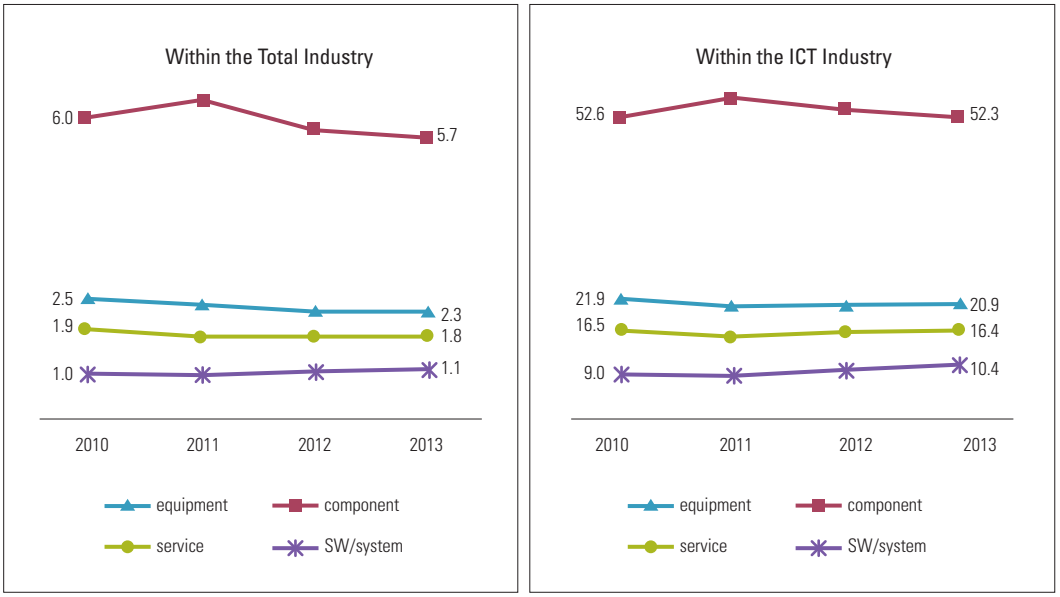
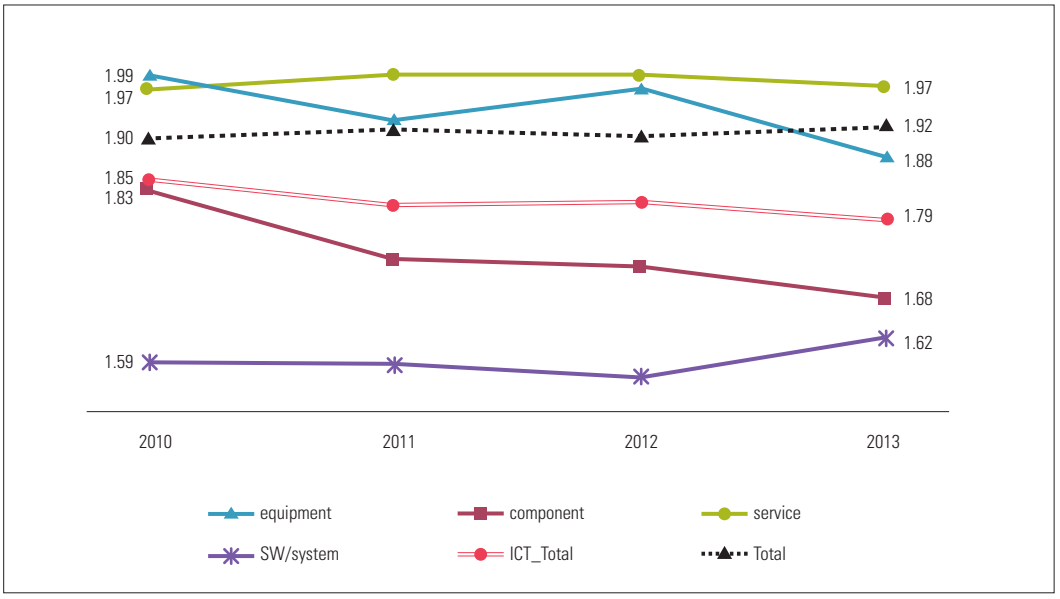


FIGURE 2. Production Inducement Coefficient



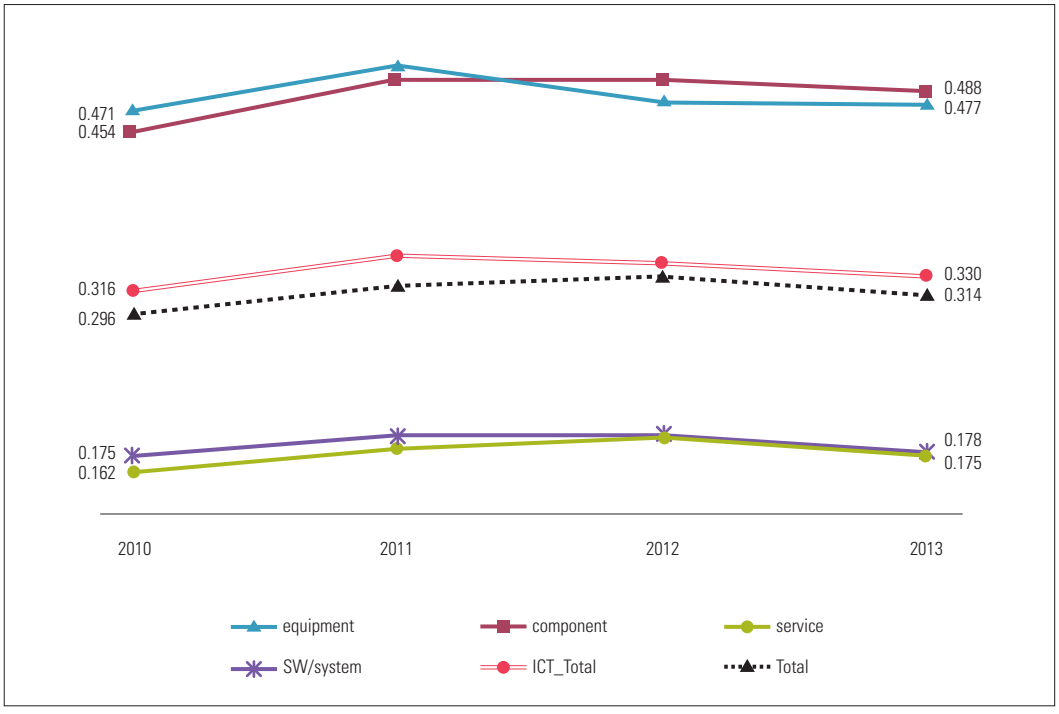
A lower domestic Production Inducement Coefficient means the imported intermediate inputs increased. The time-series trend of Import Inducement Coefficient shows this. The value increased from 0.316 in 2010 to 0.330 in 2013. Considering the subsectors, the coefficient of equipment and component are two times higher than service and SW/system sector.

TABLE 9. ICT Industry Impact on Import

		2010	2011	2012	2013
Import Inducement Coefficient	Total Industry[1)]	0.296	0.322	0.328	0.314
	ICT Industry[2)]	0.316	0.345	0.341	0.330
	- equipment	0.471	0.510	0.479	0.477
	- component	0.454	0.498	0.499	0.488
	- service	0.162	0.181	0.190	0.175
	- SW/system	0.175	0.192	0.194	0.178

Note: 1) The coefficient of "Total Industry" is the arithmetic mean for all industries.
2) The coefficient of "ICT Industry" is the arithmetic mean for the four ICT industry sectors.

FIGURE 3. Import Inducement Coefficient



4.3. Impact on Value Added

The value added of ICT Industry for 2013 is 119,450,674 million KRW. This is an increase of 8.0% from 109,738,836 million KRW in 2010. The share of ICT industry value added in total industry for 2013 is 9.2%. The value added in ICT components is 57,221,511 million KRW, which is 47.9 % of ICT Industry and 4.4 % of total industry. The shares of equipment and service sector decreased. In contrast, the shares of the component and SW/system sectors slightly increased.

The Value Added Inducement Coefficient of ICT industry for 2013 is 0.660, which means the value added increased 0.660 units when additional 1 unit demand for the ICT industry is generated. This decreased from 0.686 in 2010 to 0.660 in 2013. Production activities intensified toward a intermediate-input centered structure. The coefficient for the ICT service sector, 0.804, is the highest, and for the equipment sector, 0.516, the lowest.

The value added inducement effect of the ICT industry is almost equal to the total industry. For 2013, Value Added Inducement Coefficient of ICT industry is 0.660 when the total industry's coefficient is 0.663. But, the ICT service and SW/system sector coefficients are over 0.804, much higher than Value Added Inducement Coefficient for industry overall.

TABLE 10. ICT Industry Impact on Value Added

		2010	2011	2012	2013
Value Added (million KRW)	Total industry	1,244,630,570	1,209,956,238	1,251,455,261	1,303,238,191
	ICT industry	109,738,836	111,886,239	113,753,932	119,450,674
	- equipment	15,969,350	14,973,514	15,714,567	16,827,314
	- component	50,146,962	55,078,773	54,504,087	57,221,511
	- service	25,223,158	22,970,443	23,309,464	24,146,151
	- SW/system	18,399,366	18,863,509	20,225,814	21,255,698
Value Added Inducement Coefficient	Total industry[1)]	0.707	0.655	0.649	0.663
	ICT industry[2)]	0.686	0.645	0.649	0.660
	- equipment	0.531	0.482	0.514	0.516
	- component	0.550	0.496	0.496	0.506
	- service	0.839	0.802	0.790	0.804
	- SW/system	0.825	0.799	0.796	0.813

Note: 1) The coefficient of "Total Industry" is the arithmetic mean for all industries.
2) The coefficient of "ICT Industry" is the arithmetic mean for the four ICT industry sectors.

FIGURE 4. The Share of Each ICT Sector Value Added in Total/ICT Industry (%)

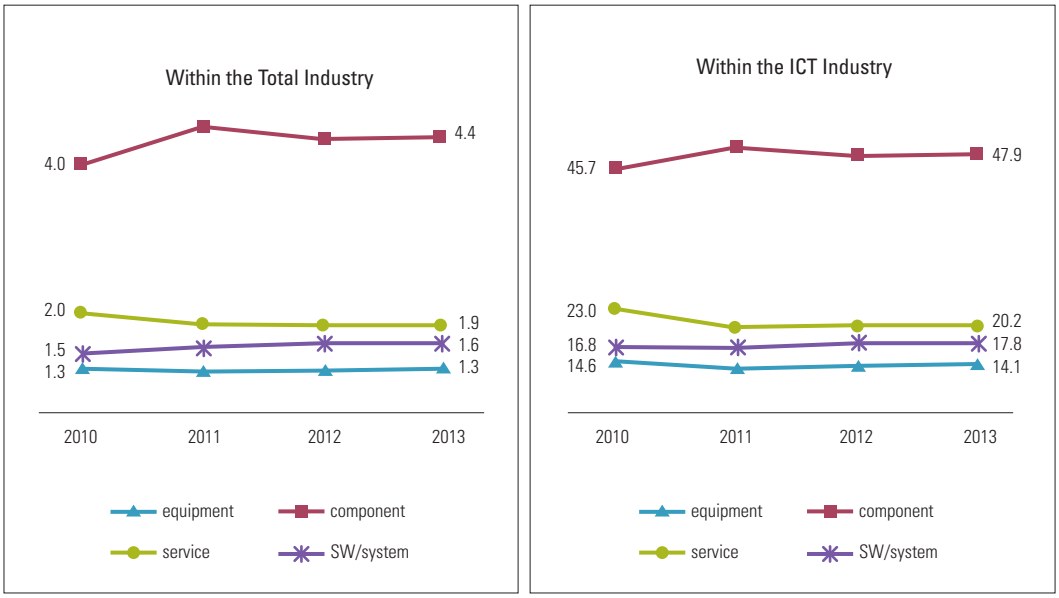
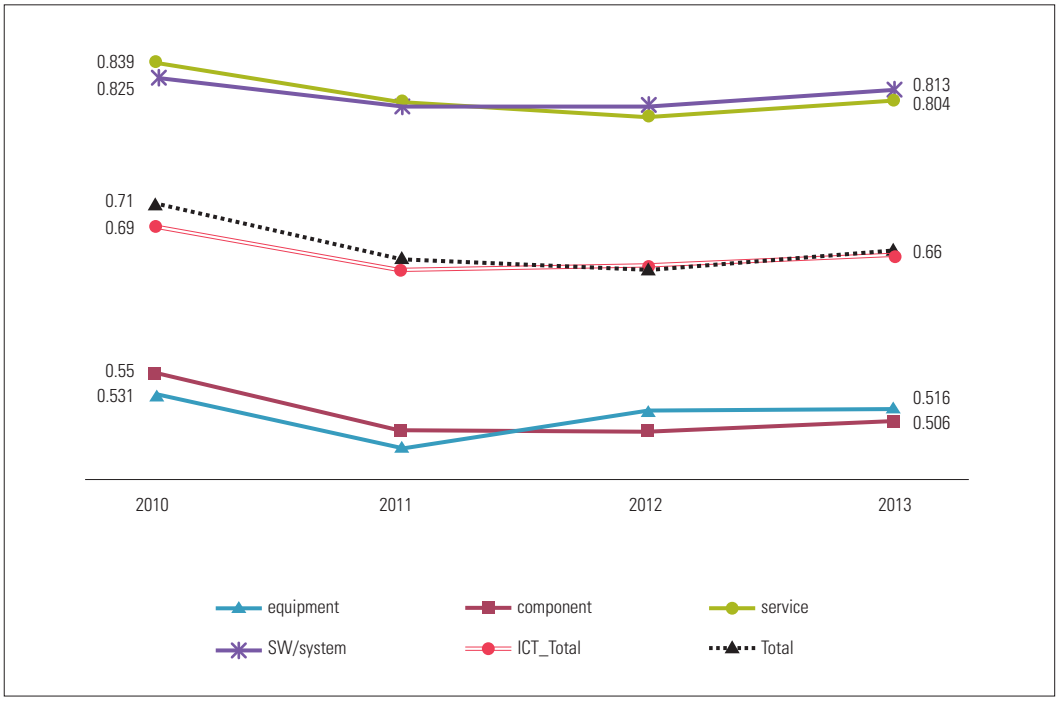


FIGURE 5. Value Added Inducement Coefficient



4.4. Impact on Employment

The employment of the ICT Industry for 2013 is 770,181 persons. This is a decrease of 2.7% than 791,306 in 2010. The share of ICT employment in total employment in 2013 is 4.7%. Employment in the ICT SW/system subsector is 282,070, which is 36.6% of the ICT industry and 1.7% of total industry. The ratio of services and devices to total industry is decreasing. In contrast the proportion of the SW/system subsector significantly increased.

The Employment Inducement Coefficient of ICT industry for 2013 is 7.4. It means the direct and indirect domestic employment increases 7.4 persons when additional 1 billion KRW demand for the ICT industry are generated. This value decreased from 7.9 in 2010 to 7.4 in 2013. The coefficient of the ICT SW/system and service sectors are over 10.0 for 2013. The coefficient of ICT equipment and component are less 4.0 for 2013.

The employment inducement effect of the ICT industry is lower than total industry. For 2013, Employment Inducement Coefficient of ICT industry is 7.4 when the total industry's coefficient is 8.6. The ICT service and SW/system sector coefficients are over 10.0, which are much higher than total industry's Employment Inducement Coefficient. So, ICT service and SW/system sector are important in terms of employment inducement.

TABLE 11. ICT Industry Impact on Employment

		2010	2011	2012	2013
Employment (person)	Total industry	14,563,440	15,384,170	16,021,946	16,299,252
	ICT industry	791,306	800,494	784,262	770,181
	- equipment	109,764	92,558	84,221	76,712
	- component	202,183	212,007	209,209	208,022
	- service	224,332	221,678	207,439	203,377
	- SW/system	255,027	274,251	283,393	282,070
Employment Inducement Coefficient (person per 1billion KRW)	Total industry[1)]	8.8	8.7	8.6	8.6
	ICT industry[2)]	7.9	7.6	7.5	7.4
	- equipment	4.7	4.1	4.0	3.7
	- component	4.5	4.0	3.9	3.8
	- service	9.9	9.9	9.9	10.0
	- SW/system	12.4	12.4	12.0	11.9

Note: 1) The coefficient of "Total Industry" is the arithmetic mean for all industries.
2) The coefficient of "ICT Industry" is the arithmetic mean for 4 ICT industry sectors.

FIGURE 6. The Share of Each ICT sector Employment in Total/ICT Industry (%)

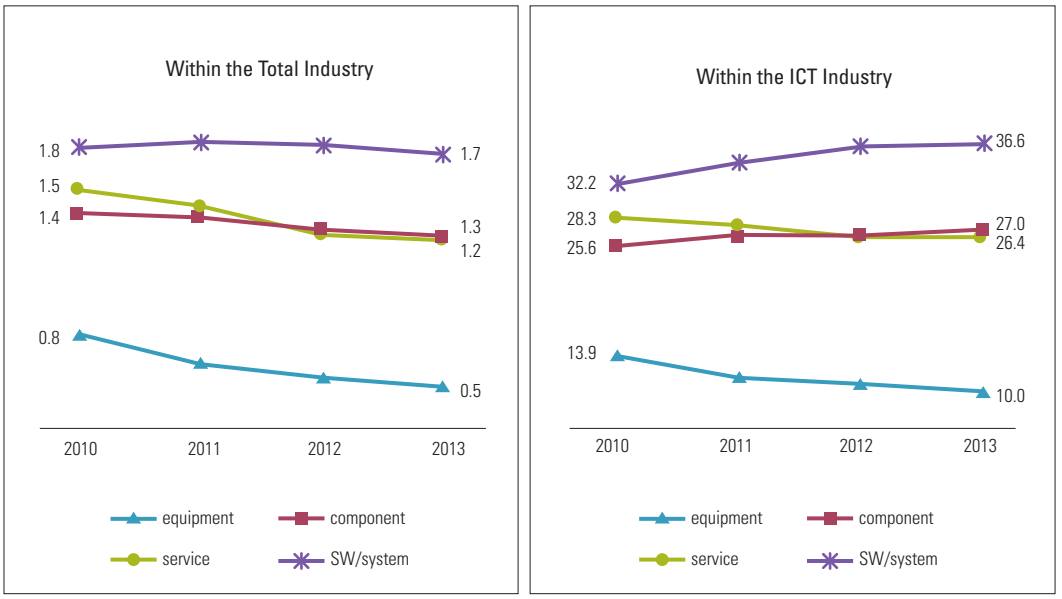
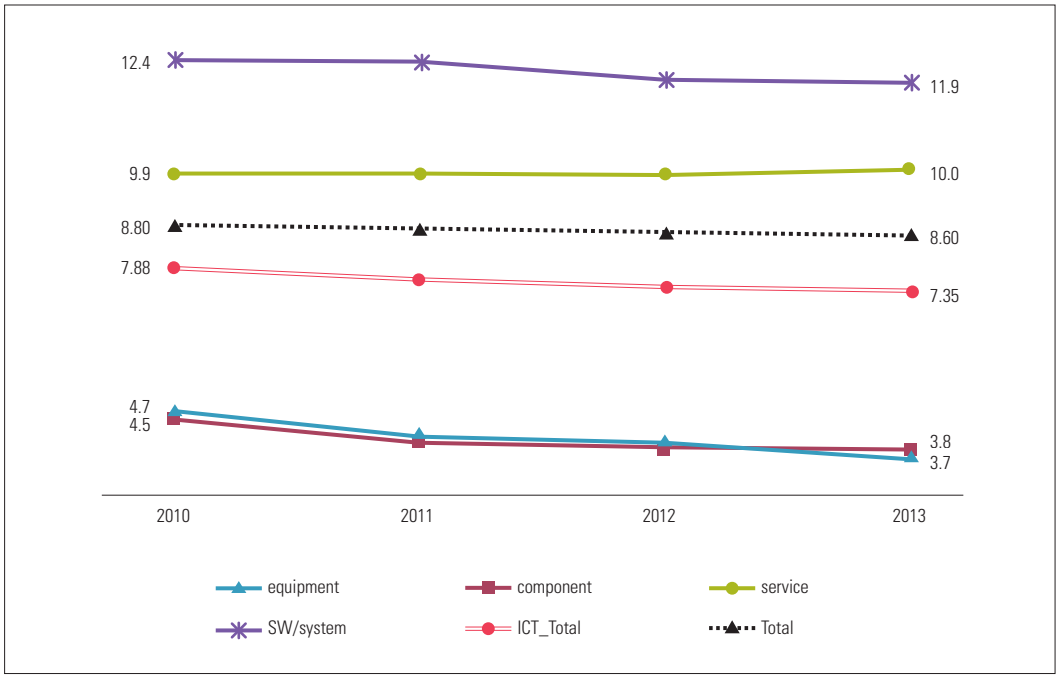


FIGURE 7. Employment Inducement Coefficient



5. CONCLUSION

The economic impact of the ICT industry on the Korean economy differs when examined by subsector. First, the share of equipment output within the ICT industry is 20%. Its Production Inducement Coefficient is decreasing. Its Import Inducement Coefficient is higher than other subsectors. The share of employment in the ICT equipment sector is very low and has been decreasing. While Korea has gained the reputation of a 'device industry leading country,' the reality does not quite live up to it.

The component sector proves to be the key ICT sector in Korea. The share of the component sector's output and value added is over 50% of the ICT industry. However, the impact on national economy has declined recently. Its Production Inducement Coefficient is decreasing and its Import Inducement Coefficient is higher than other subsectors.

The share of service sector's output in ICT industry is only 16%, but its Production Inducement Coefficient is higher than any other ICT sector. Its Import Inducement Coefficient is low and its Employment Inducement Coefficient is very high. If the demand for ICT service increases by 1 unit, then there is a strong positive impact on domestic production and employment.

For the SW/system subsector, the Production Inducement Coefficient is lower than any other ICT sector. However, the impact on employment is great. The size of employment is larger than any other ICT sector and the employment share of the SW/system sector in the ICT industry increased recently. Its Employment Inducement Coefficient is also very high. The SW/system sector plays an important role in ICT industry growth and promoting national employment.

Considering these conditions, we derive strategic considerations for the development of the ICT industry in Korea. First, for the growth of national economy, there should be policies that promote the ICT component and service sectors. The ICT component sector's production is more than 50% of the ICT industry, but its impact has declined. Nevertheless, the ICT component industry is still the most important sector. So policies that enlarge ICT component production and reinforce its forward and backward linkage effect should be introduced. However, because the import inducement impact of ICT component industry is high, localization of intermediate inputs must be done simultaneously.

Next, production in the ICT service sector is only 16% of the ICT industry, yet its production inducement is the highest. And there is active forward and backward linkage effect. Therefore, the policies that promote the ICT service sector can lead growth not only in the sector but in the overall national economy. For example, active policies that foster emerging industries such as big data analysis and cloud computing services are needed. Deregulation policies for ICT convergence services that facilitate market entrance should also be considered.

Second, policies that promote ICT SW/system and service sectors should be targeted to expand to-

tal employment. The proportion of SW/system sector's employment in ICT industry is high and has been increasing. Its Employment Inducement Coefficient is the highest, too. Therefore, strategic policies are necessary to promote the SW/system industry and its market size. It would create new employment effectively. In the process, the quality of labor should be considered since the general working conditions of the SW/system is poor.

Finally, policies that enlarge the ICT service sector's employment should be implemented. The Employment Inducement Coefficient of the service sector is high, but the employment share of the service sector in the ICT industry has decreased. This suggests that the sector has developed into labor-saving model. Therefore, it is necessary to promote the service sector to establish a new employment-creating model.

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