A Research on the Industrial Structural Changes Influenced by the Information and Communication Technology Penetration: The Cases of Japan and Indonesia

(情報通信技術の浸透による産業構造の変化に関する研究
−日本とインドネシアを例として)

Ubaidillah Zuhdi

7412701

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Graduate School of Science and Technology
Department of Industrial Administration
Tokyo University of Science

Abstract

The purposes of this study are (1) to deeply and comprehensively analyze the role of Information and Communication Technology (ICT) and influences of it penetration on the industrial structural changes of Japan and Indonesia, and (2) to give the new contribution on the topic of the analysis of the industrial structural changes of particular countries. This study employs Input-Output (IO) and statistical analyses as instruments of the analysis. The originality of this study is to develop the new model that facilitates IO and statistical analyses in describing the changes, namely the Constrained Multivariate Regression (CMR) model, as well as the deep and comprehensive analysis itself. This analysis consists of three processes, namely (1) observation, (2) exploring, and (3) improvement.

I do the observation process by using the simple output multiplier analysis and Structural Decomposition Analysis (SDA). The former tool has a static point of view while the dynamic perspective is owned by the latter one. The analysis period for Japanese case in the processes is from 1995-2005 while for the case of Indonesia is from 1990-2005. The results show that, from the view point of SDA, ICT sectors had an important role on the industrial structural changes of Japan during the analysis period. The opposite perspective, however, appears from the results of the calculation by using the simple output multiplier analysis. On the other hand, on the case of Indonesia, the results show that ICT sectors did not have an important role on the industrial structural changes of Indonesia from 1990-2005. This phenomenon can be seen both in the points of view of SDA and simple output multiplier analysis.

I conduct the exploring process on the next stage. This process focuses on the investigation to know the influences of ICT penetration on above changes during the period of the analysis. I employ the CMR model as an instrument of the analysis of this stage. In this stage, a slight modification is made on the analysis period of Japanese case, namely from 1995-2005 to 1985-2005.

The results of the statistical analysis show that the penetration of ICT, separately and jointly, gave the significant influences on Japanese industrial structural changes during the analysis period. I use computers and telecommunication equipment in describing this technology in the case of Japan. The results of the microscopic level analysis emphasize this phenomenon.

In contrast to the case of Japan, I do not conduct the joint-explanatory variable calculations in Indonesian case. In other words, in this case, the investigations are separately conducted for each explanatory variable and only focused on Indonesian ICT-influenced sectors. I use Gross Domestic Product (GDP) per capita growth and telephone lines per 100 people as explanatory variables in this case. ICT aspect is represented by the latter variable.

The results of the statistical analysis show that the explanatory variables, during the analysis period, gave the significant influences on the structural changes of above sectors. Based on the statistical significance values, on the period, the structural changes of all analyzed sectors got the stronger influence from the telephone lines per 100 people than the GDP per capita growth. The results of the microscopic level analysis describe that, during the analysis period, the influences given by explanatory variables to the IO coefficients of the analyzed sectors generated the different patterns. However, in contrast to the case of Japan, the general results regarding the influences of ICT penetration on the changes of the industrial structure cannot be achieved on Indonesian case. I argue that this phenomenon is happened because the points of the analysis period in this case are too few, and the negative correlation value between explanatory variables used in this case.

I also conduct the improvement process. This stage aims to know the ways to improve the ICT sectors of analyzed countries in the future. In other words, the motivation of conducting this stage is to improve these sectors. The demand-pull IO quantity model is employed in the process. The analysis period of the process is same with the observation stage. I use several scenarios which include domestic and international aspects when conducting the calculations in the process.

The results show that, on Japanese case, export and outside households consumption modifications give the positive impacts on the total outputs of Japanese ICT sectors while the opposite effect is delivered by the change of imports. On the other hand, on Indonesian case, the biggest positive effect on the total outputs of Indonesian ICT sectors is delivered by the change of households and non-profit private institutions consumptions. Conversely, the modification of imports gives the negative impact. This study also gives the policy recommendations based on the results of calculations in the third process. These recommendations focus on Indonesian case. These recommendations are (1) to implement the broadband internet service especially on the dense area, (2) to improve the mobile telecommunication access quality, (3) to improve the national postal service, (4) to improve the broadcasting services, (5) to improve the export activities regarding the ICT commodities, (6) to construct the import restriction policy regarding ICT products (this policy should focus on the products which Indonesian ICT sectors have an ability to produce), (7) to settle the regulatory system which have the right combination on tariffs and subsidies, (8) to make clear the precedents and rules of regulatory decisions, and (9) to make clear the regulatory decisions.

Contents

1. Introduction

1.1 Background

The fact that technology is an important thing in the society is undeniable. Asaro (2000) affirmed this fact on the following explanation:

"*While technological "progress" is not without many vocal and compelling critics, the fact that technology permeates our society is undeniable.*"

The other fact was also described by Grübler (1998) through the following explanation:

"*And through technology humans have acquired powerful capabilities to transform their natural environments locally, regionally, and, more recently, globally.*"

Many previous studies explored the benefits of the technology on the society. For example, Bevan et al. (n.d.) explained these benefits as follows:

"*Innovation and technology can deliver tangible improvements to important social outcomes, including the healthy extension of working lives, increased job retention and return to work, and improved daily functioning – all before the individuals are affected by the long-term consequences of disease.*"

The benefits could also be observed on the area of education. Gasell (2008) described this phenomenon as follows:

"*Through the findings of research over the past decade, the benefits of technology are clearly justified. With the assistance of technology, teachers and students can both improve their learning and refine skills necessary for tomorrow.*"

One of the widely used technologies is an Information and Communication Technology (ICT). Obviously, this technology also gives many contributions to the society. Atkinson and Stewart (2013) argued that these contributions are (1) to create high-paying jobs, (2) to comprise a significant share of Gross Domestic Product (GDP), (3) to drive the productivity and growth of GDP, (4) to help build the high-growth companies, (5) to create new sectors and ways of doing business, (6) to be a key source of the competitive advantage, and (7) to drive the innovation.

On the other hand, Toivanen (2011) explained the importance of the technology as follows:

"*ICT is recognized as an important vehicle to address global development challenges. As a general purpose technology, ICT has the evident potential to improve the delivery of basic services, such as health, education and information, in under-served areas and regions, and thereby address many of the deprivation conditions that create and maintain poverty. Deservedly, policy frameworks and practices of harnessing knowledge, new technologies and ICT for the benefit of the world's poor are being re-considered in the developing countries, donor governments, as well as by academics and other stake-holders.*"

Meanwhile, Kelles-Viitanen (2003) described the benefits of the technology as follows:

"*It has been argued here that ICT can contribute to poverty reduction, if it is tailored to the needs of the poor and if it is used in the right way and for the right purposes. It can also boost economic growth, but it is unlikely to lead to poverty reduction in countries where there are persisting and fundamental socio-economic inequalities.*"

This study is conducted to analyze the role of ICT and effects of it penetration on the national economy, which refers to the industrial structural changes, of analyzed countries as well as conducting the comparison between these. I select the representation of developed and developing countries for the comparison. In this study, the former country is Japan while Indonesia represents the latter one. I hope this study can expand the discussion on the economic topic, especially on the field of the industrial structural changes of particular countries.

1.2 Purposes of the study

The purposes of this study, based on above explanations, can be described as follows:

- To deeply and comprehensively analyze the role of ICT and influences of it penetration on the industrial structural changes of Japan and Indonesia.
- To give the new contribution on the topic of the analysis of the industrial structural changes of particular countries.

1.3 The structure of the manuscript

This study is organized as follows. The next Chapter reviews the literatures used in this study. Chapter 3 explains the industrial structural changes of analyzed countries using the static perspective. This Chapter also investigates the ways to enhance the industrial sectors of analyzed countries which the focus is ICT sectors.

Chapter 4 discusses the changes using the dynamic point of view. The analysis using statistical instrument, in order to know the relationships between ICT and the changes, is conducted in Chapter 5. Chapter 6 connects the findings of this study. This Chapter also recommends policies regarding the ICT aspects for an analyzed country. The final Chapter, Chapter 7, describes the conclusions of this study and suggests the future researches regarding the discussed topic.

2. Review of the Literature

This Chapter conducts the review process for the literatures used in this study. This process aims to know the position of previous studies which the topics are the industrial structural changes, economic impacts of Information and Communication Technology (ICT), Input-Output (IO) analysis, and the policies of ICT. Further, the process is conducted in order to know the existing gap of study in the areas. Knowing this gap opens the opportunity to fulfill it and to make the originality or a new contribution.

2.1 Literatures regarding the structural changes

This section discusses the literatures related to the structural changes. Stijepic (2010) explained the definition of these changes as follows:

"*The term "structural change" refers to changes in the sector-structure of an economy, where "sectors" are some theoretical "groups" of goods and services (e.g. agricultural sector, manufacturing sector, services sector). In fact, structural change is one of the most striking empirical facts of the development process; most prominent examples of structural change are "industrialization" and "transition to a services economy". Even more importantly, it is well known that structural change has some key impacts on economy and society, especially on (aggregate) economic growth.*"

Many previous studies discussed the topic. For example, Quatraro (2012) provided the evidence regarding the empirical relevance of a structural change in the conditions of a present economic. Memedovic and lapadre (2009) presented an analysis of quantitative of sectoral trends in the global economy. Their study focused on the discussions of the historical evolutions of agriculture, industry, and services which refer to its share on the world value added. Their study covered six continental regions and a forty-year period.

Besides, Hayashi (2005) evaluated the industrialization achievement of Indonesia and clarified the major challenges of sustaining industrialization. He employed Input-Output (IO) analysis as an instrument of analysis. The analysis period of his study was from 1995-2000. Dennis and Iscan (2010) examined how a policy bias against agriculture impacts the convergence speed in income per capita, change of structure, and growth of economy. They employed a cross-country analysis as an analysis tool. The data of their study were novel cross-country time-series data sets with direct assesses of the taxation of agriculture.

2.2 Literatures regarding the economic impacts of Information and Communication Technology

Many previous studies discussed the impacts of ICT on the economic aspects. For example, using US as an object of study, Margherio et al. (1998) explained about the relationship between Information Technology (IT) and Gross Domestic Product (GDP) as follows:

"*One of the most notable economic developments in recent years has been the rapid increase in the IT sector's (computing and communications) share of investment activity and of the gross domestic product (GDP). It grew from 4.9 percent of the economy in 1985 to 6.1 percent by 1990 as the PC began to penetrate homes and offices. The next spurt started in 1993, with the burst of commercial activity driven by the Internet. From 1993 to 1998, the IT share of the economy will have risen from 6.4 percent to an estimated 8.2 percent… With such rapid expansion, IT's share of total nominal GDP growth has been running almost double its share of the economy, at close to 15 percent.*"

The details of above phenomena can be seen in Figure 2.1.

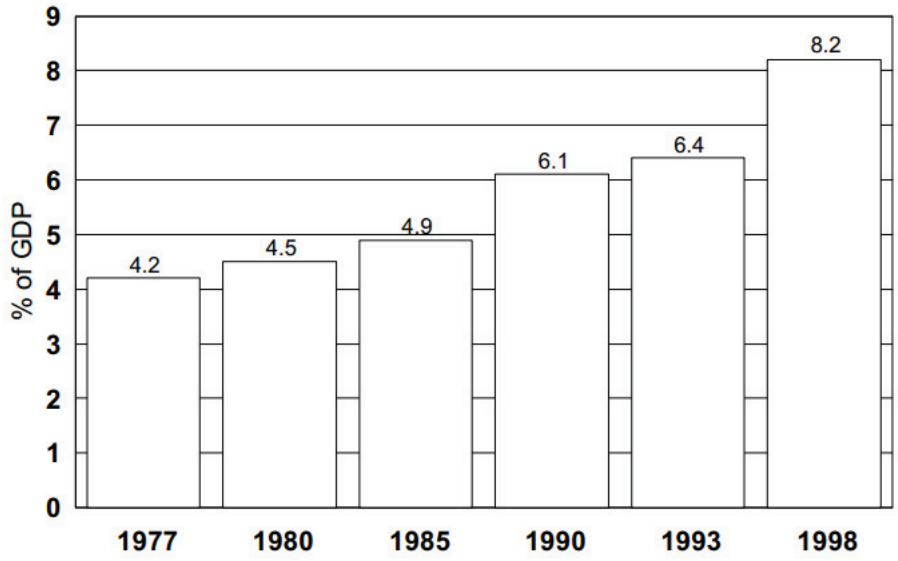

Figure 2.1. IT's share of the economy grows (Source: US Department of Commerce, Economics and Statistics Administration; in Margherio et al., 1998)

Organisation for Economic Co-operation and Development (OECD) (2004b) explained that ICT has substantial effects on the economic performance and individual firms success, in particular when investments in skills, organizational change, and innovation are also considered.

Takase and Murota (2004) developed and used economic and energy models to investigate the impacts of IT investment on the energy consumption and CO_2 emissions in Japan and US. They argued that Japan would save more energy by promoting IT than not. For the case of US, they explained that further enhancing IT use in the future will have a large income effect, and the energy use will increase. They also argued that these US-phenomena caused by the advance of substitution effect.

Besides, Yoda and Mori (2001) analyzed the impacts of IT investment on Japanese industrial structure by using extended Principal Component for Regression Analysis (PCR) model. OECD (2004a) explained that ICTs are media for the growth of economy. More specifically, this organization described about this phenomenon as follows:

"*There is evidence from the OECD countries that ICTs facilitate economic growth, principally by increasing productivity, though this is a long-term rather than immediate outcome of ICT investment. There is little or no clear evidence that the same outcome is being achieved in developing countries, largely because almost no relevant research has been undertaken.*"

Before ending the discussion of the impacts, I would like to explore the term of "digital economy". This term was described by OECD (2012) as follows:

"*The digital economy is an umbrella term used to describe markets that focus on digital technologies… The digital economy is a vital sector, driving very substantial growth. Furthermore, the impact of the digital economy extends beyond information goods and services to other areas of the economy as well as lifestyles more generally. The development of mobile devices, in particular, has greatly expanded the reach of the internet in society. Consequently, competition issues arising in the digital economy have become increasingly significant for competition authorities.*"

Above explanations confirm that ICT has been used widely in society and has an important role on the market competition.

2.3 Literatures regarding Input-Output Analysis

This subsection discusses IO analysis literatures. This subsection is divided into two parts, namely basic IO analysis, and extension and applications of this approach. This distinction aims to explain that the method has been widely developed.

2.3.1 Basic Input-Output Analysis

IO analysis is a method to analyze the relationships among industrial sectors in economy. The fundamental information of this method was explained by Miller and Blair (2009) as follows:

"*The fundamental information used in input-output analysis concerns the flows of products from each industrial sector, considered as a producer, to each of the sectors, itself and others, considered as consumers. This basic information from which an input-output model is developed is contained in an interindustry transaction table. The rows of such a table describe the distribution of a producer's output throughout the economy. The columns describe the composition of inputs required by a particular industry to produce its output.*"

They also described the basic model of IO analysis as follows:

$$x_i = z_{i1} + \cdots + z_{ij} + \cdots + z_{in} + f_i = \sum_{j=1}^{n} z_{ij} + f_i \qquad (2.1)$$

where Z_{ij}, X_i, f_i, and n are the monetary values of the transactions between the pairs of sectors (from each sector i to each sector j), the total output (production) of sector i, the total final demand for sector i's product, and the sector numbers, respectively.

The definition of the method was also described by Tanaka (2011) as follows:

"*Input-output analysis is a basic method of quantitative economics that portrays macroeconomic activity as a system of interrelated goods and services. The analysis usually involves constructing a table in which each horizontal row describes how one industry's total product is divided among various productive processes and final consumption. Each vertical column denotes the combination of productive resources used within one industry. Each figure in any horizontal row is also figure in a vertical column. Input-Output tables can be constructed for whole economies or for segments within economies.*"

Above definition, once again, affirms that the method is a tool which explains the transactions happened among industries in economy. Figures 2.2 and 2.3 show the tables that explain the basic components of the method, namely (1) transactions among industries, (2) final demand, and (3) value added. On the other hand, Figure 2.4 shows the matrix of IO transaction. This matrix is useful for describing monetary and products flows in IO analysis.

		PRODUCERS AS CONSUMERS								FINAL DEMAND			
		Agric.	Mining	Const.	Manuf.	Trade	Transp.	Services	Other	Personal Consumption Expenditures	Gross Private Domestic Investment	Govt. Purchases of Goods & Services	Net Exports of Goods & Services
PRODUCERS	Agriculture												
	Mining												
	Construction												
	Manufacturing												
	Trade												
	Transportation												
	Services												
	Other Industry												
VALUE ADDED	Employees	Employee compensation								GROSS DOMESTIC PRODUCT			
	Business Owners and Capital	Profit-type income and capital consumption allowances											
	Government	Indirect business taxes											

Figure 2.2. IO transaction table (Source: Miller and Blair, 2009, with the slight modification)

	Industry 1	Industry 2	Final demand	Total domestic products
Industry 1	x_{11}	x_{12}	F_1	X_1
Industry 2	x_{21}	x_{22}	F_2	X_2
Gross value added	V_1	V_2		
Total domestic products	X_1	X_2		

Figure 2.3. Basic transaction table (Source: Japanese Ministry of Internal Affairs and Communications, 2009, with the slight modification)

Purchasing Sectors → / Selling Sectors ↓	Inputs to: Agricul-ture	Manufac-turing	Others	Final Demand (X+K+G+C)	Total Gross Output
	1	*2*	*3*	*4*	*5*
Agriculture	-	15	5	22	42
Manufacturing	12	-	17	16	45
Others	8	12	-	30	50
Inports	7	5	8	7	27
Primary inputs	15	13	20	-	48
Total Gross Input	*42*	*45*	*50*	*75*	*212*

Figure 2.4. IO transaction matrix (Source: Chand, n.d., with the slight modification)

One of the important instruments in IO analysis is IO coefficient. Miller and Blair (2009) described that this coefficient is described as follows:

$$a_{ij} = \frac{z_{ij}}{X_j} \tag{2.2}$$

where a_{ij}, z_{ij}, and X_j are the input needed by sector j from sector i to make one unit of product, the inter-industry sales by sector i to sector j, and the total production of the sector j, respectively. This equation is used in order to describe the term of the industrial structure which is used in this study. Figure 2.5 explains the details of the structure. Based on the information in this Figure, the coefficient for t period is described by a_{ij} (t).

	Industry 1	Industry 2
Industry 1	a_{11}	a_{12}
Industry 2	a_{21}	a_{22}
Gross value added	v_1	v_2
Total domestic products	1.0	1.0

Figure 2.5. Input coefficient table (Source: Japanese Ministry of Internal Affairs and Communications, 2009, with the slight modification)

Besides, the other important instrument in IO analysis is Leontief inverse matrix. The explanation about this matrix was explained by Miller and Blair (2009) as follows:

The equation 2.1 can be written as:

$$\begin{aligned} x_1 &= a_{11}x_1 + \cdots + a_{1i}x_i + \cdots + a_{1n}x_n + f_1 \\ &\vdots \\ x_i &= a_{i1}x_1 + \cdots + a_{ii}x_i + \cdots + a_{in}x_n + f_i \\ &\vdots \\ x_n &= a_{n1}x_1 + \cdots + a_{ni}x_i + \cdots + a_{nn}x_n + f_n \end{aligned} \tag{2.3}$$

The equation 2.3 can be modified as:

$$\begin{aligned} x_1 - a_{11}x_1 - \cdots - a_{1i}x_i - \cdots - a_{1n}x_n &= f_1 \\ &\vdots \\ x_i - a_{i1}x_1 - \cdots - a_{ii}x_i - \cdots - a_{in}x_n &= f_i \\ &\vdots \\ x_n - a_{n1}x_1 - \cdots - a_{ni}x_i - \cdots - a_{nn}x_n &= f_n \end{aligned} \tag{2.4}$$

Grouping the x_1 together in the first equation, the x_2 in the second, and so on, the equation (2.4) can be written as:

$$
\begin{aligned}
&(1-a_{11})x_1 - \cdots - a_{1i}x_i - \cdots - a_{1n}x_n = f_1 \\
&\vdots \\
&-a_{i1}x_1 - \cdots + (1-a_{ii})x_i - \cdots - a_{in}x_n = f_i \\
&\vdots \\
&-a_{n1}x_1 - \cdots - a_{ni}x_i - \cdots + (1-a_{nn})x_n = f_n
\end{aligned}
\tag{2.5}
$$

Let the matrix I be the *n* x *n* identity matrix, the matrix that the value of the main diagonal is 1 while 0 elsewhere, then the matrix of (I – A) can be written as:

$$
\begin{bmatrix}
1-(a_{11}) & -a_{12} & \cdots & -a_{1n} \\
-a_{21} & (1-a_{22}) & \cdots & -a_{2n} \\
\vdots & \vdots & \ddots & \vdots \\
-a_{n1} & -a_{n2} & \cdots & (1-a_{nn})
\end{bmatrix}
\tag{2.6}
$$

The complete *n* x *n* system described in the equation (2.5) can be represented by the following matrix formula:

$$(I-A)x = f \tag{2.7}$$

Using the results of the standard matrix algebra for linear equations, the equation (2.7) can be written as:

$$x = (I-A)^{-1} f = Lf \tag{2.8}$$

L or $(I - A)^{-1}$ is the representation of Leontief inverse matrix. The function of this matrix is described by Anonymous (n.d.) as follows:

"*As applied to regional interindustry or input-output analysis, the values in this matrix (= Leontief coefficients) represent the total direct and indirect (and, possibly "induced") requirements of any industry j (typically in columns) supplied by other industries (i) within the region in order for industry j to be able to deliver $1 worth of output to final demand.*"

2.3.2 Extensions and applications of Input-Output Analysis

Today, IO analysis has been extended and widely applied. It application could be seen in many areas. For example, Sancho (2009) showed that the way to calibrate the Constant Elasticity of

Substitution (CES) production and functions of utility when indirect taxation impacting inputs and the consumption is available. Wood and Dey (2009) gave a summary of construction techniques and methods applied to assign greenhouse gas accounts to industry sectors and of the use of IO analysis to subsequently measure the Australian carbon footprint.

On the other hand, Andrew et al. (2009) used the Multi-Regional Input-Output (MRIO) model based on the dataset provided by the Global Trade Analysis Project (GTAP). They applied the model to quantify errors introduced by miscellaneous approximations of it. Nakano (2014) analyzed the tables of employment matrix (industrial sectors and occupations) extracted from linked IO tables. His study aimed to identify the patterns of a socio-industrial state of operators and wireless technology technicians. Besides, the other evidence of an extension of IO analysis could be seen on the Structural Decomposition Analysis (SDA) model. This model is described in more details in Chapter 4.

2.4 Literatures regarding the Information and Communication Technology policies / strategies

This subsection discusses the historical ICT policies of Japan and Indonesia. This discussion focuses on the policies of these countries from 2000-2005 and the newest period. The discussion is needed to know the strategies have been applied by government of each country in advancing ICT aspects. Besides, the discussion is also done in order to know the steps of the development of these strategies. I hope the discussion can open the opportunity to improve the aspects, directly or indirectly.

2.4.1 The case of Japan

A) 2001

The first explanation is about the ICT policies of Japan on 2001. Japanese Ministry of Internal Affairs and Communications (2001) explained that the government's efforts to bring about an advanced information and communications network society are:

- A policy package for new economic development toward the rebirth of Japan
  They described this effort as follows:

  "*The government adopted its Policy Package for New Economic Development toward the Rebirth of Japan in October 2000. The new development policies place emphasis on four areas: (1) Aggressive promotion of the IT revolution; (2) Responding to environment issues including the construction of a recycling society; (3) Measures concerning the elderly in pursuit of a future society with abundant vitality; and (4) Development of urban*

infrastructure that seeks convenience and amenity. Information and communications is among the four areas and is a key item that serves as a pillar of the policies."

- New action plan for economic growth
  They described this effort as follows:

  "*In response to the Policy Package for New Economic Development toward the Rebirth of Japan, the Cabinet adopted a New Action Plan for Economic Growth in December 2000. This plan comprises five key areas including the development of environment to promote creative economic activities by enterprises and the creation of new industries as well as promotion of a business environment that fosters international competitiveness. The discussion of the IT Strategy Council is reflected in the plan to the greatest possible extent.*"

- Internet Fair 2001 Japan
  They described this effort as follows:

  "*The Internet Fair 2001 Japan (INPAKU) is an Internet-based fair that will be held for one year beginning on December 31, 2000 as a part of the New Millennium Projects included in the Policy Measures for Economic Rebirth adopted by the Ministerial Meeting on Economic Measures in November 1999. The government provides a server that corresponds to the fairgrounds; the national government and local governments as well as enterprises, non-profit organizations, and individuals can create home pages (pavilions) to exchange various types of information on the Internet.*"

They also described the ways to promote an information and communications reform, namely:

- Introduction of a new tariff system
  They described this way as follows:

  "*In May 1998, the Ministry of Posts and Telecommunications (MPT; now the Ministry of Public Management, Home Affairs, Posts and Telecommunications, MPHPT) revised the Telecommunications Business Law so that fees for services provided by Type I telecommunications carriers are simply reported to the ministry. The MPT also decided to introduce a "price cap system" in which reasonable basic fees levels are set for services for which there is little competition. If a carrier sets its basic fee for a given service at or below the*

preset level, the reporting requirement holds; if it sets the fee higher than the preset level, the fee must be approved by the MPT."

- Dialing parity system
  They described this way as follows:

  "*In the past, when a telephone user made a telephone call from a telephone registered with NTT using another carrier, the user had to dial a carrier identification number (a four digit number beginning with "00"). There were concerns that this would hinder fair competition between NTT and other carriers, so the MPT (now the MPHPT) began investigations into a dialing parity system. In response to the results of these investigations, a dialing parity system (known as MY LINE) was introduced in May 2001.*"

- Telephone number portability
  They described this way as follows:

  "*A telephone number portability system that enables a user to keep the same telephone number even when changing the contracted telecommunications carrier was introduced in March 2001 based on a report of the Telecommunications Council.*"

- Review of the connection system
  They described this way as follows:
  "*In order to decrease further charges for connecting between two NTT companies (East and West) and other carriers, the Telecommunications Business Law was revised in May 2000 and a review was conducted for the introduction of a long-run incremental cost method (LRIC). Also, with respect to reducing charges for connections between carriers, the Japan–United States Deregulation Talks reached an inter-governmental agreement in July 2000 that process would be reduced by 22.5% over three years. In addition, in December 2000, the Telecommunications Council submitted its first report discussing the thoughts on the handling of the facilities of mobile telecommunications carriers and the fiber-optic facilities of NTT East and NTT West with respect to connectivity and expanding the reduction of rates between carriers.*"

- Promotion of new information and communications business
  They described this way as follows:

"*In order to promote new business in the information and communications field, the MPHPT conducts a number of support measures including financial support through the Telecom Venture Investment Partnership Fund, support for venturing on a new business based on innovative technology through the advanced technical research and development subsidy fund system (telecom incubation), and establishment of the Information and Communications Venture Subsidy Fund System.*"

B) 2002

The next explanation is about the ICT strategies of Japan on 2002. Japanese Ministry of Internal Affairs and Communications (2002) explained that some of these strategies are:

- Realization of an advanced information and communications network society
  They argued that this strategy can be divided into:
  -. Promotion of a national IT strategy.
  -. e-Japan-related budget.

- Development of policies for the new information and communications era
  They argued that this strategy can be divided into:
  -. Competition policy of the telecommunications industry for the promotion of the IT revolution.
  -. Provision of asymmetrical regulations.
  -. Creation of a telecommunications business dispute settlement commission.
  -. Implementation of a universal service fund.
  -. Development of a competitive environment in the telecommunications sector.
  -. Review of the long run incremental cost model.
  -. Approach to the development of broadcasting.
  -. Promotion of policies for the effective utilization of radio waves.

- Advanced in networks
  They argued that this strategy can be divided into:
  -. Development and promotion of the network infrastructure.
  -. Promotion of advances in broadcasting.
  -. Convergence of communications and broadcasting.

- Promotion of content and applications, and development of human resources
  They argued that this strategy can be divided into:

-. Formation of a new content distribution market toward the broadband network era.
-. Promotion of telework and SOHO (Small Office / Home Office).
-. Promotion of new information and communications businesses.
-. Development of human resources.

- Promoting the digitization of public areas
  They argued that this strategy can be divided into:
  -. Promotion of the local digitization.
  -. Online administrative procedures and laying the groundwork for public certifications.
  -. Development of public systems.
  -. Local government wide area network.
  -. Digitization of processing applications and notices at local governments.
  -. Measures toward the design of a Geographic Information System (GIS).
  -. Promotion of the digital museum concept.
  -. Local development through IT.

C) 2003

The next explanation is about the ICT policies of Japan on 2003. Japanese Ministry of Internal Affairs and Communications (2003) explained that one of the policies is achieving a society of advanced information and communications networks. Further, this policy could be divided into:

- Building a new, Japan-inspired IT society
  They argued that this part can be described as follows:
  "*Based on the e-Japan strategy formulated by the government in January 2001, efforts have been made in Japan "to provide high-speed constant Internet access to at least 30 million households and ultra high-speed constant Internet access to at least 10 million households" so as to make Japan the world's most advanced IT nation. As a result, steady achievements have been made toward accomplishing this strategy, including accomplishing the target number of households having access to the Internet and offering the lowest high-speed Internet access fees in the world. However, the number of households that actually subscribe to the high-speed or ultra high-speed Internet services is considerably smaller than the number of those that can have access to such services, indicating stagnation in the rate of actual use.*
  In light of this situation, the Internet Use-Promoting Committee of the Department on Information Communications Policy of the MPHPT's Telecommunications Council discussed the direction of the IT strategy and compiled an interim report in January 2003. The interim

report covers proposals about "building a new, Japan-inspired IT society" while giving consideration to the balance between the upgrading of the infrastructure and expansion of use."

- Promoting the IT national strategy
  They argued that this part can be described as follows:

  "*The government established the IT Strategic Headquarters and has promoted the IT national strategy based on the Basic Law on the Formation of an Advanced Information and Telecommunications Network Society (IT Basic Law) that entered into force in January 2001. The headquarters formulated the e-Japan Strategy in January 2001 toward "making Japan the world's most advanced IT nation within five years." It also formulated the e-Japan Priority Policy Program in March 2001 for materializing said strategy, and the e-Japan 2002 Program in June 2001 for reflecting said priority policy program upon the measures to be taken in fiscal 2002. Furthermore, it set up the Acceleration and Advancement of e-Japan 2002 Program in November 2001. In addition, the headquarters drastically reviewed the e-Japan Priority Policy Program and created the e-Japan Priority Policy Program-2002 in June 2002. Furthermore, the IT Strategic Headquarters set up the Expert Study Committee on Future IT Strategy in November 2002 and continues its efforts to review the e-Japan Strategy in order for Japan to remain being the world's most advanced IT nation even in and after 2006.*"

- Budget Related to e-Japan
  They argued that this part can be described as follows:

  "*The government budget in fiscal 2003 relating to the formation of an advanced information and communications network society totals 1.5358 trillion yen. The MPHPT's budget related to IT is 131.3 billion yen, up 4.8% from the initial budget of 125.2 billion yen in fiscal 2002. In the supplementary budget for fiscal 2002, a total of 287.9 billion yen was allocated as budget relating to formation of an advanced information and communications network society.*"

- Implementation of the "e!Project"
  They argued that this part can be described as follows:

"*Since it is essential to enhance national understanding on IT for promoting the IT revolution, the "e!Project" was implemented based on the e-Japan 2002 Program. The "e!Project" is a showcase for displaying the image of the world's most advanced IT nation to be achieved in 2005 to the general public and the entire world. Under the budget for fiscal 2002, demonstrative experiments were conducted with regard to the desirable utilization of IT in six fields including education and local administration.*"

D) 2004

The next explanation is about the ICT policies of Japan on 2004. Japanese Ministry of Internal Affairs and Communications (2004) explained that one of the policies is realizing a society of advanced information and communication networks. Further, this policy could be divided into:

- Building a new, Japan-inspired IT society
  They argued that this part can be described as follows:

  "*The Telecommunications Council, an advisory body of the MPHPT, conducted discussions on the direction of IT strategy from now on, and in July 2003 the Internet Use-Promoting Committee of the Department on Information Communications Policy issued its third interim report. In this interim report, it is proposed that the government, industry, and academia should cooperate in the creation of a "new, Japan-inspired IT society" that takes advantage of the special features and strengths of Japan, such as its mobile phone, intelligent home appliance, digital television, and optic-fiber technologies, does not simply follow the West, and can be transmitted as a model to the whole world.*
  The interim report suggests that a "new, Japan inspired IT society" will be formed centered on the three use axes of (a) the ubiquitous network society, (b) the age of high-quality images, and (c) the interconnection of the Internet and digital television. In addition, as measures for realizing a "new, Japan-inspired IT society," the interim report proposes, among other things, the realization of a network environment that is useful for users and the distribution of contents that lead to affluent lives for users."

- Promoting the IT national strategy
  They argued that this part can be described as follows:

  "*Responding correctly to the social and economic structural changes that are occurring on a global scale as a result of the utilization of information and communications technology has become an urgent issue for Japan as well. In January 2001 the government established the*

IT Strategic Headquarters, formulated the e-Japan Strategy aimed at "making Japan the world's most advanced IT nation within five years," and set about constructing IT infrastructure. Since then Internet diffusion in Japan has made great strides. The goal of constructing an environment enabling "high-speed Internet use by 30 million households and ultra-high-speed Internet use by 10 million households" has already been achieved, and the construction of systemic infrastructure related to e-commerce and e-government has also made progress.

Accordingly, recognizing that the first-phase targets of the IT strategy are in the process of being achieved, the IT Strategic Headquarters evolved the strategy into the second phase of the expansion of IT use and in July 2003 formulated the e-Japan Strategy II. For the realization of an "energetic, worry-free, exciting and more convenient" society, the e-Japan Strategy II takes up seven areas for leading efforts: medical services, food, lifestyle, small and medium enterprises financing, knowledge, employment and labor, and public service."

- Budget related to e-Japan
  They argued that this part can be described as follows:

  "*The fiscal 2004 government budget relating to the formation of an advanced information and communications network society totals 1.40 trillion yen. Of this, the IT-related budget of the MPHPT amounts to 134.8 billion yen, up 2.1% over the initial budget for the previous fiscal year of 132.0 billion yen.*"

E) 2005

The next explanation is about the ICT policies of Japan on 2005. Japanese Ministry of Internal Affairs and Communications (2005) explained that one of the policies is promoting ICT to private companies. Further, this policy could be divided into:

- Measures for improving credibility of electronic data
  They argued that this part can be described as follows:

  "*(1) Promotion of use of time business*

  The time business, which involves time distribution services (distribution of accurate time information on networks) and time certification services (certification of the time at which the electronic data existed and non-tampering thereafter by certifying the validity of the time stamp attached to the electronic data), is becoming increasingly important recently for improving the credibility of distributed or stored electronic data in various fields such as

e-commerce. The MIC is making active efforts to promote the use of the time business by, for example, formulating and releasing "Guidelines on Time Business" in November 2004, which would enable users of private-sector time businesses to use their services with confidence.

(2) Digitization of documents obliged by statute to be stored

The statutory obligation on private business operators, etc. to store documents on paper had been an impeding factor for increasing the efficiency of business activities and operational management in the private sector. Therefore, it was set forth in the e-Japan Strategy II Acceleration Package (decided by the IT Strategic Headquarters in February 2004) to enact a uniform law, which basically allows electronic storage of documents and account books in the private sector, while ensuring the accuracy, readability, etc. according to the content or nature of the documents. In response to this, the Law for the Use of Information Communications Technology for the Storage of Documents by Private Sector Companies and the Law on Improvement of the Related Laws in Line with Entry into Force of the Law for the Use of Information Communications Technology for the Storage of Documents by Private Sector Companies (e-Document Law) were established in November 2004 and entered into force in April 2005."

- Establishment of environment for promoting the creation and growth of ICT venture companies

  They argued that this part can be described as follows:

  "*The creation of new businesses is believed to be important for achieving sustainable development of the Japanese industry and stimulating the Japanese economy. On the other hand, many recently started ICT venture companies face such problems as a lack of business accomplishments, lack of established technical evaluation, and lack of physical collateral and credibility, and often have difficulty in procuring funds, securing staff, and finding clients, which makes it hard for them to turn an excellent technology into a new business. Therefore, in order to promote the startup and growth of ICT venture companies, the MIC provides various support measures in the areas of fund supply, human resources, know-how, and so on in cooperation with the related ministries and agencies.*"

F) 2013

The next explanation is about the ICT policies of Japan on 2013. Japanese Ministry of Internal Affairs and Communications (2013) explained that one of the policies is a promotion of a comprehensive strategy. Further, this policy could be divided into:

- Promotion of a national strategy
  They argued that this part can be described as follows:

  "*The Japanese government put into force the Basic Act on the Formation of an Advanced Information and Telecommunications Network Society and set up the Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society (Comprehensive IT Strategic Headquarters) in January 2001; this worked for fast, high priority implementation of policy on the formation of an advanced information and telecommunications network society. In addition, a cabinet decision was made on a new IT strategy ("Declaration on the Creation of the World's Most Advanced IT Nation.") in June 2013.*"

- Development of cloud services
  They argued that this part can be described as follows:

  "*(1) Activities of the Japan Cloud Consortium*
  In order for industry, academia and government to cooperate with each other in promoting the dissemination of cloud services, the Japan Cloud Consortium, a private organization, was established in December 2010. This consortium, comprised of more than 400 companies and organizations as of April 2013, and nine working groups are conducting such activities as considering a specific service model, sharing of information and identifying new tasks."

- ICT productivity acceleration
  They argued that this part can be described as follows:

  "*In addition to being a resource-starved country with a declining birth rate and an aging population, Japan faces the pressing challenge of stimulating economic growth. For this reason, we need to take advantage of our world leading broadband infrastructure and work actively to raise productivity through the application of ICT. Therefore, in cooperation with related bodies of related ministries, agencies and municipalities, the MIC is implementing initiatives to support small, medium and venture companies, etc. for business in the fields of information and communications.*"

Above explanations show to us the seriousness of Japanese government in advancing the aspects of ICT.

2.4.2 The case of Indonesia

A) 2001-2005

Indonesian Telematics Coordinating Team (TKTI) (2001) explained that the government's five years action plan, from 2001-2005, for the development and implementation of ICT in Indonesia can be described as follows:

"*1. Policy and legal framework*

The Government of Indonesia recognizes the need to create a conducive and enabling legal and regulatory environment to support the ICT development. It is prepared by 1) deregulating existing ICT-related acts and drafting necessary ICT-related legislation and regulation to ensure a clear-guided and transparent framework; 2) facilitating interaction among stakeholders; 3) promoting collaboration with international counterparts in various matters as well as the provision of national information infrastructure including covering remote areas.

In addition to the need of a conducive and enabling legal and regulatory framework, it is also extremely important to have one agency, which manages and coordinates all the initiatives and efforts related to the ICT development. Based on a Presidential Decree No. 50/2000, TKTI has the mandate to formulate and update the ICT policy framework as well as administer and coordinate with related government agencies, private sectors, and society at large to ensure the effective implementation. The TKTI secretariat is also being strengthened to assure the achievement of directions stated in the Policy Framework.

2. Human Capacity Building

In regard to ICT human resources, the Government of Indonesia recognizes the enormous potential of the ICT usage to extend and enrich human capacities. The introduction and utilization of ICT education are critically essential and have to begin at the earliest age possible. School and university curricula will be gradually adapted. The Government, together with all stakeholders, implements and boost private sector's participation in providing equal opportunity to access information through distance learning programs as well as the development of standardized and user friendly interface software in Indonesian language to overcome the language barriers. The Government also enhances the ICT awareness and readiness of its employees by intensifying ICT education and training.

3. Infrastructure

The Government, as facilitator and motivator, develops the various forms of partnership and collaboration with domestic and foreign private sectors to increase ICT infrastructure access

and coverage, especially to underserved and less profitable areas. An information network infrastructure is vital to bridge digital divide between urban and rural areas, in addition to support decentralization process. The Government also considers funding support schemes to encourage the development of information network services for small medium enterprises (SME) and for the provision of non-commercial services for people in rural areas. In addition to those efforts, the Government continues to develop the competitive market environment for the ICT business that ensures the private sectors will be able to grow efficiently. It includes developing solid strategies and initiatives to encourage the international participation in expanding and improving information networks.

4. Applications

Networking within the public administration is a prerequisite for improving transparency and accountability in various government transactions an effectiveness in public services as well as for increasing the efficiency of the decentralization process. The private sector plays a central role in translating the potential of ICTs into activities that bring the real economic growth. Thereby, without some forms of intervention from the Government, the threat of the digital that divides urban and rural areas will become more apparent. To overcome this problem, the Government develops the models of partnership and cooperation with the private sector to maximize the utilization of domestic commercial networks."

B) 2012

The next explanation is about the ICT policies of Indonesia on 2012. Indonesian Ministry of Communication and Information Technology (2012) explained that one of the policies is a green ICT policy. This policy could be described as follows:

"*Green ICT is a concept of low energy and ICT resource usages, besides reducing emission and garbage produced by activities in ICT field. ICT devices have been used extensively by Indonesian, therefore we need to pay attention to things caused by it, because it clearly contribute in making carbon emission print and other environmental negative effects such as ICT industrial waste. Based on those facts, government needs to conceptualize the Green ICT. As a commitment in implementing environmentally safe technology, the government has implemented several policies that were embodied in regulations, education and the boost awareness, and also the business initiative. These policy steps also being realized in further government policy planning regarding the Green ICT technology implementation.*"

The policy is described in more details in Figure 2.6.

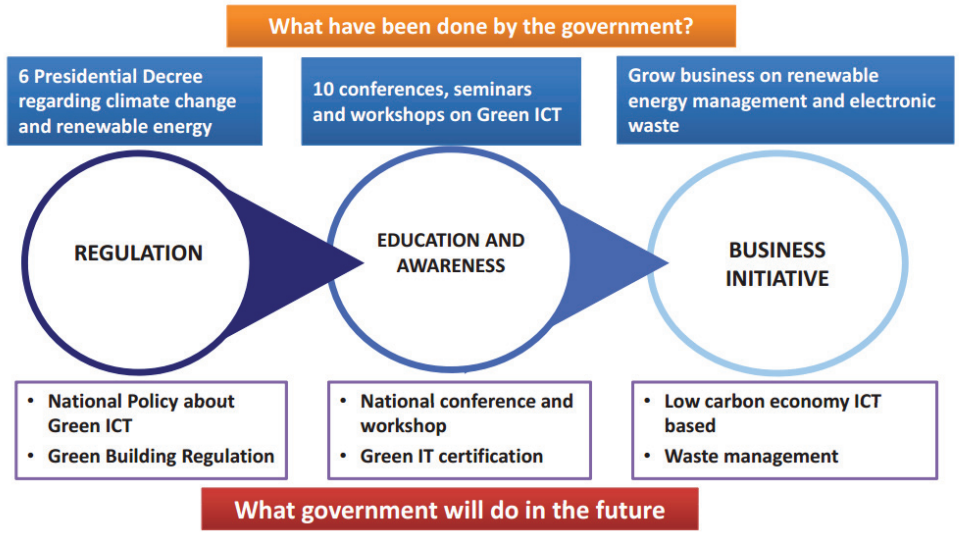

Figure 2.6. A Green ICT implementation policy (Source: Indonesian Ministry of Communication and Information Technology, 2012)

2.5 Position and originality of the research

Based on the review of literatures, the study which analyzes the role of ICT and influences of it penetration on the national industrial structural changes of a particular country is still thin. Consequently, the model to investigate the influences, and the comprehensive discussion for this topic, such as a comparison study, are also still limited. This study is conducted in order to fulfill this gap. Figure 2.7 describes the details of the position of this study in the areas of ICT researches.

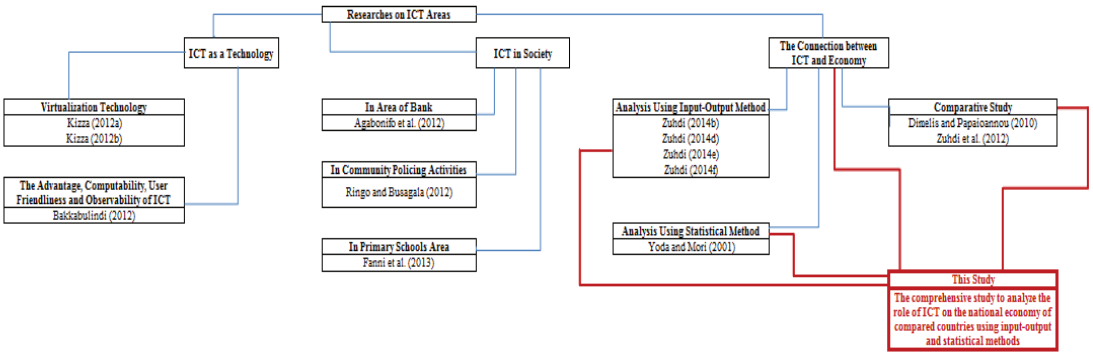

Figure 2.7. The position of this study in the areas of ICT researches

More specifically, the research position of this study is described as follows:

"The study which deeply and comprehensively analyzes the role of ICT and the influences of it penetration on the industrial structural changes of compared countries using IO and statistical analyses as analysis instruments."

The originality of this study can be seen on the proposed new model for analyzing above influences as well as the deep and comprehensive analysis itself.

3. An Analysis of Industrial Structural Changes by the "Static" Output Multiplier Analysis and An Application of the Demand-Pull Input-Output Quantity Model

3.1 Using the Simple Output Multiplier Analysis and the Demand-Pull Input-Output Quantity Model: An application of Input-Output Analysis

This Chapter analyzes the industrial structural changes of Japan and Indonesia using multiplier analysis, one of the analysis instruments in Input-Output (IO) Analysis. The focus of this section is Information and Communication Technology (ICT) sectors. The instrument has several types and each type discusses the different topic. Miller and Blair (2009) explained these types as follows:

"*Several of the most frequently used types of multipliers are those that estimate the effects of exogenous changes on (a) outputs of the sectors in the economy, (b) income earned by households in each sector because of the new inputs, (c) employment (jobs, in physical terms) that is expected to be generated in each sector because of the new outputs and (d) the value added that is created by each sector in the economy because of the new outputs.*"

This Chapter focuses on the output multiplier. The explanation about this multiplier was described by Miller and Blair (2009) as follows:

"*An output multiplier for sector j is defined as the total value of production in all sectors of the economy that is necessary in order to satisfy a dollar's worth of final demand for sector j's output."*

The multiplier has two types, namely simple and total output multipliers. The explanation about the former multiplier, according to them, can be seen as follows:

"*For the simple output multiplier, this total production is obtained from a model with households exogenous. The initial output effect on the economy is defined to be just the initial dollar's worth of sector j output needed to satisfy the additional final demand. Then, formally, the output multiplier is the ratio of the direct and indirect effect to the initial effect alone.*"

They also explained about the latter one, namely:

"*If we consider the input coefficients matrix closed with respect to households… we capture in the model the additional induced effects of household income generation through payments for*

labor services and the associated consumer expenditures on goods produced by the various sectors."

Miller and Blair (2009) also explained about the equation of the multipliers. The equation for the former multiplier is:

$$m(o)_j = \sum_{i=1}^{n} l_{ij} \tag{3.1}$$

where $m(o)_j$, n, and l_{ij} are the simple output multiplier for sector j, sector numbers, and sector-to-sector multipliers matrix, respectively. For the latter one, the equation is:

$$\overline{m}(o)_j = \sum_{i=1}^{n+1} \bar{l}_{ij} \tag{3.2}$$

where $\overline{m}(o)_j$, n, and $\bar{l}_{ij}$ are the total output multiplier for sector j, sector numbers, and sector-to-sector multipliers matrix with respect to the households endogenous, respectively. This section focuses on the former one. Further, the term of "static" can be used to explain the characteristic of this multiplier.

Besides, this Chapter also analyzes the ways to encourage the industrial sectors of analyzed countries which the focus is ICT sectors. More specifically, this section also discusses the dynamics of these sectors caused by the changes of final demands on the economy. In this part, this section employs the demand-pull IO quantity model as a tool of analysis. Miller and Blair (2009) argued that in this model the prices of sectoral outputs are fixed while the changes emerge on the quantities of outcomes. According to them, the equation of the model is:

$$\mathbf{f}^1 = [f_i^1] \text{ or } \Delta\mathbf{f} = [\Delta f_i] \tag{3.3}$$

where **f** describes the matrix of final demands on the economy. Above equation is addressed to exogenous variables. For endogenous variables, the equation is:

$$\mathbf{x}^1 = \mathbf{L}^0\mathbf{f}^1 \text{ or } \Delta\mathbf{x} = \mathbf{L}^0(\Delta\mathbf{f}) \tag{3.4}$$

where **x** and **L** are the vector of sectoral outputs, and Leontief inverse matrix, respectively. 0 and 1 explain current and future periods, respectively.

In this discussion, the competitive imports are included as one of the sources of analysis. In other words, this Chapter is also called "an impact analysis to know the effects of final demands changes on the domestically produced outputs with respect to and considering competitive imports".

The scenarios used in this discussion for Japanese case are described in Table 3.1 while Table 3.2 focuses on Indonesian case. "Whole sector change" and "pure change" conditions are considered in the calculation. The former word explains the condition which the modifications of final demands are addressed to all industrial sectors of analyzed countries while the latter one only focuses on ICT sectors. In this discussion, the former one will be called "condition A" while "condition B" is used in describing the latter condition.

Table 3.1. The scenarios of final demands modification used in the discussion (Japanese case)

Component of final demand	Scenario		
	1	2	3
	Exports modification	Imports modification	Outside households consumption modification
Exports	Increases 30%	Constant	Constant
Imports	Constant	Increases 30%	Constant
Outside households consumption	Constant	Constant	Increases 30%

(Source: Zuhdi et al., 2013b, with slight modifications)

Table 3.2. The scenarios of final demands modification used in the discussion (Indonesian case)

Component of final demand	Scenario		
	1	2	3
	Exports modification	Imports modification	Households and non-profit private institutions consumptions modification
Exports	Increases 30%	Constant	Constant
Imports	Constant	Increases 30%	Constant
Households and non-profit private institutions consumptions	Constant	Constant	Increases 30%

(Source: Zuhdi et al., 2013b, with slight modifications)

3.2 Existing literatures on Multiplier Analysis and Demand-Pull Input-Output Quantity Model

Many previous studies employed multiplier analysis as a tool of analysis. For example, Mäenpää (2008) compared the environmental multipliers of monetary and physical Leontief inverses. Nouve et al. (2008) explained about the use of Social Accounting Matrix (SAM) as a microsimulation Computable General Equilibrium (CGE) model. Dias et al. (2008) developed a new type of IO multiplier specifically well suited to quantify the effects of changes of final demand (in consumption, investment or exports). They analyzed these effects on the sectoral output growth potential of the economy.

Cantuche and Amores (2008) merged environmental IO analysis and other approaches co-exist, such as the econometric modelling, in order to address the calculation of unbiased and consistent multipliers of CO_2 emission and their respective confidence intervals. Their study focused on Denmark. Banouei et al. (2009) analyzed the growth and income multipliers of several countries using standard SAM model. Their study focused on Iran, India, Malaysia, and Indonesia. Besides, Kim (2009) proposed a simple change to SAM in order to analyze the impacts of the multiplier of a new sector.

Meanwhile, the study uses the demand-pull IO quantity model as an analysis tool is usually called "impact analysis" study. Many previous studies conducted this analysis. For example, McNicoll and Baird (1980) analyzed the economy of Shetland using the model. In addition, they only focused on the oil final demand as a point of forecast. Zuhdi (2014a) employed the model in investigating the ways to encourage the creative industries of Japan. On the other hand, using the model, Zuhdi (2014c) analyzed the Indonesian creative industries. His study indicated that the activities of the import related to the products of these industries, especially the products which domestic producers are possible to produce, should be mitigated if the enhancement of total outputs of the sectors on the future period would like to be achieved. Besides, Zuhdi and Prasetyo (2014) examined the dynamics of total outputs of specific sectors caused by final demands changes. They focused on Japan and applied three scenarios, namely (1) the change of exports, (2) the change of imports, and (3) the change of consumption expenditures of outside households.

3.3 Data sources and adjustment

This Chapter uses IO tables available for Japan (1995, 2000, and 2005) and Indonesia (1990, 1995, and 2005) over the time period examined as data sources. Former data are obtained from the website of Japanese Ministry of Internal Affairs and Communications (2008b) while latter ones are acquired from the expert, and researcher at Statistics Indonesia (*Badan Pusat Statistik*). Data for Japan in 1995, 2000, and 2005 consist of 93, 104, and 108 industrial sectors,

respectively. On the other hand, the data for Indonesia in 1990, 1995, and 2005 consist of 161, 172, and 175 industrial sectors, respectively.

For the sake of compatibility across the different periods, industrial sectors in data are aggregated into 89 sectors for Japanese case and 159 sectors for the case of Indonesia before conducting the calculations. These sectors can be seen in Tables 3.3 and 3.4. The process of adjustment in order to get proper data is addressed to the 2005 IO table of Indonesia before conducting the aggregation procedure. ICT sectors used in this Chapter can be observed in Tables 3.5 and 3.6. These data are also used in following Chapters.

Table 3.3. Japanese industrial sectors (89 sectors)

No.	Sector name
1	Crop cultivation
2	Livestock
3	Agricultural services
4	Forestry
5	Fisheries
6	Metallic ores
7	Non-metallic ores
8	Coal mining, crude petroleum and natural gas
9	Foods
10	Beverage
11	Feeds and organic fertilizer, n.e.c.
12	Tobacco
13	Textile products
14	Wearing apparel and other textile products
15	Timber and wooden products
16	Furniture and fixtures
17	Pulp, paper, paperboard, building paper
18	Paper products
19	Printing, plate making and book binding
20	Chemical fertilizer
21	Industrial inorganic chemicals
22	Petrochemical basic products and intermediate chemical products
23	Synthetic resins

24	Synthetic fibers
25	Medicaments
26	Final chemical products, n.e.c.
27	Petroleum refinery products
28	Coal products
29	Plastic products
30	Rubber products
31	Leather, fur skins and miscellaneous leather products
32	Glass and glass products
33	Cement and cement products
34	Pottery, china and earthenware
35	Other ceramic, stone and clay products
36	Pig iron and crude steel
37	Steel products
38	Steel castings and forgings, and other steel products
39	Non-ferrous metals
40	Non-ferrous metal products
41	Metal products for construction and architecture
42	Other metal products
43	General industrial machinery
44	Special industrial machinery
45	Other general machines
46	Machinery for office and service industry
47	Electrical appliance
48	Motor vehicles
49	Ships and repair of ships
50	Other transportation equipment and repair of transportation equipment
51	Precision instruments
52	Miscellaneous manufacturing products
53	Building construction
54	Repair of construction
55	Civil engineering
56	Electricity
57	Gas and heat supply

58	Water supply
59	Waste management service
60	Commerce
61	Finance and insurance
62	Real estate agencies and rental services
63	House rent
64	Railway transport
65	Road transport (except transport by private cars)
66	Self-transport by private cars
67	Water transport
68	Air transport
69	Freight forwarding
70	Storage facility service
71	Services relating to transport
72	Communication
73	Broadcasting and information services
74	Public administration
75	Education
76	Research
77	Medical service and health
78	Social security
79	Other public services
80	Advertising, survey and information services
81	Goods rental and leasing services
82	Repair of motor vehicles and machine
83	Other business services
84	Amusement and recreational services
85	Eating and drinking places
86	Accommodations
87	Other personal services
88	Office supplies
89	Activities not elsewhere classified

n.e.c.: Not elsewhere classified

(Source: Zuhdi, 2014a, with slight modifications)

Table 3.4. Indonesian industrial sectors (159 sectors)

No.	Sector name
1	Paddy
2	Maize
3	Cassava
4	Other root crops include sweet potatoes
5	Groundnut
6	Soybeans
7	Other beans
8	Vegetables
9	Fruits
10	Cereals and other food crops
11	Rubber
12	Sugarcane
13	Coconut
14	Oil palm
15	Fiber crops
16	Tobacco
17	Coffee
18	Tea
19	Clove
20	Other estate crops
21	Other agriculture
22	Livestock and livestock product except fresh milk
23	Fresh milk
24	Poultry and its product
25	Other livestock raising
26	Wood
27	Other forest product
28	Sea fish and other sea products
29	Inland water fish and its product
30	Coal
31	Crude oil
32	Natural gas and geothermal
33	Tin ore

34	Nickel ore
35	Bauxite ore
36	Copper ore
37	Gold and silver ore
38	Other mining
39	Crude salt
40	Quarrying, all kinds
41	Meat and entrails of slaughtered animal
42	Processed and preserved meat
43	Dairy products
44	Canning and preserving of fruits and vegetables
45	Drying and salting of fish
46	Processed and preserved fish
47	Copra, animal oil, and vegetables oil
48	Rice
49	Wheat flour
50	Other flour
51	Bakery product and the like
52	Noodle, macaroni, and the like
53	Sugar
54	Peeled grain, chocolate, and sugar confectionery
55	Milled and peeled coffee
56	Processed tea
57	Soya bean products
58	Other foods
59	Animal feeds
60	Alcoholic beverages
61	Non-alcoholic beverages
62	Tobacco products
63	Cigarettes
64	Yarn and cleaning kapok
65	Textile
66	Made up textile goods except wearing apparel
67	Knitting mills
68	Wearing apparel
69	Manufacture of carpet, rope, twine, and other textile

70	Leather tanneries and leather finishing
71	Manufacture of footwear and leather products
72	Sawmill and preserved wood
73	Manufacture of plywood and the like
74	Wooden building components
75	Manufacture of furniture and fixtures mainly made of wood, bamboo, and rattan
76	Manufacture of other products mainly made of wood, bamboo, rattan, and cork
77	Manufacture of non-plastic plait
78	Pulp
79	Paper and cardboard
80	Paper and cardboard products
81	Printing and publishing
82	Basic chemical except fertilizer
83	Fertilizer
84	Pesticides
85	Synthetic resins, plastic and fiber
86	Paints, varnishes and lacquers
87	Drugs and medicine
88	Native medicine
89	Soap and cleaning preparation
90	Cosmetics
91	Other chemical products
92	Petroleum refineries products
93	Liquefied of natural gas
94	Smoked and crumb rubber
95	Tire
96	Other rubber products
97	Plastic products
98	Ceramic and earthenware
99	Glass products
100	Clay and ceramic structural products
101	Cement
102	Other non-ferrous products
103	Basic iron and steel

104	Basic iron and steel products
105	Non-ferrous basic metal
106	Non-ferrous basic metal products
107	Kitchen wares, hand tools, and agricultural tools
108	Furniture and fixed primarily made of metal
109	Structural metal products
110	Other metal products
111	Prime movers engine
112	Machinery and apparatus
113	Electric generator and electrical motor
114	Electrical machinery and apparatus
115	Communication, electronic equipment, and apparatus
116	Household electronics appliances
117	Other electrical appliances
118	Battery and storage battery
119	Ship and its repair
120	Train and its repair
121	Motor vehicle except motor cycle
122	Motor cycle
123	Other transport equipment
124	Aircraft and its repair
125	Measuring, photographic, and optical equipment
126	Jewelry
127	Musicals instruments
128	Sporting and athletics goods
129	Other manufacturing industries
130	Electricity and gas
131	Water supply
132	Residential and non-residential buildings
133	Construction on agriculture
134	Public work on road, bridge, and harbor
135	Construction and installation on electricity, gas, water supply, and communication
136	Other construction
137	Trade
138	Restaurant

139	Hotel
140	Railway transport
141	Road transport
142	Sea transport
143	River and lake transport
144	Air transport
145	Services allied to transport
146	Communication services
147	Banking and other financial intermediaries
148	Insurance and pension fund
149	Building and land rent
150	Business services
151	General government
152	Education services
153	Health services
154	Other community services
155	Private motion picture and its distribution
156	Amusement, recreational, and cultural services (private)
157	Repair shop n.e.c
158	Personal and household services
159	Other goods and services n.e.c

n.e.c.: Not elsewhere classified

(Source: Zuhdi et al., 2014a, with slight modifications)

Table 3.5. ICT sectors of Japan used in this Chapter

No.	Sector number	Sector name
1	72	Communication
2	73	Broadcasting and information services
3	80	Advertising, survey, and information services

(Source: Zuhdi et al., 2012)

Table 3.6. ICT sectors of Indonesia used in this Chapter

No.	Sector number	Sector name
1	135	Construction and installation on electricity, gas, water supply, and communication
2	146	Communication services

(Source: Zuhdi et al., 2012)

3.4 Application results

3.4.1 The case of Japan

Figures 3.1, 3.2, and 3.3 describe the values of simple output multiplier of Japanese industrial sectors on 1995, 2000, and 2005, respectively. Tables 3.7, 3.8, and 3.9 explain top five Japanese industrial sectors viewed from simple output multiplier value on 1995, 2000, and 2005, respectively. ICT sectors not appear in these Tables.

The results show that the office supplies sector appears in the Tables. The values of this sector on 1995, 2000, and 2005 were 3.14, 3.15, and 3.30, respectively. The similar phenomenon is also shown by the motor vehicles sector. The values of this sector on 1995, 2000, and 2005 were 3.07, 3.12, and 3.47, respectively.

Meanwhile, Figures 3.4, 3.5, and 3.6 describe the total outputs of Japanese ICT sectors for each scenario on condition A. X_t denotes the total output of these sectors on the initial period, 2005, while total outputs on the future period are explained by X_{t+1}. Based on the information in these Figures, in this condition, the change of exports has the biggest positive impact to the total outputs of the sectors. On the other hand, the modification of imports gives the opposite impact.

Figures 3.7, 3.8, and 3.9 explain the total outputs of Japanese ICT sectors for each scenario on condition B. These Figures show that, in this condition, the exports modification has the biggest positive effect to the total outputs of broadcasting and information services, and advertising, survey, and information services sectors. On the other hand, the biggest positive impact to the communication sector is owned by the change of consumption expenditures of outside households. The change of imports, conversely, generates the negative effect.

3.4.2 The case of Indonesia

Figures 3.10, 3.11, and 3.12 describe the values of simple output multiplier of Indonesian industrial sectors on 1995, 2000, and 2005, respectively. Tables 3.10, 3.11, and 3.12 explain top five Indonesian industrial sectors viewed from simple output multiplier value on 1995, 2000, and 2005, respectively. ICT sectors not appear in these Tables.

The results show that prime movers engine sector appears in the Tables. The values of this sector on 1990, 1995, and 2005 were 2.68, 2.62, and 2.81, respectively. The similar phenomenon is also shown by the made up textile goods except wearing apparel sector. The values of this sector on 1990, 1995, and 2005 were 2.78, 2.74, and 2.59, respectively.

Meanwhile, Figures 3.13 and 3.14 explain the total outputs of Indonesian ICT sectors for each scenario on condition A. Based on the information in these Figures, in this condition, the scenario 3, the change of households and non-profit private institutions consumptions, has the biggest positive impact to the total outputs of these sectors. On the other hand, the scenario 2, the modification of imports, gives the negative impact.

Figures 3.15 and 3.16 describe the total outputs of Indonesian ICT sectors for each scenario on condition B. These Figures show that, in this condition, the modification of households and non-profit private institutions consumptions, has the biggest positive impact to the total outputs of these sectors. On the other hand, the change of imports generates the negative impact.

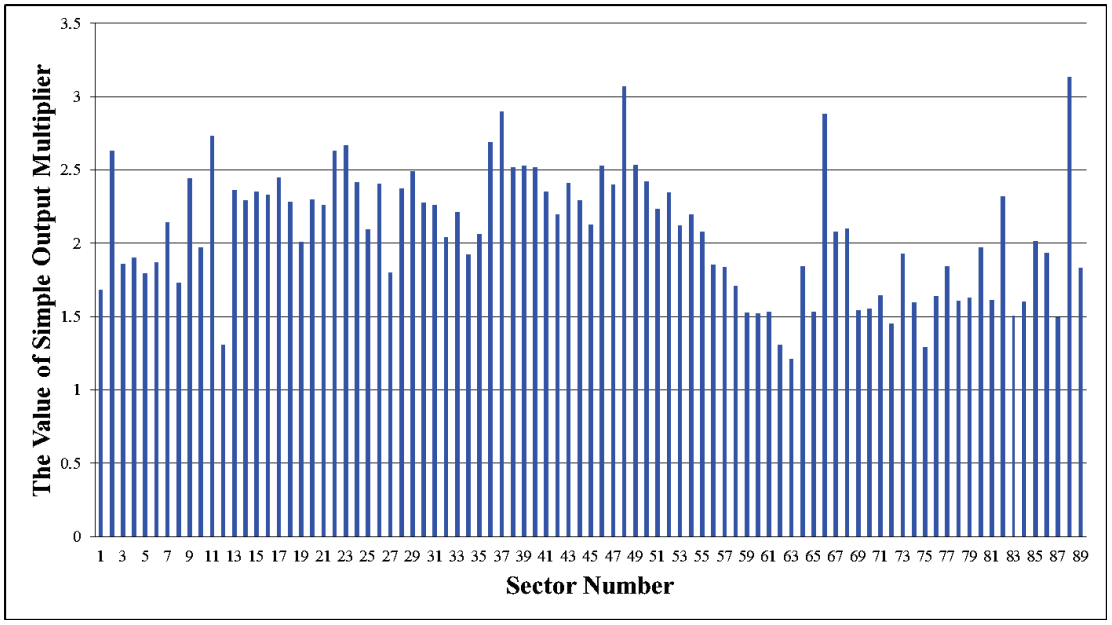

Figure 3.1. The values of simple output multiplier of all Japanese industrial sectors, 1995 (Source: Zuhdi, 2014e)

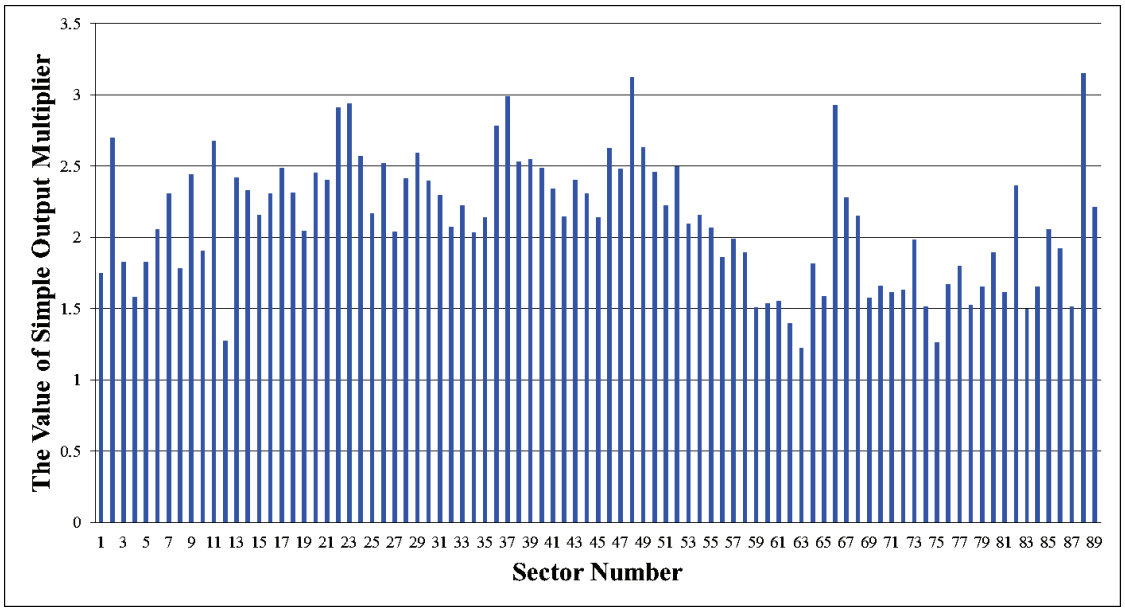

Figure 3.2. The values of simple output multiplier of all Japanese industrial sectors, 2000 (Source: Zuhdi, 2014e)

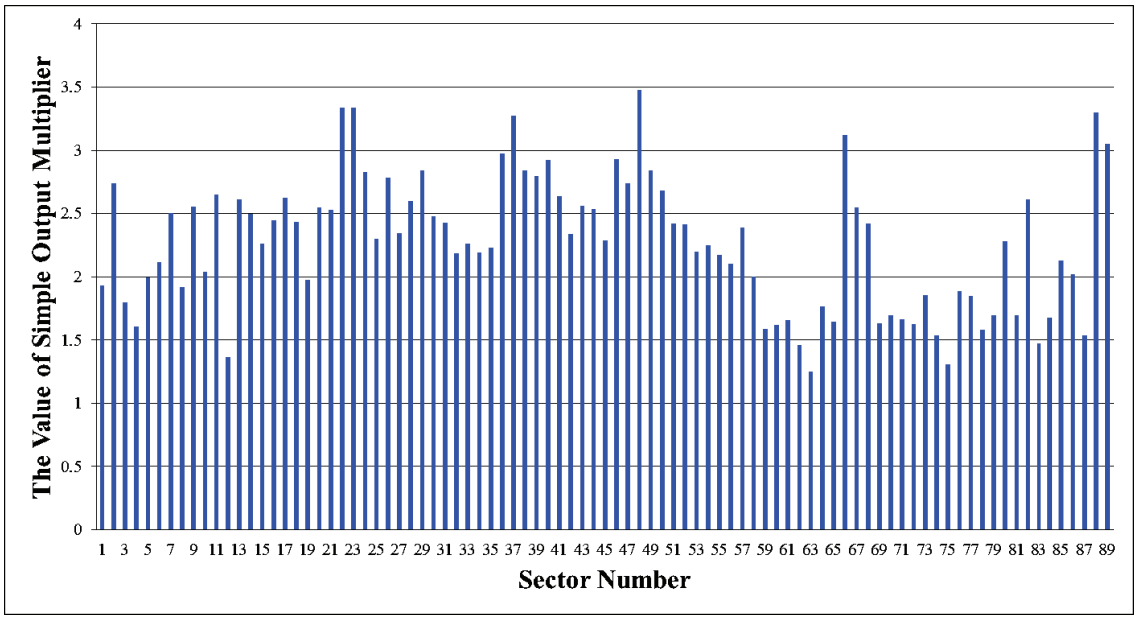

Figure 3.3. The values of simple output multiplier of all Japanese industrial sectors, 2005 (Source: Zuhdi, 2014e)

Table 3.7. Top five Japanese industrial sectors viewed from the value of simple output multiplier, 1995

No.	Sector number	Sector name	The value of simple output multiplier
1	88	Office supplies	3.14
2	48	Motor vehicles	3.07
3	37	Steel products	2.90
4	66	Self-transport by private cars	2.88
5	11	Feeds and organic fertilizer, n.e.c.	2.73

(Source: Zuhdi, 2014e)

Table 3.8. Top five Japanese industrial sectors viewed from the value of simple output multiplier, 2000

No.	Sector number	Sector name	The value of simple output multiplier
1	88	Office supplies	3.15
2	48	Motor vehicles	3.12
3	37	Steel products	2.99
4	23	Synthetic resins	2.94
5	66	Self-transport by private cars	2.93

(Source: Zuhdi, 2014e)

Table 3.9. Top five Japanese industrial sectors viewed from the value of simple output multiplier, 2005

No.	Sector number	Sector name	The value of simple output multiplier
1	48	Motor vehicles	3.47
2	23	Synthetic resins	3.34
3	22	Petrochemical basic products and intermediate chemical products	3.34
4	88	Office supplies	3.30
5	37	Steel products	3.27

(Source: Zuhdi, 2014e)

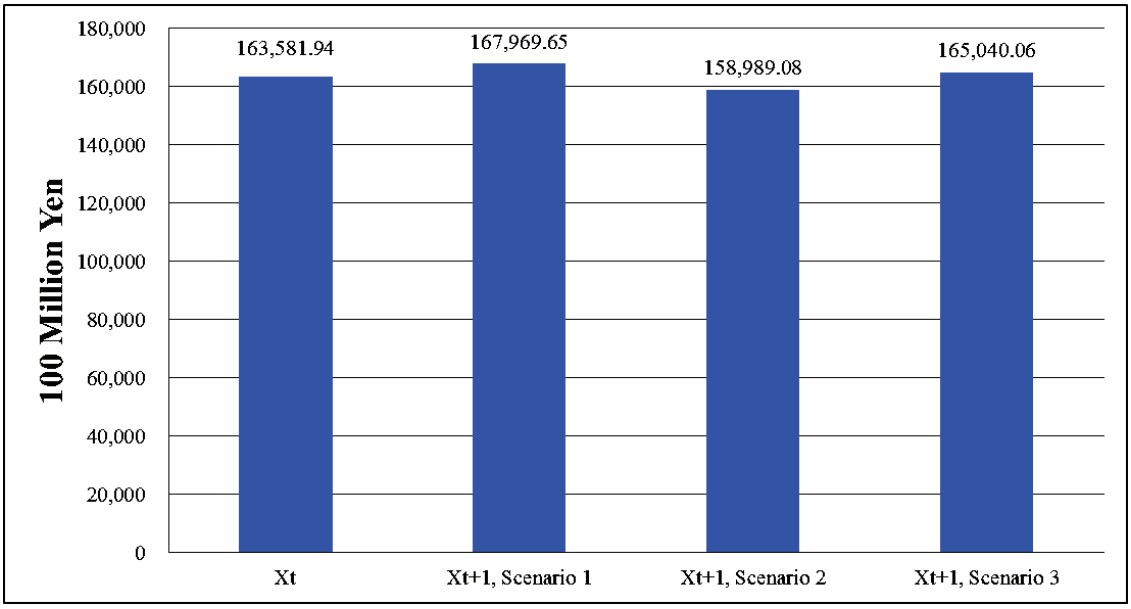

Figure 3.4. The total outputs of the communication sector for each scenario on condition A (Source: Zuhdi and Prasetyo, 2014)

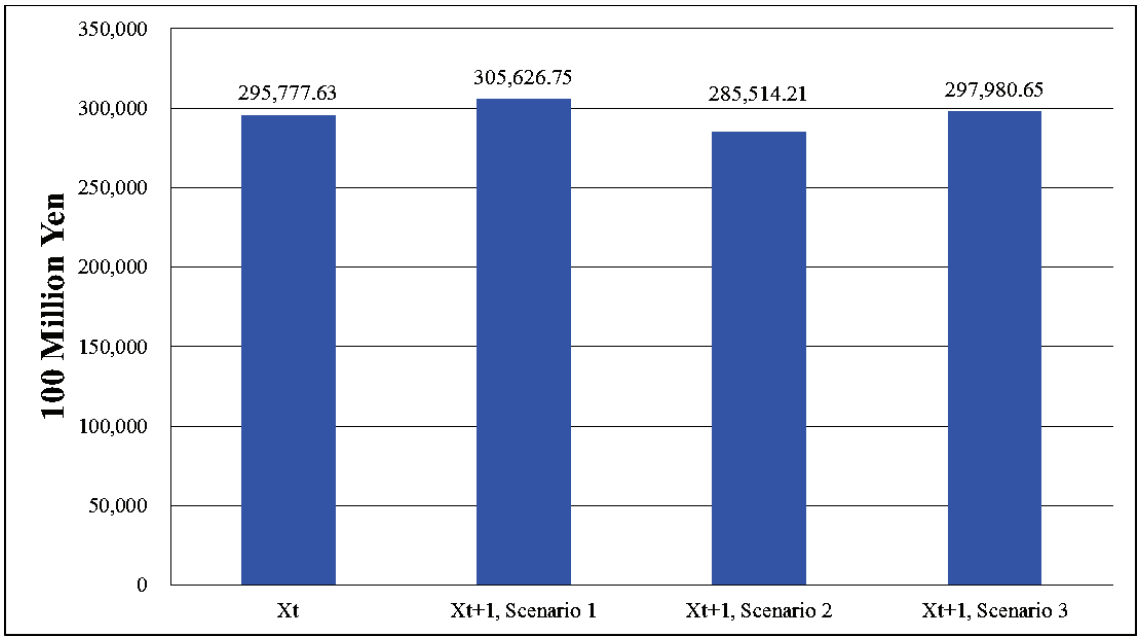

Figure 3.5. The total outputs of the broadcasting and information services sector for each scenario on condition A (Source: Zuhdi and Prasetyo, 2014)

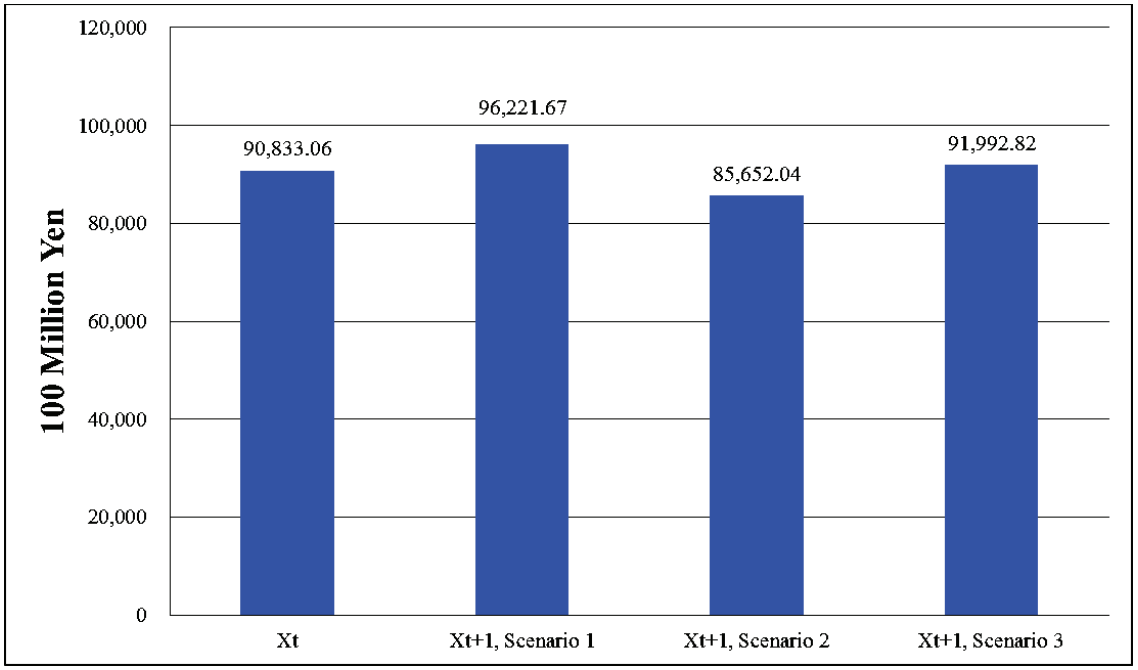

Figure 3.6. The total outputs of the advertising, survey, and information services sector for each scenario on condition A (Source: Zuhdi and Prasetyo, 2014)

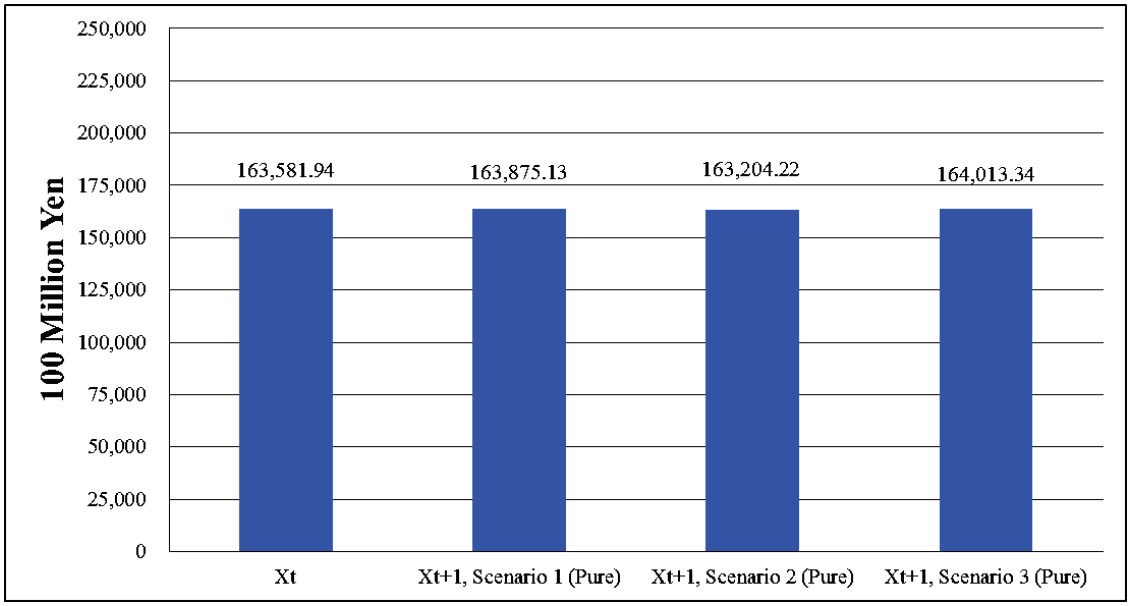

Figure 3.7. The total outputs of the communication sector for each scenario on condition B (Source: Zuhdi, 2014b)

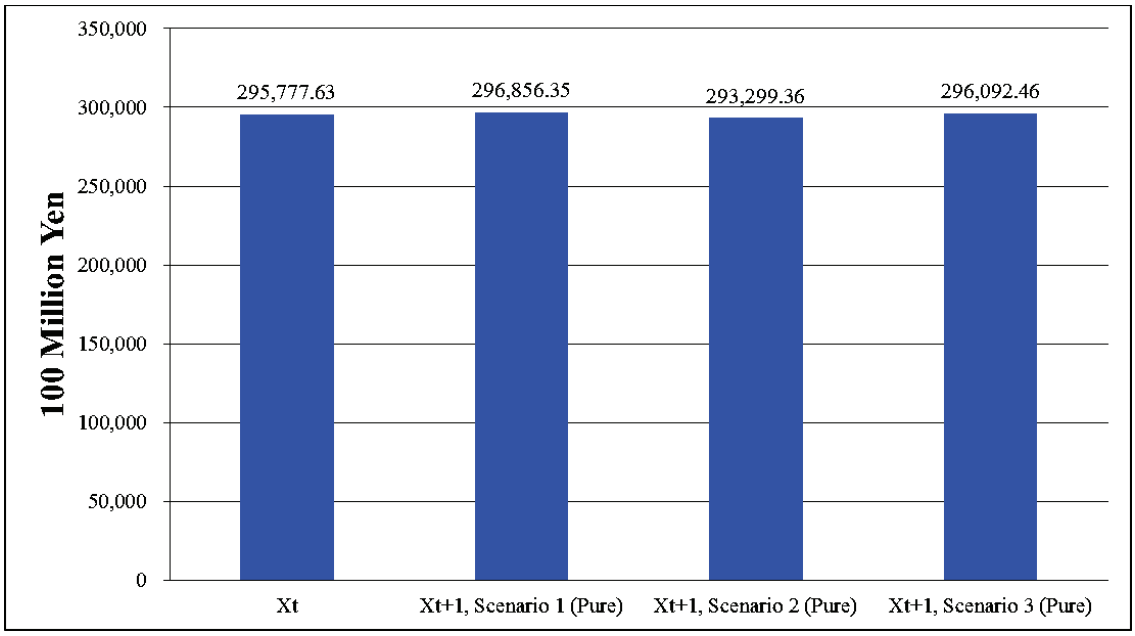

Figure 3.8. The total outputs of the broadcasting and information services sector for each scenario on condition B (Source: Zuhdi, 2014b)

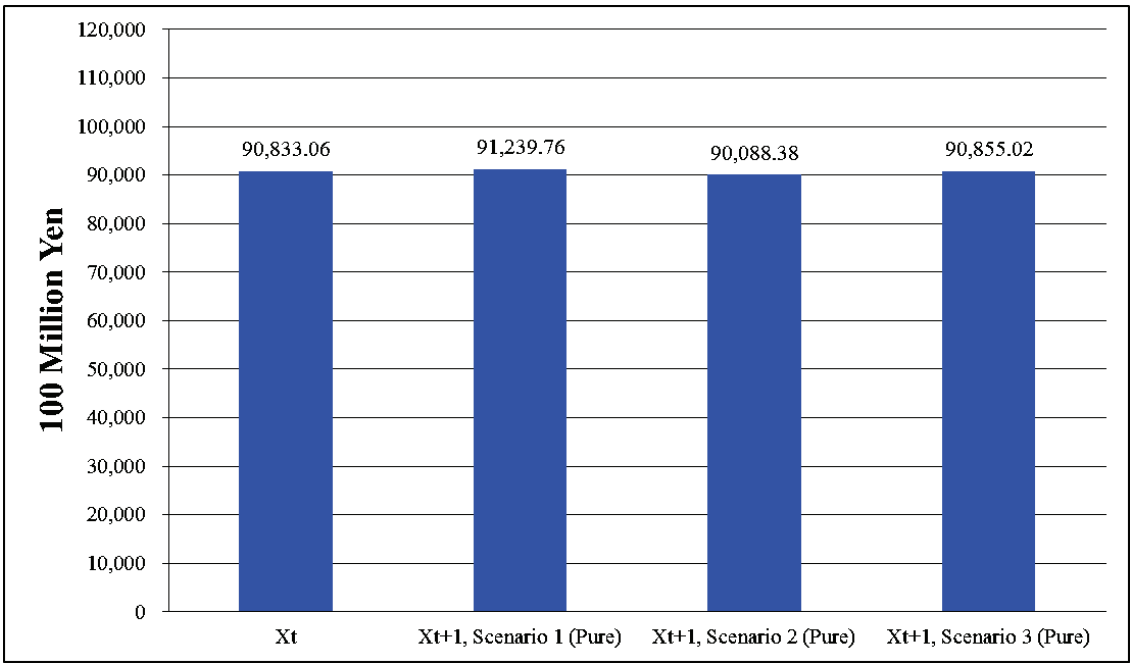

Figure 3.9. The total outputs of the advertising, survey, and information services sector for each scenario on condition B (Source: Zuhdi, 2014b)

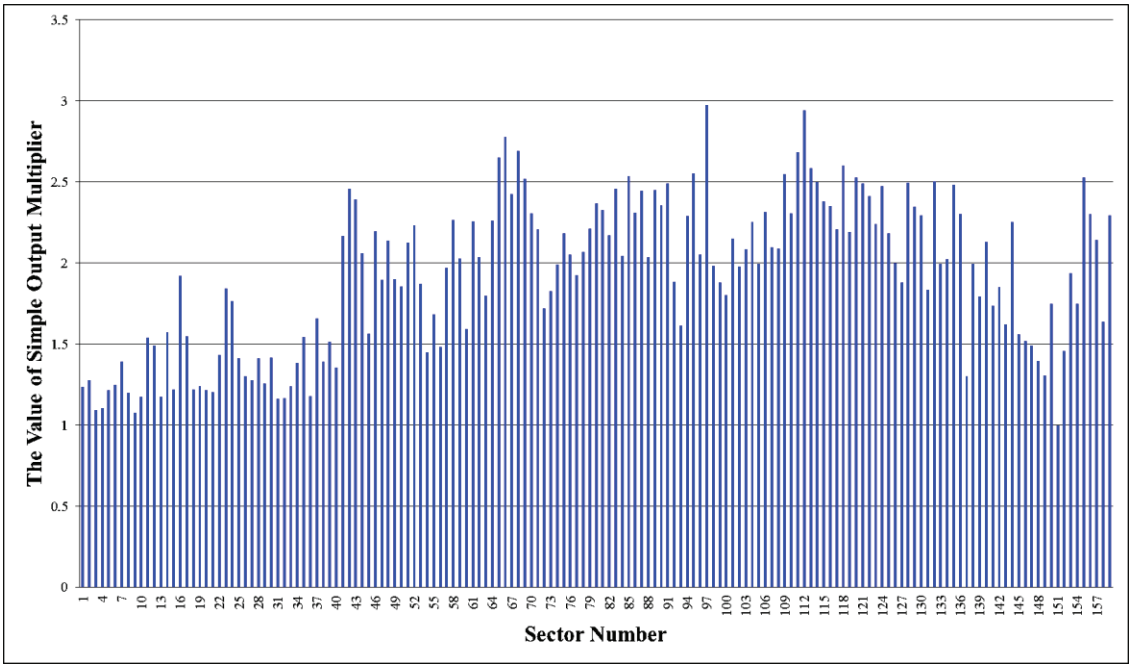

Figure 3.10. The values of simple output multiplier of all Indonesian industrial sectors, 1990 (Source: Zuhdi, 2014f)

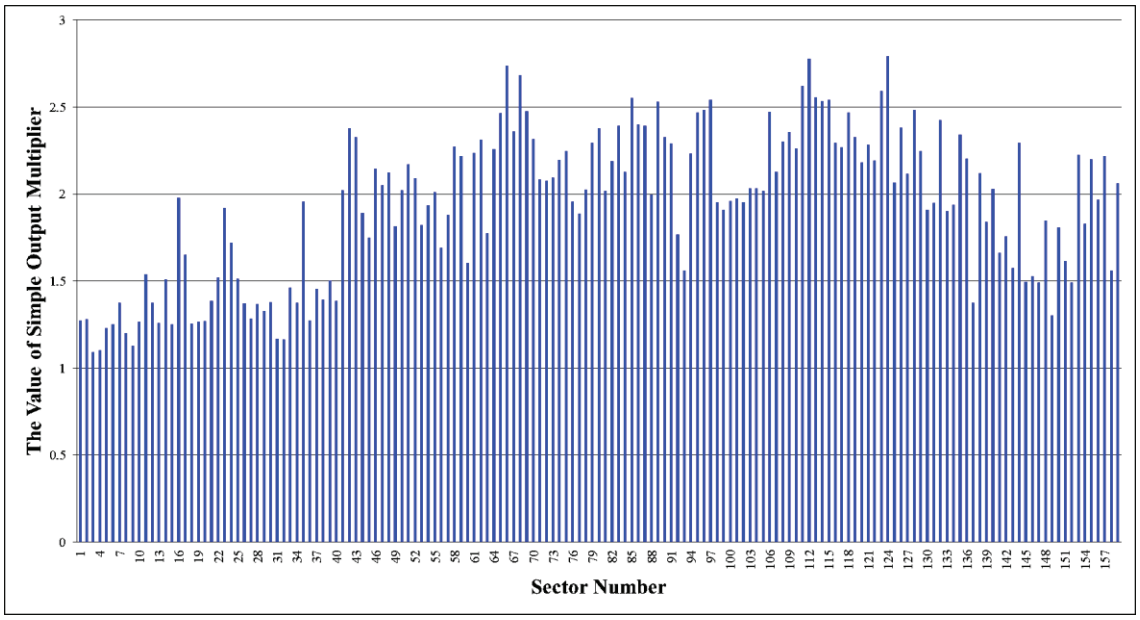

Figure 3.11. The values of simple output multiplier of all Indonesian industrial sectors, 1995 (Source: Zuhdi, 2014f)

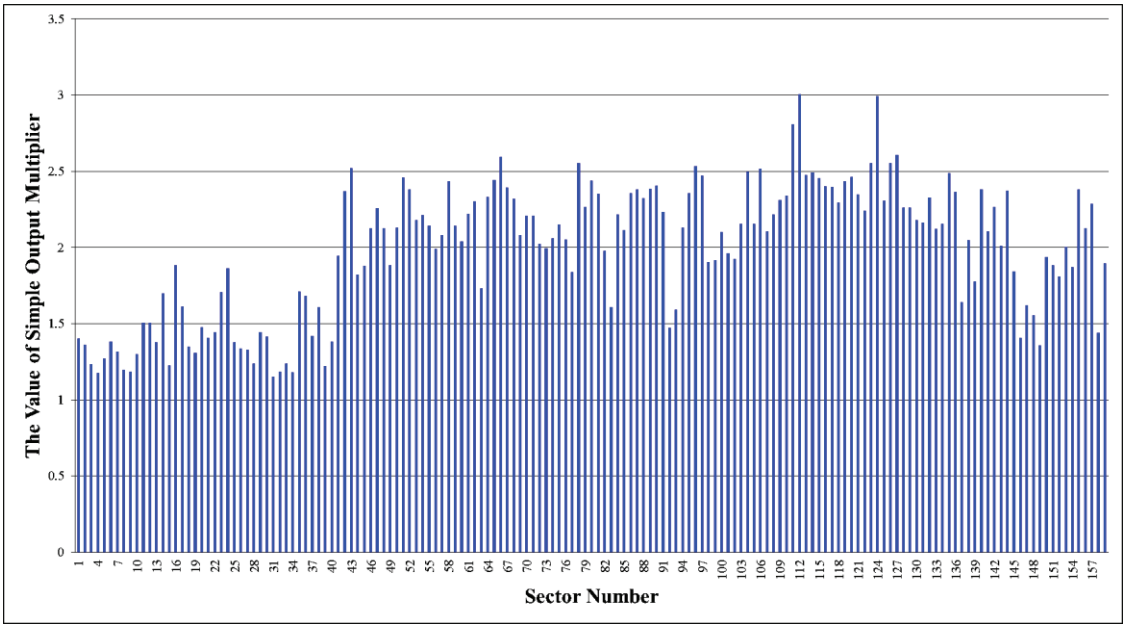

Figure 3.12. The values of simple output multiplier of all Indonesian industrial sectors, 2005 (Source: Zuhdi, 2014f)

Table 3.10. Top five Indonesian industrial sectors viewed from the value of simple output multiplier, 1990

No.	Sector number	Sector name	The value of simple output multiplier
1	97	Plastic products	2.97
2	112	Machinery and apparatus	2.94
3	66	Made up textile goods except wearing apparel	2.78
4	68	Wearing apparel	2.69
5	111	Prime movers engine	2.68

(Source: Zuhdi, 2014f)

Table 3.11. Top five Indonesian industrial sectors viewed from the value of simple output multiplier, 1995

No.	Sector number	Sector name	The value of simple output multiplier
1	124	Aircraft and its repair	2.79
2	112	Machinery and apparatus	2.78
3	66	Made up textile goods except wearing apparel	2.74
4	68	Wearing apparel	2.69
5	111	Prime movers engine	2.62

(Source: Zuhdi, 2014f)

Table 3.12. Top five Indonesian industrial sectors viewed from the value of simple output multiplier, 2005

No.	Sector number	Sector name	The value of simple output multiplier
1	112	Machinery and apparatus	3.00
2	124	Aircraft and its repair	2.99
3	111	Prime movers engine	2.81
4	127	Musicals instruments	2.61
5	66	Made up textile goods except wearing apparel	2.59

(Source: Zuhdi, 2014f)

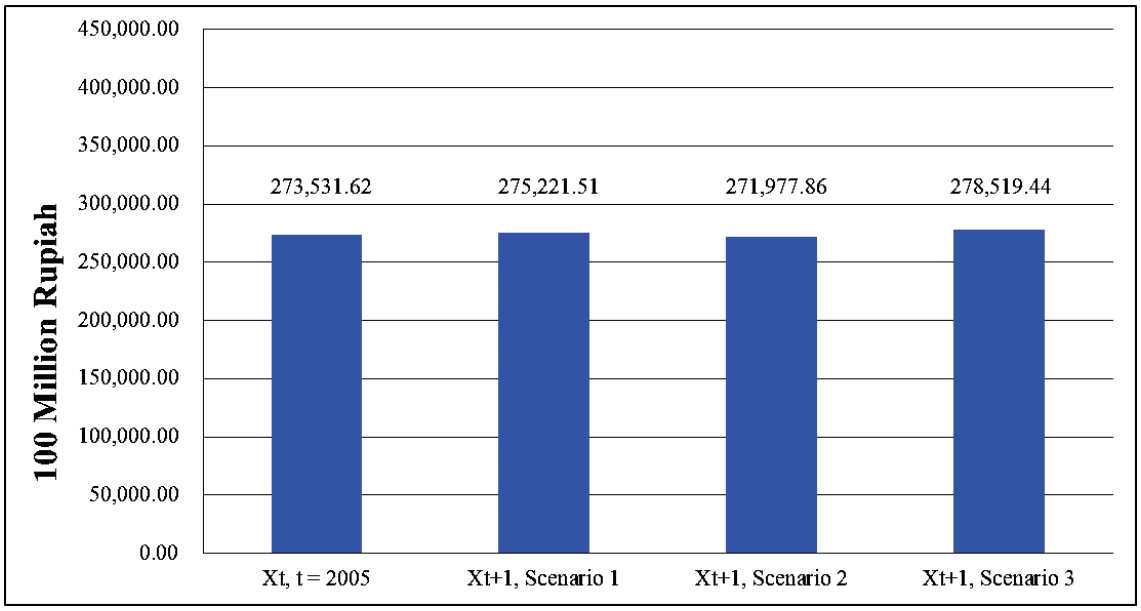

Figure 3.13. The total outputs of the construction and installation on electricity, gas, water supply, and communication sector for each scenario on condition A (Source: Zuhdi et al., 2014d)

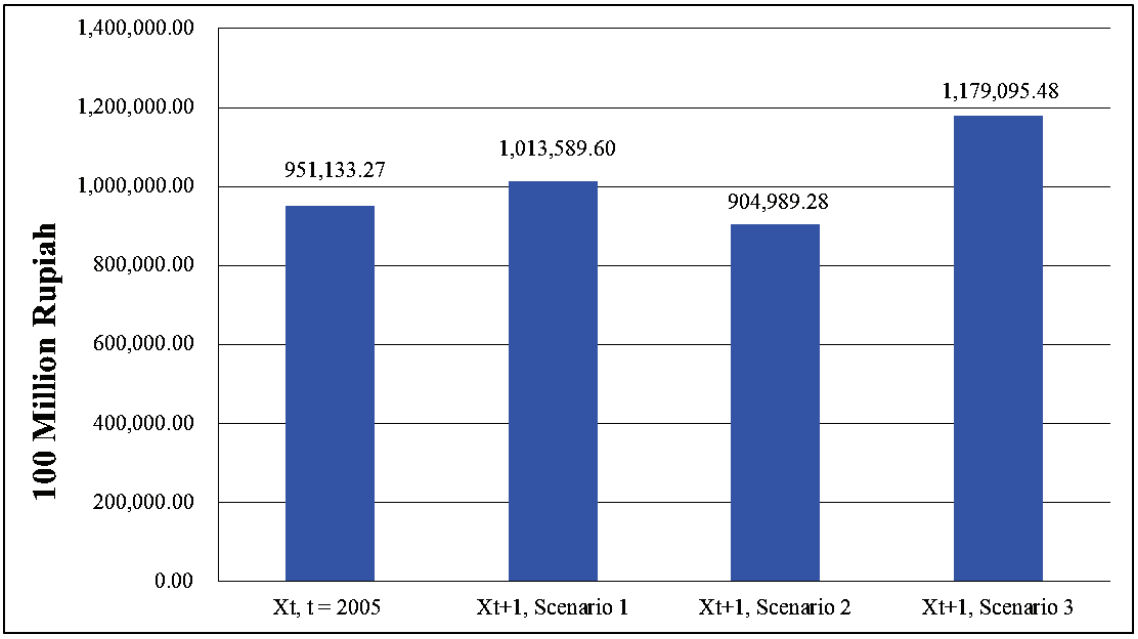

Figure 3.14. The total outputs of the communication services sector for each scenario on condition A (Source: Zuhdi et al., 2014d)

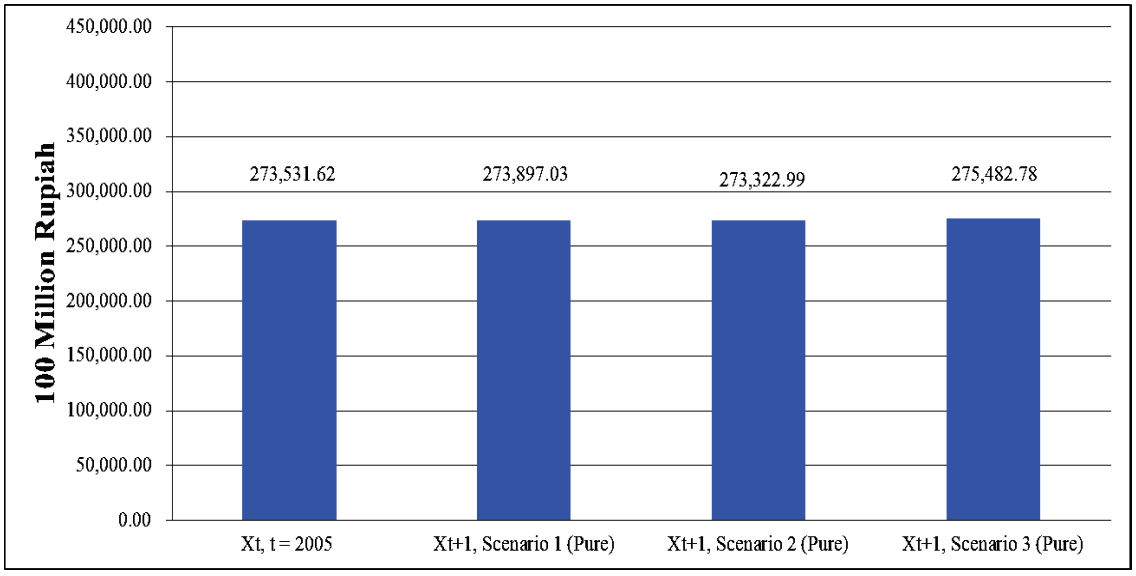

Figure 3.15. The total outputs of the construction and installation on electricity, gas, water supply, and communication sector for each scenario on condition B (Source: Zuhdi, 2014d)

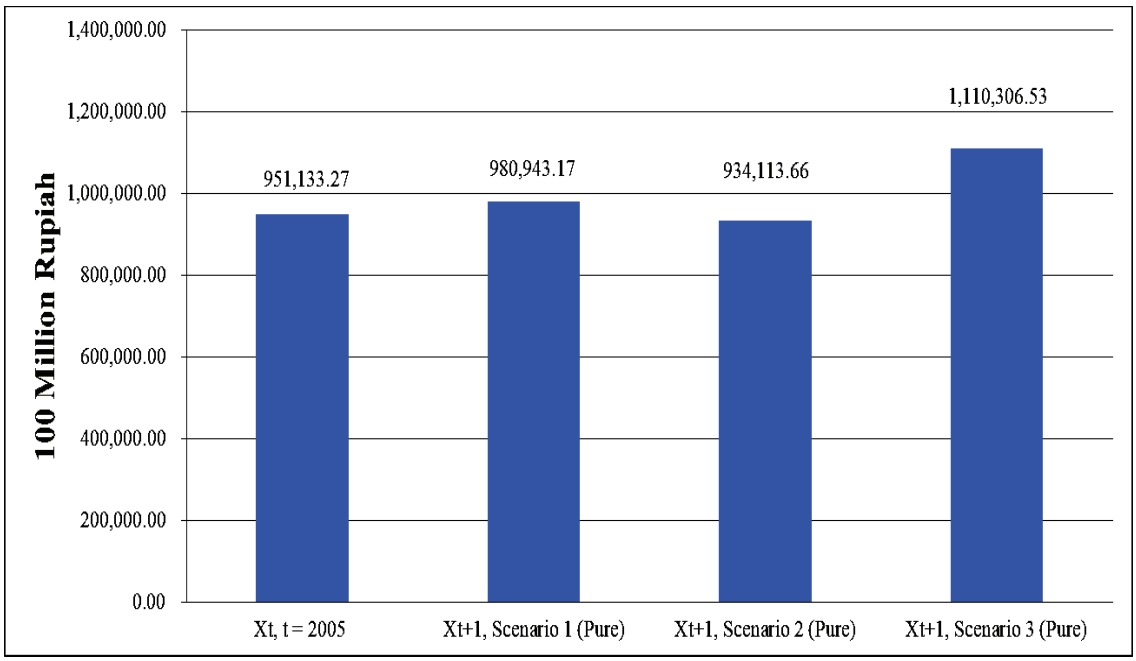

Figure 3.16. The total outputs of the communication services sector for each scenario on condition B (Source: Zuhdi, 2014d)

3.5 Findings

The results show that ICT sectors not appeared in the top five Japanese industrial sectors viewed from the simple output multiplier value on 1995, 2000, and 2005. This fact indicates that, on the period of analysis, these sectors did not have an important role in Japanese industrial structural changes. The similar phenomenon appears on the case of Indonesia.

The results also explain that Japanese and Indonesian governments should focus on the potential sectors when they consider the increasing of final demands in the future. In other words, they should prioritize the sectors which consistently appear in the top five industrial sectors viewed from the value of simple output multiplier if they have a plan to increase the final demands in the future. The purpose of this focus is to get optimal outcomes when the plan is executed. Based on the results, Japanese government should focus on office supplies and motor vehicles sectors while on the case of Indonesia the potential sectors are prime movers engine, and made up textile goods except wearing apparel sectors.

The results also show that exports and consumption expenditures of outside households modifications give the positive impact to the total outputs of Japanese ICT sectors while the opposite effect is delivered by the import changes. This phenomenon indicates that import activities regarding the ICT products should be done carefully and mitigated. Japanese government should active in endorsing this restriction. Making regulation that supports this restriction is a good example. Besides, the actions to excite ICT export and domestic markets should also be done in order to increase the

total outputs of the sectors. For example, making new types and improving the quality of ICT products. Making the competitive prices for these products is also another example. The combination of these actions can be done in order to achieve the optimal results.

On the other hand, based on the previous explanations, several similarities appear on the both conditions on the case of Indonesian. These similarities are 1) the biggest positive impact to the total outputs of Indonesian ICT sectors is delivered by the scenario 3, the change of households and non-profit private institutions consumptions, and 2) the scenario 2, the change of imports, gives the negative impact. These characteristics will be used as a foothold in suggesting the recommendations for the sectors.

Zuhdi et al. (2014d) described the suggestions for improving the ICT sectors of Indonesia, namely 1) to implement broadband internet service especially on the dense area, 2) to improve the mobile telecommunication access quality, 3) to improve the national postal service, 4) to improve the broadcasting services, and 5) to improve the activities regarding the ICT commodities export. These actions focus on the improvements so the demands from households and non-profit private institutions, and the activities of the export of these sectors are expected to increase.

The maneuver regarding the activities of the import of ICT sectors, however, has not been discussed by them. This maneuver is needed because, based on the previous explanations, the change of imports will give the negative impact. In other words, import activities regarding the products of ICT should be avoided if the increasing of total outputs of Indonesian ICT sectors is expected in the future.

Above logic is strengthened by the following explanation. Import activities tend to delimitate industrial sectors in producing more outputs. This situation will be worse if the import products have the higher competitiveness in the market. The consequence of this circumstance is the decreasing of the total outputs of the sectors in the future. Therefore, the policy regarding the import restriction on ICT products is needed in order to make sure the enhancement of the total outputs of the sectors.

Obviously, the import activities are still needed by ICT sectors of Indonesia. This fact seems especially on the ICT products which these sectors do not produce. In other words, the import restriction policy should focus on the products of ICT which the sectors have an ability to produce.

4. An Analysis of Dynamic Industrial Structural Changes: An Application of Structural Decomposition Analysis

4.1 The structural decomposition analysis: An analysis from the dynamic perspective

This Chapter analyzes the industrial structural changes using Structural Decomposition Analysis (SDA), one of the analysis tools in Input-Output (IO) analysis. This tool is chosen because it can observe the changes from the dynamic perspective. More specifically, it can analyze the position of a particular sector in the structural changes of a specific country from the dynamic view. As with Chapter 3, this study focuses on the Information and Communication Technology (ICT) sectors of Japan and Indonesia. The discussed objects in this part are also the 89 industrial sectors of Japan and 159 industrial sectors of Indonesia. The analysis period is also same with Chapter 3, namely 1995-2005 for the case of Japan while the case of Indonesia is 1990-2005.

The description of SDA was mentioned by Roy et al. (2004) as follows:

"*SDA is nowadays a common descriptive tool in studying changes over time. The central idea is that the change in some variable is decomposed, usually in an additive way, into the changes in its determinants. It thus becomes possible to quantify the underlying source of the changes.*"

The SDA model used in this Chapter refers to the standard growth factor decomposition equation which was suggested by Chenery and Syrquin. The description of this equation is as follows. This description is based on the explanation of Akita and Hau (2008).

The equation is based on the supply-demand balance formula for the national IO accounts, namely:

$$\mathbf{X} = \mathbf{AX} + \mathbf{D} + \mathbf{E} - \mathbf{M} \tag{4.1}$$

where **X**, **D**, **E**, and **M** are vectors of gross output, domestic final demands, exports, and imports, respectively. **A** is a matrix of technical coefficients. If one describes $\mathbf{M} = \hat{\mathbf{m}}(\mathbf{AX} + \mathbf{D})$, where $\hat{\mathbf{m}}$ is a diagonal matrix of import ratios, then one can modify the equation (4.1) as:

$$\mathbf{X} = \hat{\mathbf{p}}(\mathbf{AX} + \mathbf{D}) + \mathbf{E} \tag{4.2}$$

where $\hat{\mathbf{p}}$ is a diagonal matrix of domestic supply ratios and $\hat{\mathbf{p}} = \mathbf{I} - \hat{\mathbf{m}}$. One can get gross domestic outputs necessary to fulfill a specific level of domestic final demands and exports by solving the equation (4.2) for **X**:

$$\mathbf{X} = \mathbf{B}(\hat{\mathbf{p}}\mathbf{D} + \mathbf{E}) \tag{4.3}$$

where $\mathbf{B} = (\mathbf{I} - \hat{\mathbf{p}}\mathbf{A})^{-1}$ is the domestic Leontief inverse. In order to solve for the changes in gross outputs, $\Delta\mathbf{X} = \mathbf{X_t} - \mathbf{X}_0$, in terms of the changes in domestic and export demands and the changes in the two structural parameters, $\hat{\mathbf{p}}$ and **A**, the equation (4.3) can be written as:

$$\Delta\mathbf{X} = \mathbf{B}_t[\hat{\mathbf{p}}_t\Delta\mathbf{D} + \Delta\mathbf{E} + \Delta\hat{\mathbf{p}}(\mathbf{A}_0\mathbf{X}_0 + \mathbf{D}_0) + \hat{\mathbf{p}}_t\Delta\mathbf{A}\mathbf{X}_0] \tag{4.4}$$

An equation (4.4) is the standard growth factor decomposition formula suggested by Chenery and Syrquin. This equation can be written as:

$$\Delta\mathbf{X} = DD + EE + IS + IO \tag{4.5}$$

where $\Delta\mathbf{X}$, DD, EE, IS, and IO are the changes of gross outputs, the effects of the expansions of domestic final demands, the effects of the expansions of exports, the effects of the changes of import ratios (domestic supply ratios) or import substitutions, and the effects of the changes of technical coefficients, respectively.

Domestic final demands, DD, can be disaggregated into several factors. In this Chapter, this aspect is decomposed into four components. For Japanese case, these components are (1) the consumption expenditures of outside households, or DD1, (2) the consumption expenditures of privates, or DD2, (3) general government consumption expenditures, and the social fixed capital depreciation, or DD3, and (4) a fixed capital formation, and an increase in stocks, or DD4. For the case of Indonesia, DD1 explains the consumption expenditures of households and non-profit private institutions, DD2 is the consumption expenditures of profit private institutions, DD3 describes the government consumption expenditures, and DD4 elaborates a fixed capital formation, and the changes in stocks.

4.2 Existing literatures on Structural Decomposition Analysis

Many previous studies focused on SDA as a main discussion topic as well as a tool of analysis. For example, Dietzenbacher and Los (2000) examined the phenomenon of one variable changes into the changes in its determinants which several of the determinants are not independent. They used the decomposition of value added growth as an example. Kagawa and Inamura (2000), based on the rectangular IO framework, proposed a model of hybrid to assess the impacts of the changes in the energy demand structure, the IO structure of non-energy, and the non-energy final demand on energy intensities and total energy requirements. They decomposed the structure of the demand of an IO system into the structure of energy sectors and other sectors.

Dietzenbacher and Hoekstra (2000) analyzed the effects of technological change and trade on the output of industrial sectors in Netherlands by using structural decomposition. Kagawa et al. (2002), based on an IO system of inter-country, suggested a spatial structural decomposition analysis to assess the impacts of the changes in intra- and inter-country linkages on the embodied energy demand in analyzed countries. Their study focused on China and Japan. Besides, Mukhopadhyay (2002) explored the changes of CO_2 emissions in India during 1973-74 to 1996-97 using the SDA approach.

4.3 Application results

4.3.1 The case of Japan

Tables 4.1 and 4.2 explain top five sectors which were influential in the structural changes of Japanese national economy from 1995-2000 (the first period of Japan) and from 2000-2005 (the second period of Japan), respectively. For Japan, ICT sectors included among these sectors in both periods. In other words, from a macroscopic view, ICT sectors played an important role in shifting the structure of Japanese economy from 1995-2005, which suggests that these sectors were prioritized by Japanese government during this period. Further, the inclusion of ICT sectors on the list indicates that the government's strategies regarding ICT in Japan have been successful.

The values of decomposition factors on the case of Japan are shown in Table 4.3. DD3, general government consumption expenditures, and the social fixed capital depreciation, was the most influential decomposition factor in Japanese national economic structural changes from 1995-2000, whereas the effects of the expansions of exports, EE, was the most influential from 2000-2005. On the other hand, among the decomposition factors, the effects of the changes of import ratios, IS, was the factor making the smallest contribution to the structural changes in Japanese national economy over both periods. These findings indicate that Japanese government was very active in the first period of Japan, and that in the second period exporters played a more important role. Meanwhile, the negative value on import activities is natural because these

actions tend to decrease the allocation of domestic producers in making the outputs. Based on the values, one can argue that, from 1995-2005, the activities of the import of Japan increased.

4.3.2 The case of Indonesia

Tables 4.4 and 4.5 describe top five sectors which were influential in the structural changes of Indonesian national economy from 1990-1995 (the first period of Indonesia), and from 1995-2005 (the second period of Indonesia), respectively. In neither period, ICT sectors included among these sectors. In other words, ICT sectors, from a macro perspective, did not have an important role in the national economic structural changes of Indonesia from 1990-2005. This finding suggests that ICT sectors were not prioritized by Indonesian government during this period. As shown in the Tables, trade sector was found to be the industry that has the important role in the changes.

Table 4.1. Top five sectors which were influential in the structural changes of Japanese national economy, 1995-2000

No.	Sector number	Sector name	Value (100 million Yen)
1	74	Public administration	100,235.87
2	80	Advertising, survey, and information services	97,726.61
3	77	Medical service and health	80,261.19
4	72	Communication	70,072.69
5	47	Electrical appliance	37,315.73

(Source: Zuhdi et al., 2012)

Table 4.2. Top five sectors which were influential in the structural changes of Japanese national economy, 2000-2005

No.	Sector number	Sector name	Value (100 million Yen)
1	73	Broadcasting and information services	267,081.42
2	60	Commerce	112,557.90
3	48	Motor vehicles	103,839.35
4	37	Steel products	53,697.28
5	77	Medical service and health	50,620.37

(Source: Zuhdi et al., 2012)

Table 4.3. The values of decomposition factors on the case of Japan, 1995-2005

1995-2000		2000-2005	
Factor	Value (100 million Yen)	Factor	Value (100 million Yen)
DD3	246,766.38	EE	347,754.34
EE	232,406.54	IO	342,023.24
DD2	63,760.43	DD3	87,723.37
IO	8,621.51	DD2	-6,273.86
DD1	2,821.65	DD1	-12,068.56
DD4	2,653.06	DD4	-17,971.83
IS	-144,095.22	IS	-264,094.41

(Source: Zuhdi et al., 2012)

Table 4.4. Top five sectors which were influential in the structural changes of Indonesian national economy, 1990-1995

No.	Sector number	Sector name	Value (100 million Rupiah)
1	137	Trade	487,268.52
2	132	Residential and non-residential buildings	306,269.37
3	150	Business services	238,193.25
4	138	Restaurant	212,883.49
5	147	Banking and other financial intermediaries	202,307.68

(Source: Zuhdi et al., 2012)

The values of decomposition factors on the case of Indonesia are shown in Table 4.6. DD1, the consumption expenditures of households and non-profit private institutions, was the most influential decomposition factor on Indonesian national economy observed over both periods. On the other hand, among the decomposition factors, IS, the effects of the changes of import ratios, made the smallest contribution to the structural changes of Indonesian national economy from 1990-2005. This finding indicates that, on the analysis period, households and non-profit private institutions activities in Indonesian economy were very active. In other words, from 1990-2005, the government policy in Indonesia supported these activities. As with the previous explanation, the negative value on import activities is commonplace because these actions tend to decrease the quota of domestic producers in generating the outcomes. Based on the values,

one can argue that, from 1990-2005, the import activities of Indonesia increased. Figures 4.1 and 4.2 describe the movements of values of decomposition factors across the period of analysis for Japan and Indonesia, respectively. Meanwhile, Figure 4.3 illustrates the economic growth of ICT sectors of Japan from 1995 through 2005.

Table 4.5. Top five sectors which were influential in the structural changes of Indonesian national economy, 1995-2005

No.	Sector number	Sector name	Value (100 million Rupiah)
1	137	Trade	4,289,107.11
2	132	Residential and non-residential buildings	2,369,657.07
3	138	Restaurant	1,599,208.04
4	134	Public work on road, bridge, and harbor	1,437,422.16
5	31	Crude oil	1,396,709.27

(Source: Zuhdi et al., 2012)

Table 4.6. The values of decomposition factors on the case of Indonesia, 1990-2005

1990-1995		1995-2005	
Factor	Value (100 million Rupiah)	Factor	Value (100 million Rupiah)
DD1	4,414,603.56	DD1	27,534,509.96
DD4	1,910,534.32	EE	16,485,082.16
EE	1,376,896.92	DD4	13,304,316.77
DD3	261,721.65	DD3	3,544,379.13
IO	59,948.99	IO	465,733.05
DD2	0.00	DD2	0.00
IS	-1,767,594.64	IS	-14,468,174.20

(Source: Zuhdi et al., 2012, with slight modifications)

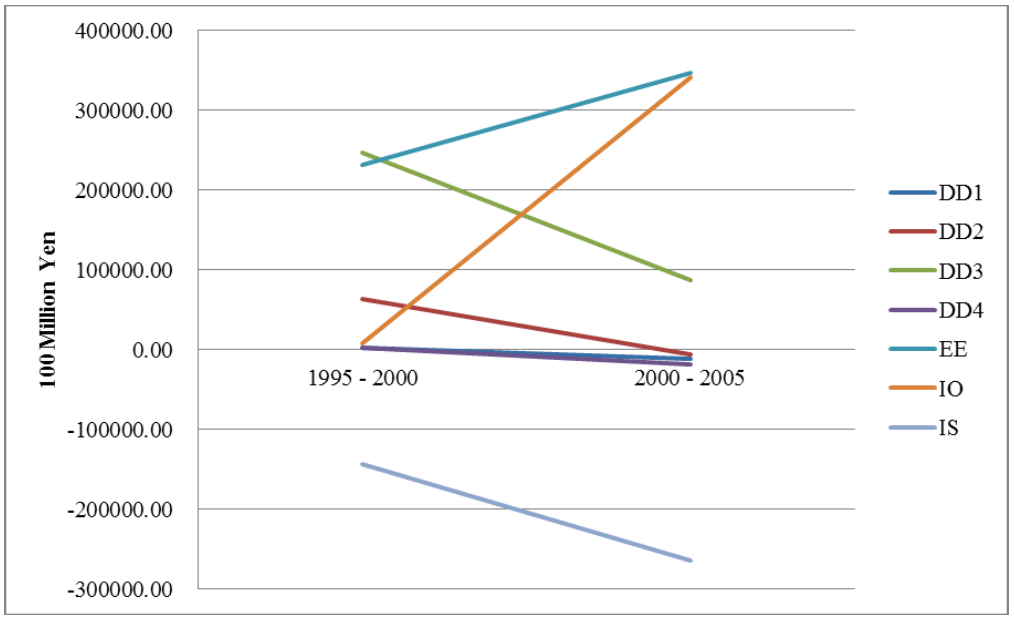

Figure 4.1. The movements of values of decomposition factors on the case of Japan (Source: Zuhdi et al., 2012)

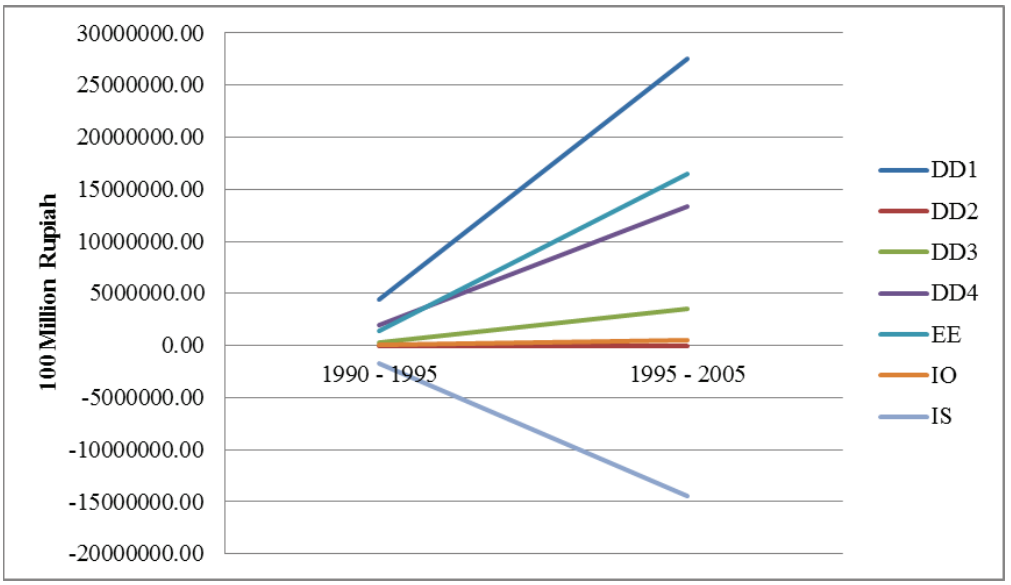

Figure 4.2. The movements of values of decomposition factors on the case of Indonesia (Source: Zuhdi et al., 2012, with slight modifications)

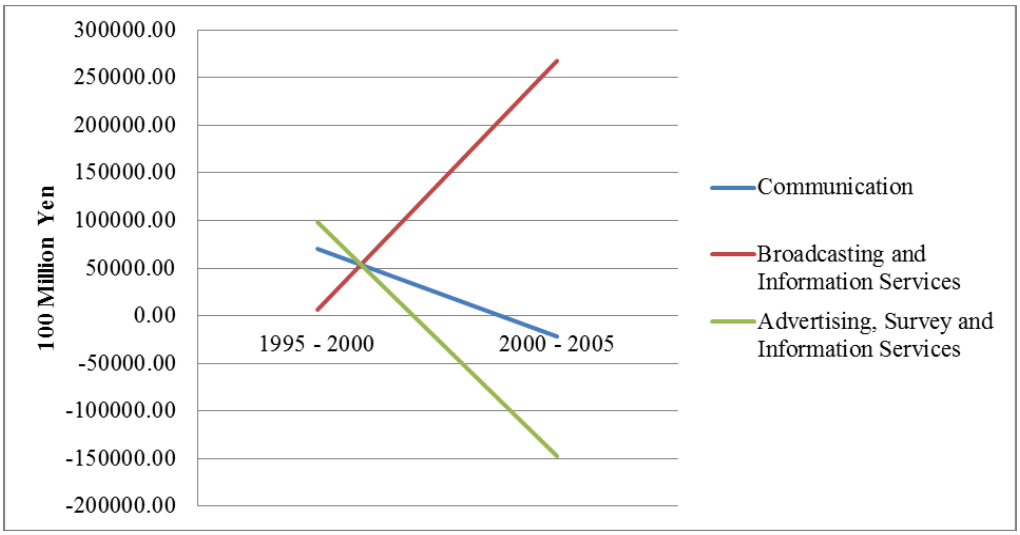

Figure 4.3. The economic growths of ICT sectors of Japan, 1995-2005 (Source: Zuhdi et al., 2012)

4.4 Findings

The results show that, from a macroscopic perspective, ICT sectors had an important role in changing the structures of the national economy in Japan, but not in Indonesia, during the 1990s and 2000s. This finding suggests that, during the periods, ICT sectors were not prioritized by Indonesian government. On the other hand, the opposite phenomenon was observed in the case of Japan, where the government played an important role in promoting ICT sectors during the analysis period.

The analysis of decomposition factors shows that, during the period of observation, the activities of households and non-profit private institutions in Indonesian economy were very active. Meanwhile, general government and social fixed capital depreciation activities were very active in Japanese economy from 1995-2000 and export maneuvers were especially active from 2000-2005. Both countries show that the import activities increased during the analysis period.

In the case of Japan, the technical coefficient (IO) was the decomposition factor that increased the most from 1995-2005. This phenomenon indicates that many new technologies were coming and developed over this period. Economic growths in most of the ICT sectors of Japan on the analysis period, however, showed the opposite trend. I have two arguments to describe these findings. First, ICT was not the focus of technological changes from 1995-2005. In other words, investment in ICT was not a priority of Japanese government during the period. Because the investment was not vigorous, the large improvement in the ICT sectors could not be achieved. Therefore, I find that, from 1995-2005, economic growths in most of the ICT sectors of Japan decreased.

Second, ICT widely spread during the period between 1995 and 2005. In other words, on this period, ICT products became more commonplace, resulting in declining on the prices of these commodities. This spread was the consequence of the vigorous investment in ICT during the period. Unfortunately, this investment was not balanced by the innovation. In other words, the market of ICT in Japan tended to be “flat”. Consequently, the demands for ICT products declined. This reduction probably impacted the economic growths of Japanese ICT sectors.

5. A Statistical Analysis of Industrial Structural Changes

5.1 The need for the statistical analysis: To know deeper the industrial structural changes

This Chapter analyzes the influences of Information and Communication Technology (ICT) penetration on the industrial structural changes of both analyzed countries using the statistical instrument. From the macroeconomic view, many existing studies discussed the relationship between ICT and economic aspects. For example, Murakami (1997) compared and reviewed the studies, and clarified some of the important aspects and mechanisms that measure the aggregate productivity of the investment of ICT. Ji and Su-Ling (2005) focused on macro- and economic oriented aspects as the means of assessing the effects of ICT on Asia-Pacific Economic Cooperation (APEC) economies. In addition, they conducted the deeper analysis on Taiwan.

Waema (2008) exposed several discussions regarding ICT in Kenya including the case study of the development of national ICT policy. His study was based on reviewing existing relevant documents and results of interviewing key persons involved in regional and national ICT policies in Kenya. Besides, Tsokota and von Solms (2013) determined the contribution of ICT on the turning-around of the economy of Zimbabwe. Their study was based on theoretical underpinnings, literature review, and reviewing Rwanda as a case study.

The above existing studies, however, have not explicitly investigated the industrial structural changes empirically. On the other hand, the Input-Output (IO) analysis described in Chapters 3 and 4 showed us the role of ICT sectors in Japanese and Indonesian industrial structural changes focusing on the IO coefficient changes. However, since the existing methods used in both Chapters have dealt with the resulted structures, the driving forces of these changes have not been discussed explicitly. The results of both Chapters showed that the role of the sectors is possible to change if the different method is applied. The results, however, only focused on the macroscopically observation. In other words, the deeper analysis regarding the causality of structural changes has not been analyzed by using the existing methods. This Chapter aims to conduct this analysis with proposing a new statistical method.

In this Chapter, I develop a Constrained Multivariate Regression (CMR) model as an analysis tool. A Likelihood Ratio Test (LRT) is used to evaluate the statistical significance of the model. This study considers two levels, macro and micro. At the macro level, this study analyzes the results of LRT calculations. On the other hand, at the micro level, this study analyzes the changes of IO coefficients.

5.2 The formulations of the statistical analysis of industrial structural changes

This subsection compares previous and proposed methods which analyze the influences of driving forces to the industrial structural changes of the specific country. Yoda and Mori (2001) proposed the method called extended Principal Component for Regression Analysis (PCR) based on the IO tables. This method, as written in Saito et al. (2002), is described as follows.

Let sector and explanatory variable numbers be N (n = 1..N) and M (m = 1..M) respectively. t denotes the period (t = 1..T). $\mathbf{a}_{tn}$ $(n\times 1)$ and $\mathbf{b}_{tn}$ $(m\times 1)$ vectors denote the input coefficient vector of the industry sector n (dependent variable vector) and explanatory variable vector, the part of the driving force, at period t, respectively. $\mathbf{a}_{tn}$ is non-negative and holds that the sum of the coefficients equals to unity. A linear relationship model between $\mathbf{a}_{tn}$ and $\mathbf{b}_{tn}$ is assumed by using the intermediate variable $\mathbf{z}_{pt}$ and the estimation error term $\mathbf{e}_{tn}$.

$$\begin{aligned} &\mathbf{a}_{tn} = \mathbf{c}_{0n} + \sum\nolimits_p z_{pt}\mathbf{c}_{pn} + \mathbf{e}_{tn} \\ &z_{pnt} = \boldsymbol{\beta}_{pn}{}^T\mathbf{b}_{tn}, \quad \sum\nolimits_n \mathbf{i}^T\mathbf{a}_{tn} = 1, \quad \mathbf{a}_{tn} \geq 0, \ \boldsymbol{\beta}_{pn}{}^T\boldsymbol{\beta}_{pn} = 1 \ \ (p = 1..P) \end{aligned} \tag{5.1}$$

where P (p = 1..P) represents the number of aggregated explanatory factors. The parameter vectors $\mathbf{c}_{pn}$ (p = 0…P) and $\boldsymbol{\beta}_{pn}$ are estimated in minimizing the sum of errors:

$$\min . \sum\nolimits_t \mathbf{e}_{tn}{}^T\mathbf{e}_{tn} \tag{5.2}$$

Employing a non-linear optimization technique, one can obtain the estimators.

I then propose a straightforward method in doing the calculation. The method is called CMR and also uses IO tables as data. The method is described as follows. In the beginning, I define the years of the analysis as T. Next, I define the data represent Japanese industrial structural changes, IO coefficient matrices, as *a(t)* t = 1…T. Further, in the calculation, the vectors of the IO coefficient are used. In other words, this model is applied to each industrial sector of Japan through its IO coefficient. The explanatory variables used can be described as *x(k,t)* k = 1…k. The following mathematical model, the representation of the CMR model, is employed as an elaboration of *a(t)*:

$$\begin{aligned} &a(i,t) = b0(i) + \sum\nolimits_k b(i,k)\times x(k,t) + e(i,t) \\ &a(i,t) \geq 0, \qquad \sum\nolimits_i a(i,t) = 1.0 \end{aligned} \tag{5.3}$$

where *b0(i)* and *b(i,k)* explain the regression coefficients of the model. Because the coefficients are non-negative and these summations should be unity by the definition, the constraints among estimators are imposed. *e(i,t)* explains the difference of original and estimated values. By least square method, $\min . \sum_i \sum_t e(i,t)^2$, one can obtain the parameters.

5.3 Analysis periods and aggregated sectors

The analysis period used in this Chapter is slightly different comparing with the one utilized in Chapters 3 and 4. This period difference emerges only on Japanese case. More specifically, the period of the analysis on the case of Japan in Chapters 3 and 4 was from 1995-2005 while this Chapter is from 1985-2005. The consequence of this difference can be seen on the utilized Japanese IO tables. In this Chapter, the tables for 1985, 1990, 1995, 2000, and 2005 are employed. The tables for 1985 and 1990 are obtained from the Management and Coordination Agency Government of Japan (1989, 1994). This period expansion aims to get the deeper understanding regarding the industrial structural changes happened in Japan. Besides, the expansion also facilitates the programming procedures which are executed by using General Algebraic Modeling System (GAMS) software, software for analyzing the high-level modeling system for optimization and mathematical programming (GAMS, n.d.).

Another consequence can be seen on the utilized aggregated sectors. The sectors employed in this Chapter are slightly different comparing with the ones used in Chapters 3 and 4. More specifically, the sectors used in both Chapters were 89 while for this Chapter are 78. These sectors can be seen in Table 5.1.

5.4 Application results

5.4.1 The case of Japan

5.4.1.1 An analysis of Japanese information & communication technology-influenced sectors

The methodology of this Chapter can be explained as follows. First, I do the calculation in order to get the IO coefficient matrices for each year in the analysis period. This coefficient was described in equation (2.2) by Miller and Blair (2009). More specifically, the equation is:

$$a_{ij} = \frac{z_{ij}}{X_j} \qquad (2.2)$$

where a_{ij}, z_{ij}, and X_j are the input needed by sector *j* from sector *i* to produce one unit of product, the inter-industry sales by sector *i* to sector *j*, and the total production of the sector *j*, respectively. Further, a_{ij} represents the IO coefficient from sector *i* to sector *j*.

Table 5.1. Japanese industrial sectors (78 sectors)

No.	Sector name
1	Crop cultivation
2	Livestock
3	Agricultural services
4	Forestry
5	Fisheries
6	Metallic ores
7	Non-metallic ores
8	Coal mining, crude petroleum, and natural gas
9	Foods
10	Beverages
11	Feeds and organic fertilizer not elsewhere classified
12	Tobacco
13	Textile products
14	Wearing apparel and other textile products
15	Timber and wooden products
16	Furniture and fixtures
17	Pulp and paper
18	Paper products
19	Publishing and printing
20	Chemical fertilizer
21	Basic industrial inorganic chemicals
22	Basic and intermediate chemical products
23	Synthetic resins
24	Synthetic fibers
25	Final chemical products not elsewhere classified
26	Petroleum refinery products
27	Coal products
28	Plastic products
29	Rubber products
30	Leather, fur, skins, and miscellaneous leather products
31	Glass and glass products
32	Cement and cement products

33	Pottery, china, and earthenware
34	Other ceramic, stone, and clay products
35	Pig iron and crude steel
36	Steel products
37	Steel castings and forgings, and other steel products
38	Non-ferrous metals
39	Non-ferrous metal products
40	Metal products for construction and architecture
41	Other metal products
42	General industrial machinery
43	Special industrial machinery
44	Other general machines
45	Machinery for office and service industry
46	Electrical appliance
47	Motor vehicles and repair of motor vehicles
48	Ships and repair of ships
49	Other transportation equipment and repair of transportation equipment
50	Precision instruments
51	Miscellaneous manufacturing products
52	Building construction
53	Repair of construction
54	Civil
55	Electricity
56	Gas and heat supply
57	Water supply
58	Waste management service
59	Commerce
60	Finance and insurance
61	Real estate agencies and rental services
62	House rent
63	Railway
64	Road transport (except transport by private cars)
65	Self-transport by private cars
66	Water transport
67	Air transport

68	Storage facility service
69	Services relating to transport
70	Communication
71	Broadcasting
72	Public administration and activities not elsewhere classified
73	Education
74	Research
75	Medical service, health, and social security
76	Other public services
77	Business services and office supplies
78	Personal services

(Source: Zuhdi et al., 2014b with the slight modification)

Second, I calculate the influences of explanatory variables used in this Chapter, computers (main parts and accessories) and telecommunication equipment, on Japanese industrial structural changes. These variables describe the ICT capital stocks. The changes are represented by the dynamic changes in IO coefficient vectors extracted from IO tables. I use a CMR model to conduct this calculation. The data of the variables are obtained from the website of the Japanese Ministry of Internal Affairs and Communications (n.d.). As with the main data, the periods of the variables data are 1985, 1990, 1995, 2000, and 2005.

Third, I test the statistical significance of estimators in the fitted model using LRT method. This method is based on the calculation formula of $-2N(\ln S - \ln S_0)$, where N and S are the numbers of data and the results of the performance function optimization, respectively. N is given by $K \times M \times T$ where K, M, and T are the numbers of sectors which give the inputs for discussed sector(s), the number(s) of discussed sector(s), and the numbers of periods, respectively. The degree of freedom is given by $(K - 1) \times M \times$(the number(s) of the removed explanatory variable(s)). The statistical significance of the explanatory variable is given by the formula which follows the $\chi 2$ distribution. In this Chapter, I take 0.05 as the level of significance. Therefore, I use the 0.05 level of the $\chi 2$ distribution in performing the test.

The value of the degree of freedom used for the case of Japan is $78 \times 1 \times 2 = 156$ for the joint explanatory variables and $78 \times 1 \times 1 = 78$ for the separate explanatory variables. The cutoff scores for the statistical significance are $\chi^2_{0.05}(156) = 185.86$ and $\chi^2_{0.05}(78) = 99.33$. I use these scores to investigate the statistical significance of the explanatory variables on each Japanese industrial sector. A particular explanatory variable is called to significantly influence a specific

sector if its significance score is greater than the cutoff score. I use three null hypotheses to emphasize the results of this test, namely:

- **Hypothesis 1:** Computers had no influences on the structural changes of Japanese industrial sectors from 1985-2005.
- **Hypothesis 2:** Telecommunications equipment had no influences on the structural changes of Japanese industrial sectors from 1985-2005.
- **Hypothesis 3:** Computers and telecommunications equipment jointly had no influences on the structural changes of Japanese industrial sectors from 1985-2005.

Previous calculation steps can be simplified as follows. In the beginning, I describe the original data of the five points period of the IO coefficient matrices of 78 Japanese industrial sectors as *A(t,i,j)*. The vectors of explanatory variables, *Ex_x(k,t)*, are used as the source of influences for the data. I use the CMR model in order to calculate the influences of these variables on Japanese industrial structural changes in the analysis period. I then describe the influenced original IO coefficient matrices as estimated IO coefficient matrices, *A_est(t,i,j)*. In this Chapter, GAMS software is used on the calculation. The GAMS program used in Japanese case can be seen in Appendix 1. The test using LRT method is done in the next step. The purpose of this test is to know the statistical significance of estimators in the fitted model.

Fourth, I do the deeper investigation, the microscopic investigation, which focuses on the ICT-influenced sectors. These sectors are described in Table 5.2. The reason for choosing these sectors is because the explanatory variables seem to directly impact their transaction activities. The term of "microscopic" describes that the investigation focuses on the more detailed aspects. I then calculate the standard deviation of the original IO coefficients of the sectors as a first step of the investigation. The calculation for the estimated IO coefficients is ignored because the results of this calculation generally follow the previous one. The purpose of this calculation is to know the magnitude of the changes of original IO coefficients over the period of the analysis. For each discussed sector, I choose the top ten IO coefficients which have the highest standard deviations. The reason why I choose these coefficients is because their values are higher than the internal average value. The coefficients represent the inputs which have the dynamic change. From the coefficients I choose the one which have an increasing pattern on the original data as a target for the analysis. I also discuss the input changes from value added to analyzed sectors. The coefficients of the variation, and the amount of the correlation (R) are used to gain the deeper insights regarding the influences of the variables on the discussed sectors.

Table 5.2. Japanese ICT-influenced sectors

No.	Sector number	Sector name
1	59	Commerce
2	77	Business services and office supplies
3	78	Personal services

The results of this discussion are described as follows. I firstly conduct the LRT calculation to estimate the CMR model. I show the detailed results in Appendix 2. The summary of this calculation is described in Table 5.3. From the information in this Table, I can argue that computers significantly influenced the structural changes of the majority of Japanese industrial sectors from 1985-2005. The exceptions are seen for the petroleum refinery products, coal products, and steel products sectors. The similar results are obtained for the influences of telecommunications equipment, which significantly influenced the structural changes of all Japanese industrial sectors from 1985-2005 except for the non-metallic ores, basic and intermediate chemical products, and gas and heat supply sectors. Because both explanatory variables significantly influenced the structural changes of the majority of Japanese industrial sectors from 1985-2005, I reject first and second null hypotheses. The combination of explanatory variables used significantly influenced the structural changes of all Japanese industrial sectors from 1985-2005. This is a stronger result than the previous one. Based on this result, I then reject the third null hypothesis.

Table 5.3. The summary of the LRT calculations (null model base), Japanese case

No.	Explanatory variable	The numbers of sectors which were significantly influenced	The numbers of sectors which were not significantly influenced
1	Computers	75	3
2	Telecommunications equipment	75	3
3	Combination of both	78	0

(Source: Zuhdi et al., 2013a, with the slight modifications)

Table 5.4 describes the top ten original IO coefficients of the commerce sector which were determined by the standard deviation during 1985-2005. Based on the information in this Table, the most dynamic input is the one from the real estate agencies and rental services sector, sector

number 61. For analysis, I choose $a_{70,59}$, the IO coefficient that describes the input from communication to commerce sectors, because this coefficient had an increasing pattern.

Figure 5.1 shows the changes in $a_{70,59}$ for 1985-2005. The numbers in this Figure and other ones represent the analysis years, namely 1985, 1990, 1995, 2000, and 2005, respectively. Table 5.5 shows the coefficients of the variation of the original and estimated values of this coefficient, and the correlation between these values over the same period. These results indicate that our model well follows the historical changes. In other words, during 1985-2005, the explanatory variables had a strong influence on $a_{70,59}$.

Table 5.4. Top ten original IO coefficients of the commerce sector which were viewed from the standard deviation value (1985-2005)

No.	IO coefficient	Standard deviation	Mean
1	$a_{61,59}$	0.0094	0.0376
2	$a_{71,59}$	0.0082	0.0037
3	$a_{65,59}$	0.0079	0.0314
4	$a_{60,59}$	0.0074	0.0529
5	$a_{77,59}$	0.0055	0.0607
6	$a_{70,59}$	0.0038	0.0203
7	$a_{59,59}$	0.0037	0.0147
8	$a_{19,59}$	0.0029	0.0081
9	$a_{55,59}$	0.0021	0.0103
10	$a_{26,59}$	0.0016	0.0023

(Source: Zuhdi et al., 2013a, with the slight modification)

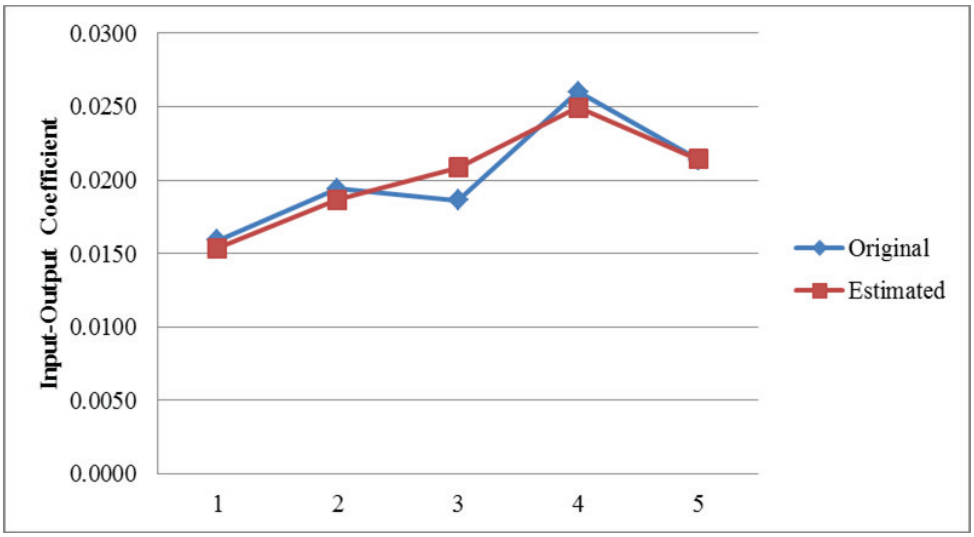

Figure 5.1. Changes in $a_{70,59}$ from 1985-2005 (Source: Zuhdi et al., 2013a)

Table 5.5. The coefficients of the variation of the original and estimated values of $a_{70,59}$, and the correlation (R) of both values (1985-2005)

The coefficients of the variation		Correlation
Original	Estimated	
0.186	0.174	0.936

(Source: Zuhdi et al., 2013a, with the slight modifications)

Changes in $a_{70,59}$ indicate that, during 1985-2005, ICT devices strengthened the relationship between commerce and communication sectors. The role of these devices in this relationship can be explained as follows. The commerce sector needs communication services, such as postal and mail delivery services, to conduct its business activities. The communication sector, as an outsider, can provide these services. As time passes, quality and quantity of ICT devices significantly increase. The emergence of computers and telecommunications equipment is an evidence of this growth. These tools enhance the intensity of the cooperation between commerce and communication sectors, especially the input from the communication sector, because the instruments expedite the flow of information between both sectors.

Figure 5.2 shows the changes of $a_{79,59}$, the input from value added to commerce sectors, during 1985-2005. This Figure shows an increasing–decreasing pattern. Table 5.6 shows the coefficients of the variation of the original and estimated values of this coefficient, and the correlation between these values over the same period. These results suggest that, during 1985-2005, the explanatory variables had a strong influence on $a_{79,59}$.

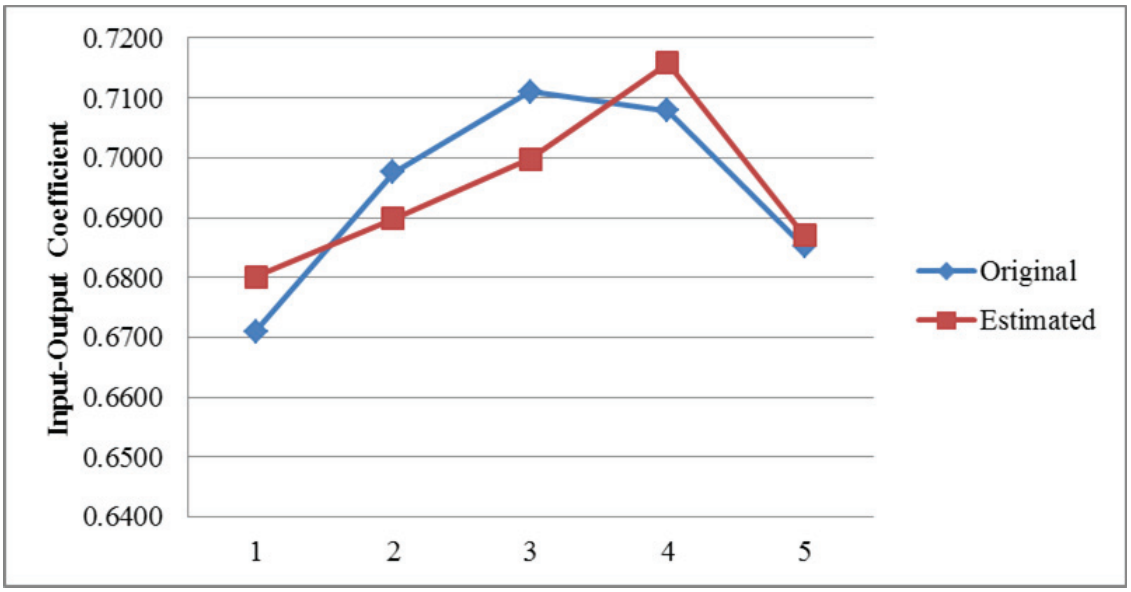

Figure 5.2. Changes in $a_{79,59}$ from 1985-2005 (Source: Zuhdi et al., 2013a)

Table 5.6. The coefficients of the variation of the original and estimated values of $a_{79,59}$, and the correlation (R) of both values (1985-2005)

The coefficients of the variation		Correlation
Original	Estimated	
0.024	0.020	0.833

(Source: Zuhdi et al., 2013a, with the slight modifications)

The increasing of the input from value added to particular sectors implies that the goods price of this sector will rise. Therefore, Figure 5.2 suggests that, during 1985-1995, the price of the commerce sector outputs increased. This pattern, refers to the original data of this IO coefficient, not continued in the following analysis years. From the estimated data for this IO coefficient, however, this pattern continued until 2000. This fact shows that ICT devices should have a positive impact on the increasing of the commerce sector output price from 1985-2000.

I believe that an increasing pattern in the estimated $a_{79,59}$ during 1995-2000 appeared due to the economic conditions. The unemployment rate in Japan continuously rose during the slow growth years, further accelerating in 1999 (United Nations, 2000). Therefore, in this period, Japanese sectors should have taken the steps to maintain good quality outputs and attractive prices without adding the employee numbers. ICT devices, which are represented by computers and telecommunications equipment, can support the sectors through, for example, to support the

quality assurance activities. However, these devices installation costs can be high, so the sectors need to preserve an attractive price to maintain the cash flow balances when these devices are employed. This argument explains the increasing pattern in the estimated $a_{79,59}$ in 1995-2000.

Table 5.7 shows the top ten original IO coefficients of the business services and office supplies sector, relative to the standard deviation during 1985-2005. This Table shows that the most dynamic input is the input from the publishing and printing sector, sector number 19. For analysis, I choose the $a_{60,77}$ IO coefficient, which describes the input from finance and insurance to business services and office supplies sectors, because this coefficient had an increasing pattern.

Figure 5.3 shows the changes in $a_{60,77}$ during 1985-2005. Table 5.8 shows the coefficients of the variation of the original and estimated values of this coefficient, and the correlation of these values over the same period. These results suggest that our model well follows the historical changes. In other words, during 1985-2005, the explanatory variables had a strong influence on $a_{60,77}$.

Table 5.7. Top ten original IO coefficients of the business services and office supplies sector which were viewed from the standard deviation value (1985-2005)

No.	IO coefficient	Standard deviation	Mean
1	$a_{19,77}$	0.0291	0.0431
2	$a_{71,77}$	0.0237	0.0427
3	$a_{47,77}$	0.0116	0.0213
4	$a_{60,77}$	0.0087	0.0396
5	$a_{77,77}$	0.0086	0.1038
6	$a_{18,77}$	0.0078	0.0141
7	$a_{46,77}$	0.0071	0.0163
8	$a_{61,77}$	0.0051	0.0120

9	$a_{43,77}$	0.0047	0.0071
10	$a_{42,77}$	0.0040	0.0066

(Source: Zuhdi et al., 2013a, with the slight modification)

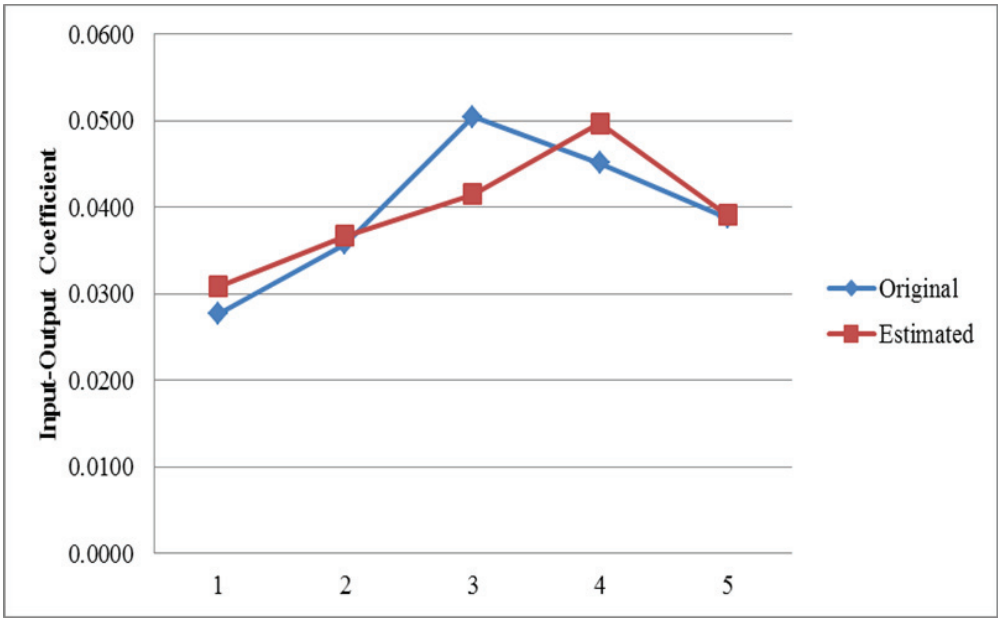

Figure 5.3. Changes in $a_{60,77}$ from 1985-2005 (Source: Zuhdi et al., 2013a)

Table 5.8. The coefficients of the variation of the original and estimated values of $a_{60,77}$ and the correlation (R) of both values (1985-2005)

The coefficients of the variation		Correlation
Original	Estimated	
0.221	0.175	0.793

(Source: Zuhdi et al., 2013a, with the slight modifications)

Changes in $a_{60,77}$ indicate that, during 1985-2005, ICT devices supported the relationship between finance and insurance, and business services and office supplies sectors. An interesting condition occurred during 1995-2000, namely a decreasing pattern was observed in the original data, but an increasing pattern appears in the estimated data. I believe that this difference is due to the economic condition of Japan during this period. As mentioned above, the unemployment

rate in Japan increased further in 1999. Clearly, both sectors were also influenced by this condition. The sectors that experiences this condition need to search the ways to increase their performance, including providing the good service, without adding the employee numbers. Using ICT devices, such as computers and telecommunications equipment, are one of the ways. These devices can reduce the human errors and thus will help to maintain their performance. This may be a factor behind the increasing pattern in the estimated $a_{60,77}$ in 1995-2000.

Figure 5.4 shows the changes in $a_{79,77}$, the input from value added to business services and office supplies sectors during 1985-2005. This Figure shows that, generally, the increasing pattern appeared in this coefficient. Table 5.9 shows the coefficients of the variation of the original and estimated values of this coefficient, and the correlation of these values over the same period. These results suggest that our model well follows the historical changes. In other words, during 1985-2005, the explanatory variables had a strong influence on $a_{79,77}$.

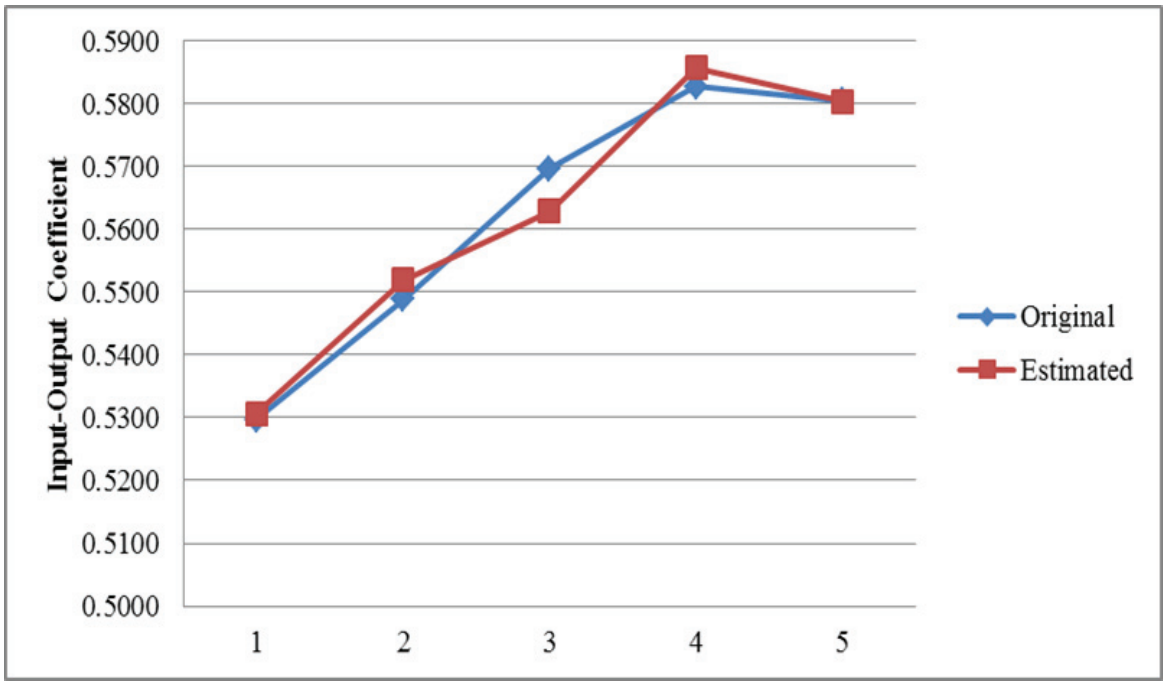

Figure 5.4. Changes in $a_{79,77}$ from 1985-2005 (Source: Zuhdi et al., 2013a)

Table 5.9. The coefficients of the variation of the original and estimated values of $a_{79,77}$, and the correlation (R) of both values (1985-2005)

The coefficients of the variation		Correlation
Original	Estimated	
0.040	0.040	0.984

(Source: Zuhdi et al., 2013a, with the slight modifications)

The increasing of the input from value added to particular sectors suggests that the goods price of this sector will rise. Therefore, Figure 5.4 explains that, during 1985-2000, the price of the outputs of the business services and office supplies sector increased. In 2000-2005, a slight decrease appeared. Both original and estimated IO coefficients in this Figure show the same pattern, suggesting that ICT devices had a positive impact on the increasing of the price of the goods of the business services and office supplies sector, especially during 1985-2000.

Table 5.10 shows the top ten original IO coefficients of the personal services sector, relative to the standard deviation during 1985-2005. This Table shows that the most dynamic input is the input from the commerce sector, sector number 59. For analysis, I choose the IO coefficient that describes the input from this industry to the personal services sector, $a_{59,78}$, because this coefficient had an increasing pattern.

Table 5.10. Top ten original IO coefficients of the personal services sector which were viewed from the standard deviation value (1985-2005)

No.	IO coefficient	Standard deviation	Mean
1	$a_{59,78}$	0.0124	0.0546
2	$a_{77,78}$	0.0077	0.0357
3	$a_{78,78}$	0.0057	0.0165
4	$a_{71,78}$	0.0055	0.0044
5	$a_{61,78}$	0.0051	0.0199

6	$a_{72,78}$	0.0039	0.0053
7	$a_{60,78}$	0.0038	0.0202
8	$a_{26,78}$	0.0031	0.0050
9	$a_{10,78}$	0.0029	0.0367
10	$a_{58,78}$	0.0029	0.0084

(Source: Zuhdi et al., 2013a, with the slight modification)

Figure 5.5 shows the changes in $a_{59,78}$ during 1985-2005. Table 5.11 shows the coefficients of the variation of the original and estimated values of this coefficient, and the correlation of these values over the same period. These results suggest that our model well follows the historical changes. In other words, during 1985-2005, the explanatory variables had a strong influence on $a_{59,78}$.

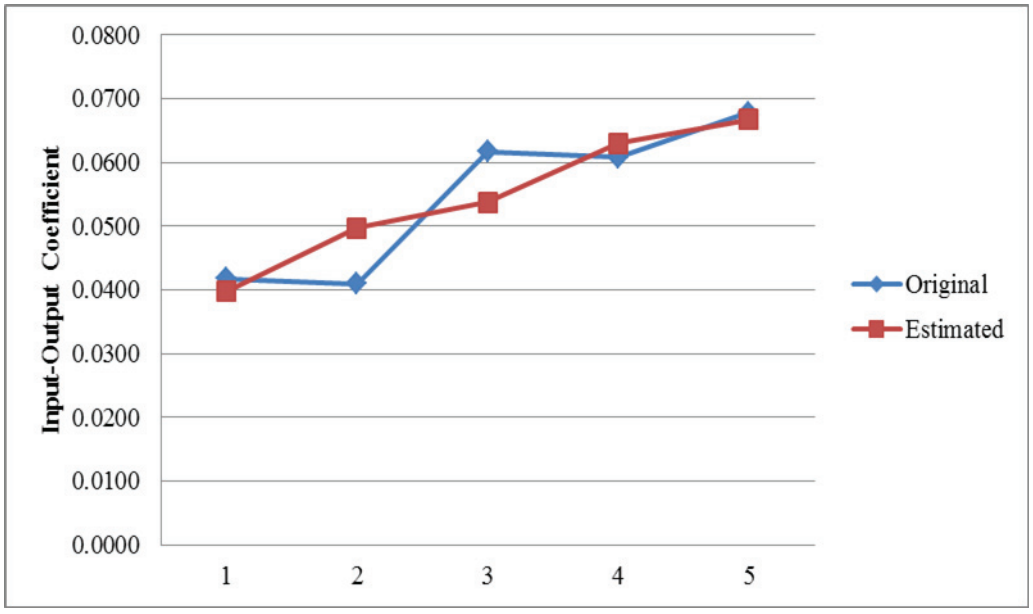

Figure 5.5. Changes in $a_{59,78}$ from 1985-2005 (Source: Zuhdi et al., 2013a)

Table 5.11. The coefficients of the variation of the original and estimated values of $a_{59,78}$, and the correlation (R) of both values (1985-2005)

The coefficients of the variation		Correlation
Original	Estimated	
0.227	0.197	0.868

(Source: Zuhdi et al., 2013a, with the slight modifications)

Changes in $a_{59,78}$ indicate that, during 1985-2005, ICT devices well supported the relationship between commerce and personal services sectors. An increasing pattern clearly appeared in this period, in both original and estimated data. I believe that this pattern appears because of the characteristics of the personal services sector. This sector needs a "field" to market its products, and the commerce sector provides this. Figure 5.5 suggests that the support from the commerce sector increased from 1985-2005. ICT devices, especially computers, promote this connection because they can expedite the flow of information. In other words, these devices strengthen business activities happen between the sectors.

Figure 5.6 describes the changes in $a_{79,78}$, the input from value added to personal services sectors, from 1985-2005. This Figure shows that, generally, decreasing pattern appeared in this coefficient in the analysis period. Table 5.12 shows the coefficients of the variation of the original and estimated values of this coefficient, and the correlation of these values over the same period. These results suggest that our model well follows the historical changes. In other words, during 1985-2005, the explanatory variables had a strong influence on $a_{79,78}$.

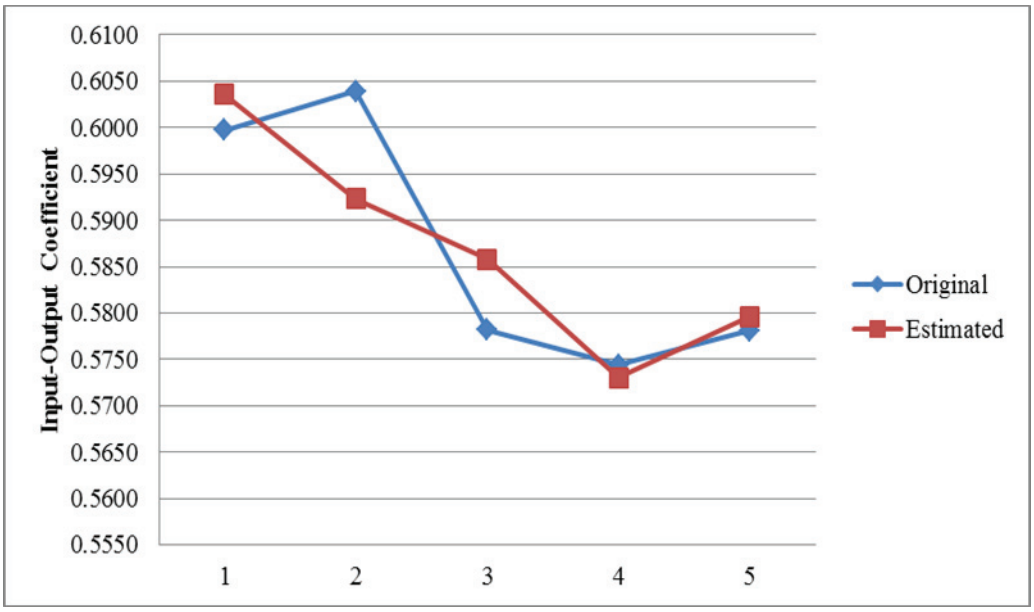

Figure 5.6. Changes in $a_{79,78}$ from 1985-2005 (Source: Zuhdi et al., 2013a)

Table 5.12. The coefficients of the variation of the original and estimated values of $a_{79,78}$, and the correlation (R) of both values (1985-2005)

The coefficients of the variation		Correlation
Original	Estimated	
0.024	0.020	0.851

(Source: Zuhdi et al., 2013a, with the slight modifications)

The decreasing of the input from value added to particular sectors suggests that the goods price of this sector will fall. Therefore, Figure 5.6 describes that, during 1985-2000, the output price of the personal services sector tended to decrease. I suggest that this downturn appeared due to the adoption of ICT devices in the personal services sector. The sectors that utilize ICT devices in production activities will be more efficient than the ones that do not. This efficiency will reduce the operating costs. Further, this reduction will decrease the prices of products. In other words, the sectors that utilize ICT devices in their business activities will be more competitive in the market than the ones that do not.

5.4.1.2 An Analysis of Japanese energy sectors

I also investigate the influences of ICT on the structural changes of Japanese energy sectors. As with the previous discussion, the explanatory variables used in this discussion are computers

(main parts and accessories) and telecommunication equipment. The analysis period is also same, namely from 1985-2005. This investigation focuses on the joint variables. The analyzed sectors in this discussion are described in Table 5.13. The hypotheses of this discussion are:

- **Hypothesis 1:** Computers and telecommunications equipment jointly had no influence on the structural changes of Japanese coal mining, crude petroleum, and natural gas sector from 1985-2005.
- **Hypothesis 2:** Computers and telecommunications equipment jointly had no influence on the structural changes of Japanese petroleum refinery products sector from 1985-2005.
- **Hypothesis 3:** Computers and telecommunications equipment jointly had no influence on the structural changes of Japanese coal products sector from 1985-2005.

Table 5.13. Japanese energy sectors

No.	Sector number	Sector name
1	8	Coal mining, crude petroleum, and natural gas
2	26	Petroleum refinery products
3	27	Coal products

(Source: Zuhdi et al., 2014c)

The results of this discussion are described as follows. Table 5.14 describes the summary of the LRT calculation for this discussion. From the information in this table, I can argue that the combination of explanatory variables used in this study had the significant influences on the structural changes of all Japanese energy sectors on the period of the analysis. Therefore, I reject all null hypotheses in this discussion.

From Table 5.14 I can also see that the sector which gets the highest influence from above combination is the coal products. On the other hand, the lowest influence value is owned by the petroleum refinery products sector. The discussions about the influences of explanatory variables used in this study in micro level are described on the following explanations.

Table 5.14. The summary of the LRT calculation for Japanese energy sectors

No.	Sector name	The statistical significance ($\chi 2$) of the combination of explanatory variables	The influence of explanatory variables
1	Coal mining, crude petroleum, and natural gas	943.20	Significant
2	Petroleum refinery products	519.86	Significant
3	Coal products	1581.89	Significant

(Source: Zuhdi et al., 2014c, with the slight modification)

Table 5.15 describes the top ten original IO coefficients of the coal mining, crude petroleum, and natural gas sector which were viewed from the value of the standard deviation during 1985-2005. From the information in this Table, I can argue that the most dynamic input is the input from the business services and office supplies sector, sector number 77. I choose $a_{60,08}$, IO coefficient describes the input from finance and insurance to coal mining, crude petroleum, and natural gas sectors, as a source of the analysis because this coefficient had an increasing pattern.

Table 5.15. Top ten original IO coefficients of the coal mining, crude petroleum, and natural gas sector which were viewed from the standard deviation value (1985-2005)

No.	IO coefficient	Standard deviation	Mean
1	$a_{77,08}$	0.0255	0.0614
2	$a_{55,08}$	0.0080	0.0730
3	$a_{60,08}$	0.0076	0.0492
4	$a_{44,08}$	0.0076	0.0040
5	$a_{74,08}$	0.0070	0.0137
6	$a_{36,08}$	0.0056	0.0100

7	$a_{72,08}$	0.0054	0.0211
8	$a_{70,08}$	0.0047	0.0162
9	$a_{08,08}$	0.0044	0.0025
10	$a_{41,08}$	0.0040	0.0258

(Source: Zuhdi et al., 2014c, with the slight modifications)

Figure 5.7 explains the changes of $a_{60,08}$ from 1985-2005. Table 5.16 shows the coefficients of the variation of the original and estimated values of this coefficient, and the correlation of these values on the analysis period. From these results I can observe that our model well follow the historical changes. In other words, I can argue that, during 1985-2005, explanatory variables had a strong influence in $a_{60,08}$.

The phenomenon in $a_{60,08}$ indicates that, during 1985-2005, ICT devices have strengthened the relationship between coal mining, crude petroleum, and natural gas and finance and insurance sectors. The role of these devices in this relationship can be described as follows. In this period, a flare-up condition happened in the world economic circumstances. This turbulent happened especially because of the end of Cold and Gulf wars. The increasing of the price of the crude oil before these wars finish was the evidence. The contribution of the finance and insurance sector to the coal mining, crude petroleum, and natural gas sector reaffirms that the management of the primary energy supply in the global market during this period was complicated. ICT devices could support this management because it could increase the security when the business transactions regarding energy happened in this period.

Besides, quality and quantity of ICT tools significantly move forward over time. For example, Internet has been expanded and penetrated very rapidly in 1990's as the price of personal computers went down rapidly. Clearly, these technological innovations as well as the software development have influenced the business structures. The consequence of the enhancement is the increasing of the intensity of the cooperation between above sectors. In other words, during the analysis period, the relationship between the industries became stronger because of the growth of ICT instruments.

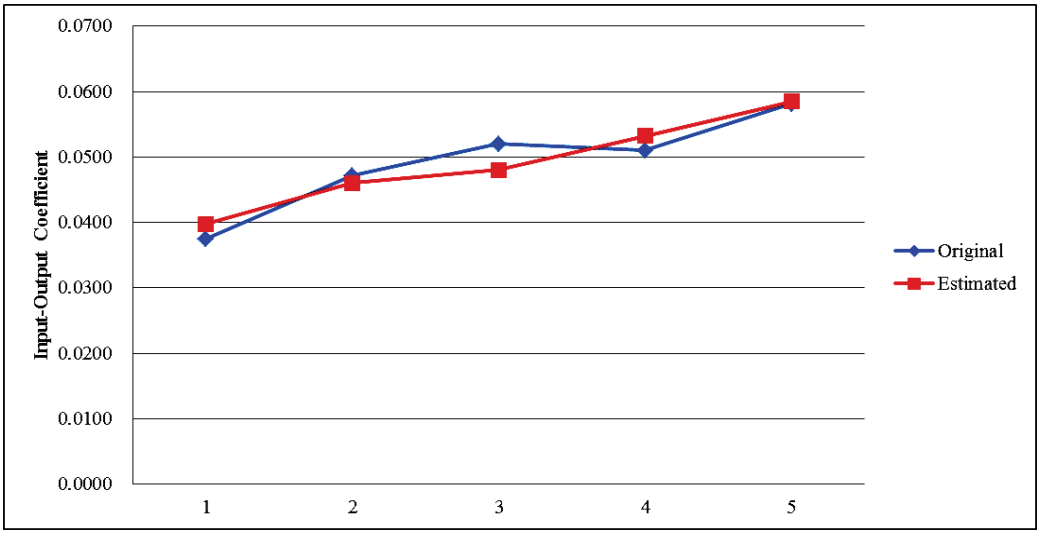

Figure 5.7. Changes in $a_{60,08}$ from 1985-2005 (Source: Zuhdi et al., 2014c)

Table 5.16. The coefficients of the variation of the original and estimated values of $a_{60,08}$, and the correlation (R) of both values (1985-2005)

The coefficients of the variation		Correlation
Original	Estimated	
0.155	0.145	0.939

(Source: Zuhdi et al., 2014c, with the slight modifications)

Table 5.17 shows the top ten original IO coefficients of the petroleum refinery products sector which were viewed from the value of the standard deviation during 1985-2005. From the information in this Table, the most dynamic input is the input from the coal mining, crude petroleum, and natural gas sector, sector number 8. I choose $a_{68,26}$, IO coefficient describes the input from storage facility service to petroleum refinery products sectors, as a source of the analysis because this coefficient had an increasing pattern.

Figure 5.8 explains the changes of $a_{68,26}$ from 1985-2005. Table 5.18 shows the coefficients of the variation of the original and estimated values of this coefficient, and the correlation of these values on the period of the analysis. From these results I can observe that our model well follow the historical changes. In other words, I can argue that, during 1985-2005, explanatory variables had a strong influence in $a_{68,26}$.

Phenomenon in $a_{68,26}$ indicates that, during 1985-2005, ICT tools have strengthened the relationship between petroleum refinery products and storage facility service sectors. The role of these tools in this relationship can be described as follows. During the analysis period, the

petroleum refinery products sector needed places and assistances for keeping its outputs. In other words, the management of the energy security was an important aspect in this period. Rapid price and political events changes in this period reaffirmed this need. The storage facility service sector, as an outsider, could provide the services. ICT tools could bridge this relationship because these could monitor the commodities all day. Consequently, the products safety could be guaranteed. Besides, using the instruments, the products condition could be easily checked.

Quality and quantity of ICT devices will be better over time. The consequence of this improvement is the increasing of the level of the cooperation between above sectors. In other words, the relationship between the industries during the analysis period became deeper because of the growth of the devices.

Table 5.19 shows the top ten original IO coefficients of the coal products sector which were viewed from the value of the standard deviation during 1985-2005. From the information in this Table, the most dynamic input is the input from the coal mining, crude petroleum, and natural gas sector, sector number 8. I choose $a_{59,27}$, IO coefficient describes the input from commerce to coal products sectors, as a source of the analysis because this coefficient had an increasing pattern.

Table 5.17. Top ten original IO coefficients of the petroleum refinery products sector which were viewed from standard deviation value (1985-2005)

No.	IO coefficient	Standard deviation	Mean
1	$a_{08,26}$	0.1079	0.4996
2	$a_{26,26}$	0.0140	0.0344
3	$a_{59,26}$	0.0067	0.0130
4	$a_{60,26}$	0.0059	0.0144
5	$a_{68,26}$	0.0047	0.0081
6	$a_{66,26}$	0.0042	0.0089
7	$a_{77,26}$	0.0033	0.0064

8	$a_{44,26}$	0.0021	0.0009
9	$a_{46,26}$	0.0018	0.0008
10	$a_{74,26}$	0.0015	0.0031

(Source: Zuhdi et al., 2014c, with the slight modifications)

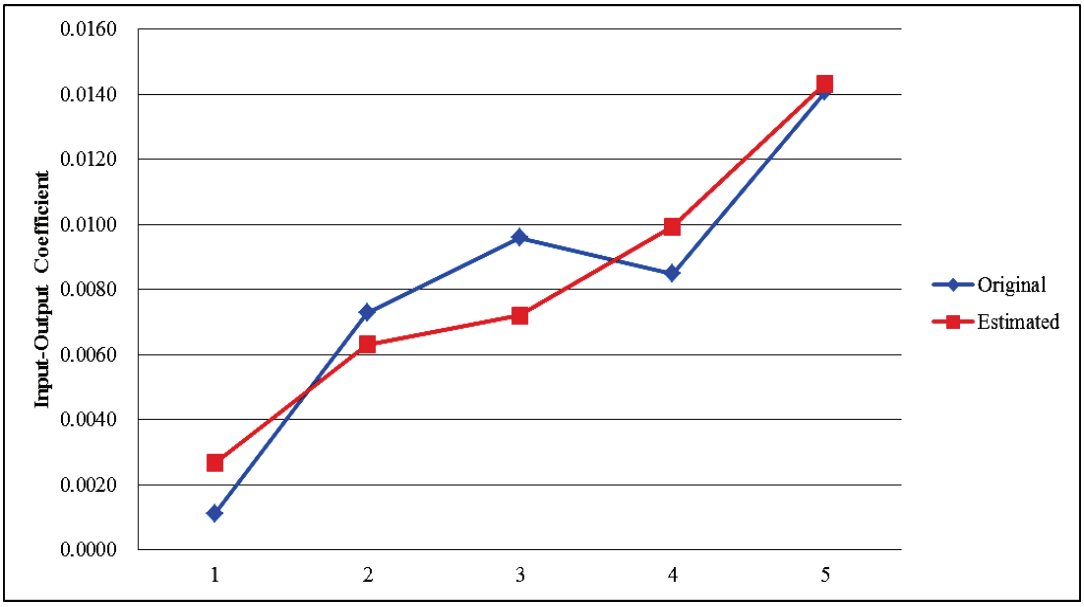

Figure 5.8. Changes in $a_{68,26}$ from 1985-2005 (Source: Zuhdi et al., 2014c)

Table 5.18. The coefficients of the variation of the original and estimated values of $a_{68,26}$, and the correlation (R) of both values (1985-2005)

The coefficients of the variation		Correlation
Original	Estimated	
0.578	0.539	0.934

(Source: Zuhdi et al., 2014c, with the slight modifications)

Figure 5.9 explains the changes of $a_{59,27}$ from 1985-2005. Table 5.20 shows the coefficients of the variation of the original and estimated values of this coefficient and, the correlation of these values on the period of the analysis. From these results I can observe that our model well

follow the historical changes. In other words, I can argue that, during 1985-2005, explanatory variables had a strong influence in $a_{59,27}$.

The phenomenon in $a_{59,27}$ indicates that, during 1985-2005, ICT devices have strengthened the relationship between coal products and commerce sectors. The role of these devices in this relationship can be described as follows. During the analysis period, coal products sector needed the media or field in order to market its outcomes. The commerce sector, as an outsider, could provide this media. ICT devices could support this relationship because these could make the process of the information exchange between the sectors better.

Table 5.19. Top ten original IO coefficients of the coal products sector which were viewed from the standard deviation value (1985-2005)

No.	IO coefficient	Standard deviation	Mean
1	$a_{08,27}$	0.0870	0.3623
2	$a_{27,27}$	0.0212	0.0676
3	$a_{51,27}$	0.0164	0.0083
4	$a_{26,27}$	0.0142	0.0837
5	$a_{64,27}$	0.0126	0.0288
6	$a_{77,27}$	0.0117	0.0225
7	$a_{59,27}$	0.0113	0.0491
8	$a_{66,27}$	0.0097	0.0327
9	$a_{68,27}$	0.0065	0.0075
10	$a_{44,27}$	0.0047	0.0021

(Source: Zuhdi et al., 2014c, with the slight modifications)

Quality and quantity of ICT tools significantly move forward in a future period. The consequence of this enhancement is the increasing of the level of business activities between above sectors. In other words, during the analysis period, the relationship between the industries became more robust because of the improvement of ICT instruments.

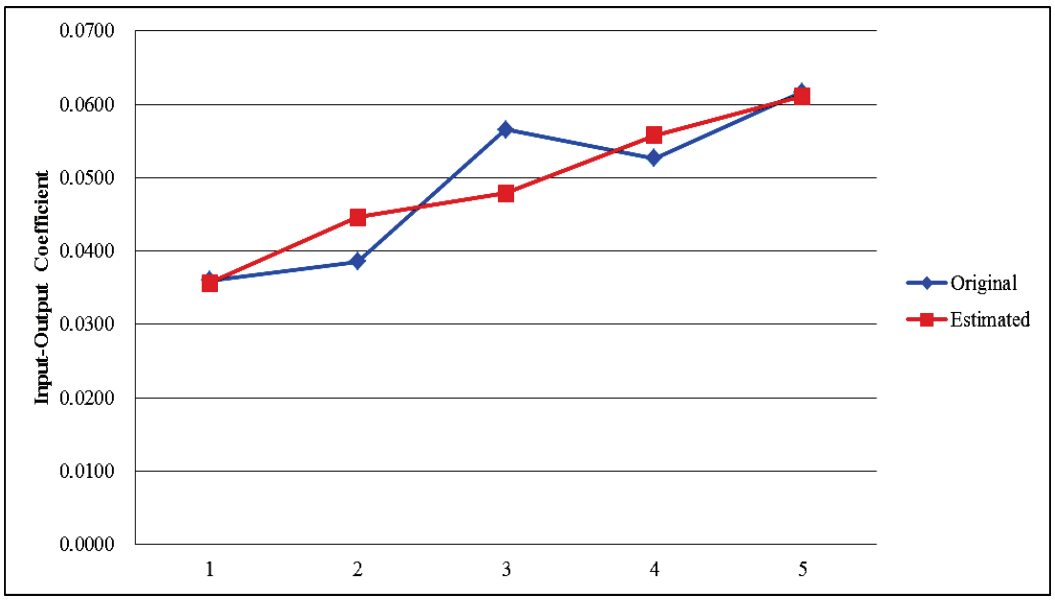

Figure 5.9. Changes in $a_{59,27}$ from 1985-2005 (Source: Zuhdi et al., 2014c)

Table 5.20. The coefficients of the variation of the original and estimated values of $a_{59,27}$, and the correlation (R) of both values (1985-2005)

The coefficients of the variation		Correlation
Original	Estimated	
0.230	0.202	0.871

(Source: Zuhdi et al., 2014c, with the slight modifications)

5.4.2 The case of Indonesia

This discussion focuses on the analysis of Indonesian case. In contrast to the previous discussions, the explanatory variables used in this discussion are growth of Gross Domestic Product (GDP) per capita and telephone lines per 100 people. The former variable explains GDP while the latter one is the representation of ICT. The data of these variables are obtained from The World Bank (2014). As with the previous Chapters, the period of the analysis of this discussion is from 1990-2005. The analyzed sectors in this discussion are described in Table

5.21. As with the previous reason, these sectors are chosen because the explanatory variables seem to give the direct impact to the business transaction activities of these industries.

Generally the methodology of this discussion is same with the previous one. The different point can be seen on the way to calculate the influences of explanatory variables and test the statistical significance. In the case of Indonesia, these calculations are separately conducted for each explanatory variable and only focus on the analyzed sectors.

Table 5.21. Analyzed sectors on the case of Indonesia

No.	Sector number	Sector name
1	137	Trade
2	150	Business services
3	158	Personal and household services

(Source: Zuhdi et al., 2014a)

Besides, the difference also appears on the value of the degree of freedom used. On Indonesian case, this value is 159×1×1 = 159. The cutoff score for the statistical significance in this discussion is $\chi^2_{0.05}$ (159) = 189.14. The hypotheses of this discussion are:

- **Hypothesis 1:** Growth of GDP per capita had no influence on the structural changes of Indonesian trade sector from 1990-2005.
- **Hypothesis 2:** Growth of GDP per capita had no influence on the structural changes of Indonesian business services sector from 1990-2005.
- **Hypothesis 3:** Growth of GDP per capita had no influence on the structural changes of Indonesian personal and household services sector from 1990-2005.
- **Hypothesis 4:** Telephone lines per 100 people had no influence on the structural changes of Indonesian trade sector from 1990-2005.
- **Hypothesis 5:** Telephone lines per 100 people had no influence on the structural changes of Indonesian business services sector from 1990-2005.
- **Hypothesis 6:** Telephone lines per 100 people had no influence on the structural changes of Indonesian personal and household services sector from 1990-2005.

The results of this discussion are described as follows. Table 5.22 describes the summary of the LRT calculation on this discussion. This summary focuses on the analyzed sectors. The details of GAMS program and LRT calculation results for Indonesian case can be seen in

Appendices 3 and 4, respectively. From the information in the Table, I can argue that the explanatory variables used in this study significantly influenced the structural changes of discussed sectors from 1990-2005. Based on this fact, I reject all null hypotheses.

Table 5.22. The summary of the LRT calculation (null model as a base), Indonesian case

No.	Explanatory variable	Influence on the trade sector	Influence on the business services sector	Influence on the personal and household services sector
1	Growth of GDP per capita	Significant	Significant	Significant
2	Telephone lines per 100 people	Significant	Significant	Significant

(Source: Zuhdi et al., 2014a, with the slight modifications)

Table 5.23 describes the top ten original IO coefficients of the trade sector which were viewed from the value of the standard deviation during 1990-2005. From the information in this table, I can argue that the most dynamic input is the input from the building and land rent sector, sector number 149. For investigating the influences of explanatory variables in the micro level, I choose $a_{141,137}$, IO coefficient describes the input from road transport to trade sectors, as a source of the analysis because this coefficient had an increasing pattern.

Table 5.23. Top ten original IO coefficients of the trade sector which were viewed from the standard deviation value (1990-2005)

No.	IO coefficient	Standard deviation	Mean
1	$a_{149,137}$	0.0239	0.0372
2	$a_{150,137}$	0.0124	0.0209
3	$a_{141,137}$	0.0098	0.0211
4	$a_{146,137}$	0.0071	0.0133
5	$a_{132,137}$	0.0062	0.0110

6	$a_{92,137}$	0.0060	0.0134
7	$a_{147,137}$	0.0056	0.0304
8	$a_{130,137}$	0.0039	0.0129
9	$a_{138,137}$	0.0039	0.0086
10	$a_{57,137}$	0.0038	0.0126

(Source: Zuhdi et al., 2014a, with the slight modifications)

Figure 5.10 explains the changes of $a_{141,137}$ from 1990-2005 which the influence was coming from the growth of GDP per capita. The numbers in this figure, also in other figures, represents the analysis years, namely 1990, 1995, and 2005. Table 5.24 shows the coefficients of the variation of the original and estimated values of this coefficient, and the correlation of these values on the analysis period. From these results I can argue that our model well follow the historical changes. In other words, I can say that, during 1990-2005, the explanatory variable had a strong influence in $a_{141,137}$.

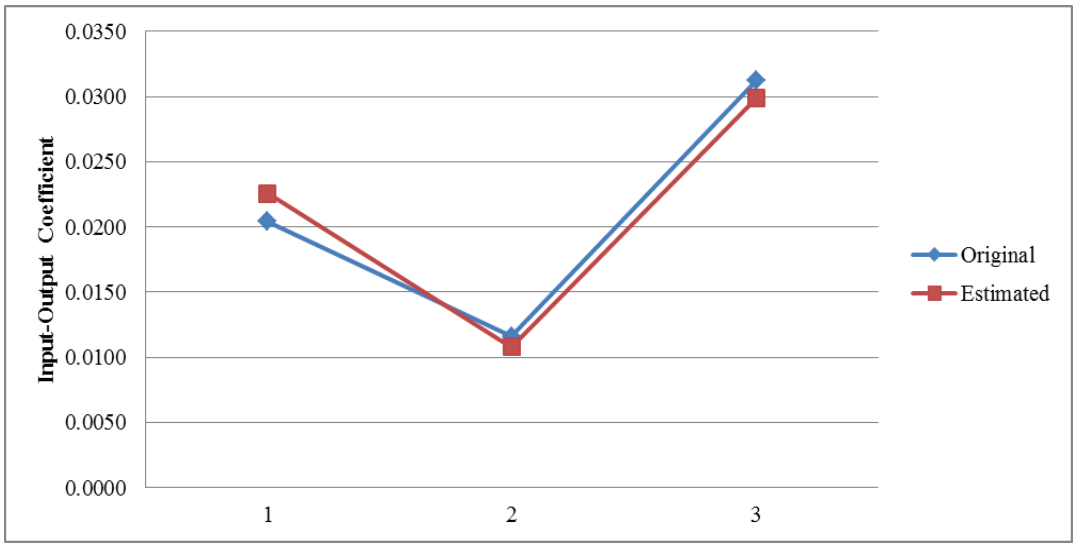

Figure 5.10. Changes in $a_{141,137}$ from 1990-2005, which were influenced by the GDP per capita growth (Source: Zuhdi et al., 2014a, with the slight modifications)

Table 5.24. The variation coefficients of the original and estimated values of $a_{141,137}$ which were influenced by the GDP per capita growth, and the correlation (R) of both values (1990-2005)

The coefficients of the variation		Correlation
Original	Estimated	
0.466	0.458	0.981

(Source: Zuhdi et al., 2014a, with the slight modifications)

Above phenomenon shows that, especially during 1995-2005, the GDP per capita growth has supported the relationship between road transport and trade sectors. Following explanation gives more complete information regarding the phenomenon. GDP is usually used as a tool of the national economic measurement. One country is called to have a good trend in economy if its GDP growth is high. The growth of GDP per capita of Indonesia in 1995-2005, compared with in 1990-1995, had a decreasing pattern. This situation should give the negative impact to the relationship. However, this impact not appeared in the period. This fact indicates that, from 1995-2005, the decreasing of the GDP per capita growth has strengthened the relationship.

Figure 5.11 explains the changes of $a_{141,137}$ from 1990-2005 which the influence was coming from the telephone lines per 100 people. Table 5.25 shows the coefficients of the variation of the original and estimated values of this coefficient, and the correlation of these values on the analysis period. From these results I can say that our model well follow the historical changes. In other words, I can argue that, during 1990-2005, the explanatory variable had a strong influence in $a_{141,137}$.

Above phenomenon shows that, during 1990-2005, the telephone lines per 100 people has supported the relationship between road transport and trade sectors. Following explanation gives the details description regarding this condition. ICT devices, including telephones, make the communication between two or more persons smoother. The impact of this situation is the increasing of the quality and quantity of the relationship among them. This logic can be used in the industrial level. Indonesia had an increasing pattern in the telephone lines per 100 people from 1990-2005. This fact explains why the phenomenon happened.

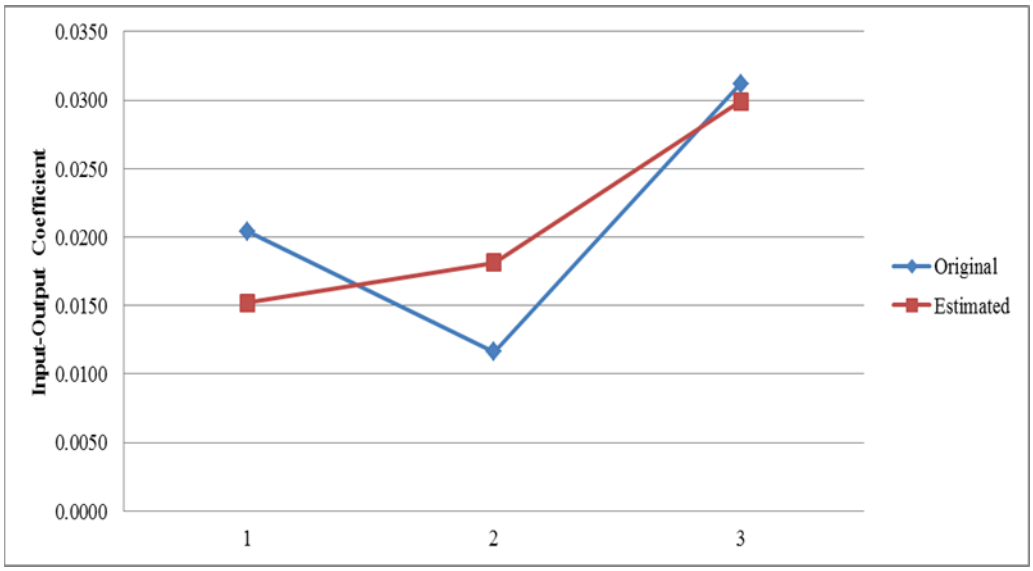

Figure 5.11. Changes in $a_{141,137}$ from 1990-2005, which were influenced by the telephone lines per 100 people (Source: Zuhdi et al., 2014a, with the slight modifications)

Table 5.25. The variation coefficients of the original and estimated values of $a_{141,137}$ which were influenced by the telephone lines per 100 people, and the correlation (R) of both values, (1990-2005)

The coefficients of the variation		Correlation
Original	Estimated	
0.466	0.370	0.793

(Source: Zuhdi et al., 2014a, with the slight modifications)

Table 5.26 describes the top ten original IO coefficients of the business services sector which were viewed from the value of the standard deviation during 1990-2005. From the information in this table, I can argue that the most dynamic input is the input from the banking and other financial intermediaries sector, sector number 147. For investigating the influence of the GDP per capita growth in the micro level, I choose $a_{152,150}$, IO coefficient describes the input from education services to business services sectors, as a source of the analysis. On the other hand, $a_{151,150}$, IO coefficient explains the input from general government to business services sectors, is used to analyze the influence of the telephone lines per 100 people. I select these coefficients because they had an increasing pattern in the analysis period.

Table 5.26. Top ten original IO coefficients of the business services sector which were viewed from the standard deviation value (1990-2005)

No.	IO coefficient	Standard deviation	Mean
1	$a_{147,150}$	0.0264	0.0727
2	$a_{157,150}$	0.0104	0.0287
3	$a_{156,150}$	0.0061	0.0035
4	$a_{144,150}$	0.0059	0.0135
5	$a_{149,150}$	0.0058	0.0133
6	$a_{158,150}$	0.0053	0.0095
7	$a_{138,150}$	0.0045	0.0095
8	$a_{152,150}$	0.0044	0.0091
9	$a_{151,150}$	0.0043	0.0025
10	$a_{137,150}$	0.0037	0.0161

(Source: Zuhdi et al., 2014a, with the slight modifications)

Figure 5.12 explains the changes of $a_{152,150}$ from 1990-2005 which the influence was coming from the GDP per capita growth. Table 5.27 shows the coefficients of the variation of the original and estimated values of this coefficient, and the correlation of these values on the analysis period. From these results I can say that our model well follow the historical changes. In other words, I can argue that, during 1990-2005, the explanatory variable had a strong influence in $a_{152,150}$.

Above phenomenon shows that, especially during 1995-2005, the GDP per capita growth gave a positive support to the relationship between education services and business services sectors. This phenomenon is unique because the growth of the GDP per capita of Indonesia in

1995-2005, compared with in 1990-1995, had a decreasing pattern. This situation supposedly had a negative impact to the relationship. However, this impact not appeared in the period. This fact explains that, from 1995-2005, the decreasing of the GDP per capita growth has tightened the relationship.

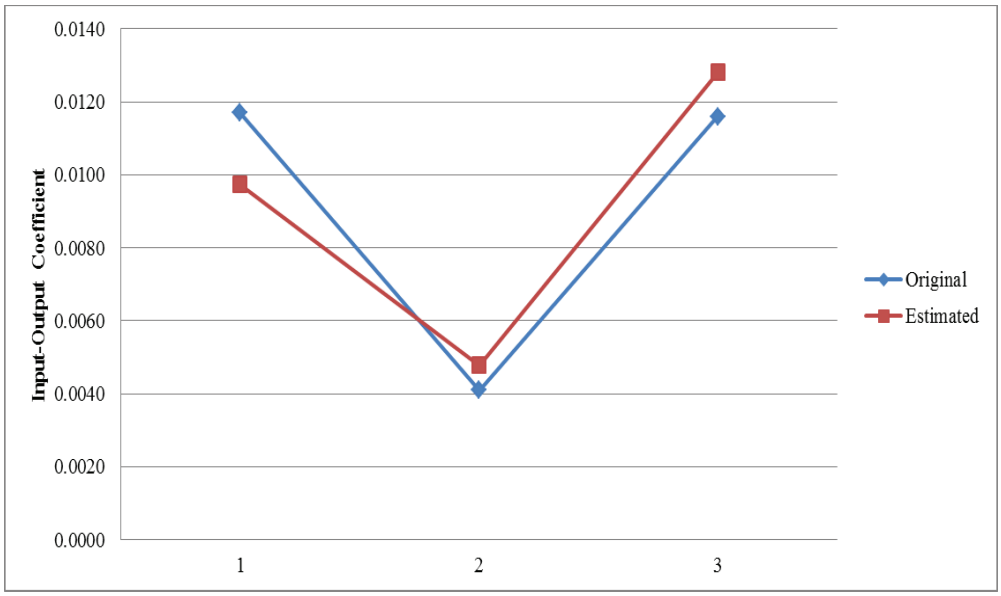

Figure 5.12. Changes in $a_{152,150}$ from 1990-2005, which were influenced by the GDP per capita growth (Source: Zuhdi et al., 2014a, with the slight modifications)

Table 5.27. The variation coefficients of the original and estimated values of $a_{152,150}$ which were influenced by the GDP per capita growth, and the correlation (R) of both values (1990-2005)

The coefficients of the variation		Correlation
Original	Estimated	
0.477	0.445	0.921

(Source: Zuhdi et al., 2014a, with the slight modifications)

Figure 5.13 describes the changes of $a_{151,150}$ from 1990-2005 which the influence was coming from the telephone lines per 100 people. Table 5.28 shows the coefficients of the variation of the original and estimated values of this coefficient, and the correlation of these values on the analysis period. From these results I can argue that our model well follow the historical changes. In other words, I can say that, during 1990-2005, the explanatory variable had a strong influence in $a_{151,150}$.

Above phenomenon indicates that, during 1990-2005, the telephone lines per 100 people have strengthened the relationship between general government and business services sectors. Following explanation gives the details information regarding this situation. ICT devices, including telephones, make the connection between two or more parties better. The consequence of this condition is to improve the quality and quantity of the relationship among them. This logic can be applied in the level of the industrial sector. Indonesia had an increasing pattern in the telephone lines per 100 people from 1990-2005. This fact explains why the phenomenon happened.

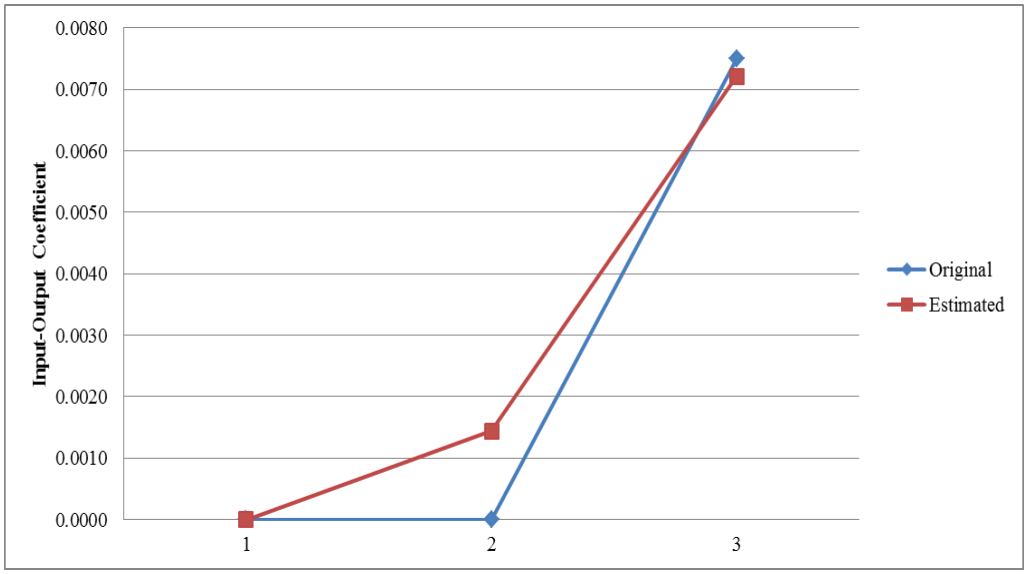

Figure 5.13. Changes in $a_{151,150}$ from 1990-2005, which were influenced by the telephone lines per 100 people (Source: Zuhdi et al., 2014a, with the slight modifications)

Table 5.28. The variation coefficients of the original and estimated values of $a_{151,150}$ which were influenced by telephone lines per 100 people, and the correlation (R) of both values, (1990-2005)

Coefficient of variation		Correlation
Original	Estimated	
1.732	1.323	0.982

(Source: Zuhdi et al., 2014a, with the slight modifications)

Table 5.29 describes the top ten original IO coefficients of the personal and household services sector which were viewed from the value of the standard deviation during 1990-2005.

From the information in this table, the most dynamic input is the input from the textile sector, sector number 65. For investigating the influences of the explanatory variables in micro level, I choose $a_{146,158}$, IO coefficient describes the input from communication services to personal and household services sectors, as a source of the analysis. I select this coefficient because it had an increasing pattern in the analysis period.

Table 5.29. Top ten original IO coefficients of the personal and household services sector which were viewed from the standard deviation value (1990-2005)

No.	IO coefficient	Standard deviation	Mean
1	$a_{65,158}$	0.0205	0.0245
2	$a_{149,158}$	0.0137	0.0542
3	$a_{130,158}$	0.0114	0.0300
4	$a_{64,158}$	0.0106	0.0123
5	$a_{150,158}$	0.0106	0.0165
6	$a_{146,158}$	0.0100	0.0097
7	$a_{116,158}$	0.0076	0.0051
8	$a_{137,158}$	0.0076	0.0113
9	$a_{92,158}$	0.0057	0.0045
10	$a_{152,158}$	0.0046	0.0029

(Source: Zuhdi et al., 2014a, with the slight modifications)

Figure 5.14 explains the changes of $a_{146,158}$ from 1990-2005 which the influence was coming from the GDP per capita growth. Table 5.30 shows the coefficients of the variation of the original and estimated values of this coefficient, and the correlation of these values on the

analysis period. From these results I can argue that our model well follow the historical changes. In other words, I can say that, during 1990-2005, the explanatory variable had a strong influence in $a_{146,158}$.

Above phenomenon shows that, especially during 1995-2005, the GDP per capita growth gave a positive endorsement to the relationship between communication services and personal, and household services sectors. This is a peculiar phenomenon because, usually, the positive support is given by the increasing of the growth of the GDP per capita. Indonesian GDP per capita growth in 1995-2005, compared with in 1990-1995, had a decreasing pattern. This situation should give a negative contribution to the relationship. However, this contribution not appeared in the period. This fact indicates that, from 1995-2005, the decreasing of the GDP per capita growth has supported the relationship.

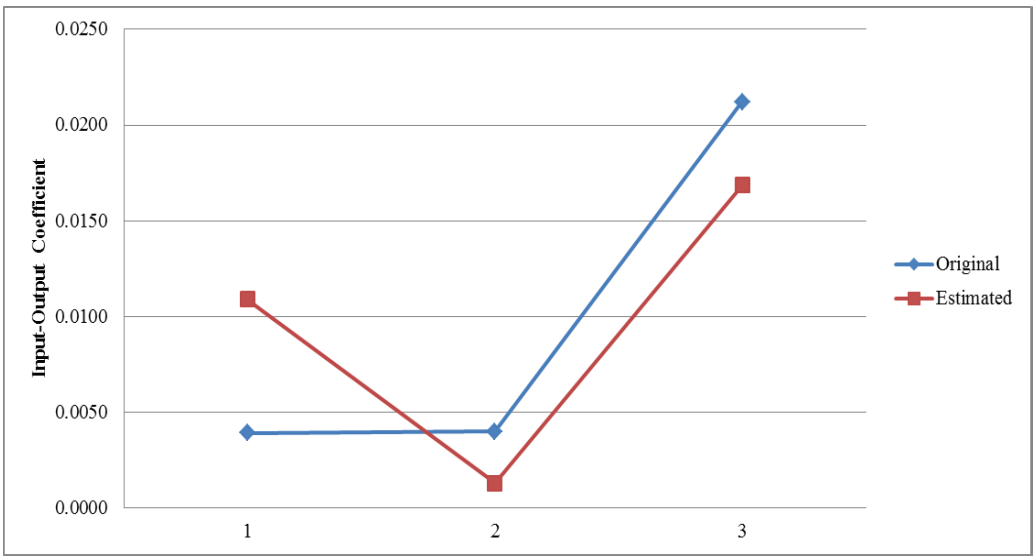

Figure 5.14. Changes in $a_{146,158}$ from 1990-2005, which were influenced by the GDP per capita growth (Source: Zuhdi et al., 2014a, with the slight modifications)

Table 5.30. The variation coefficients of the original and estimated values of $a_{146,158}$ which were influenced by the GDP per capita growth, and the correlation (R) of both values, (1990-2005)

The coefficients of the variation		Correlation
Original	Estimated	
1.027	0.811	0.788

(Source: Zuhdi et al., 2014a, with the slight modifications)

Figure 5.15 explains the changes of $a_{146,158}$ from 1990-2005 which the influence was coming from the telephone lines per 100 people. Table 5.31 shows the coefficients of the variation of the original and estimated values of this coefficient, and the correlation of these values on the analysis period. From these results I can say that our model well follow the historical changes. In other words, I can argue that, during 1990-2005, the explanatory variable had a strong influence in $a_{146,158}$.

Above phenomenon shows that, during 1990-2005, the telephone lines per 100 people have endorsed the relationship between communication services and personal, and household services sectors. Following explanation gives the details description regarding this circumstance. ICT devices, including telephones, make one person easier to conduct the communication with others. This situation will increase the quality and quantity of the relationship among them. This logic can be adopted in the industrial level. From 1990-2005, the amount of the telephone lines per 100 people of Indonesia increased. This fact explains why the phenomenon happened.

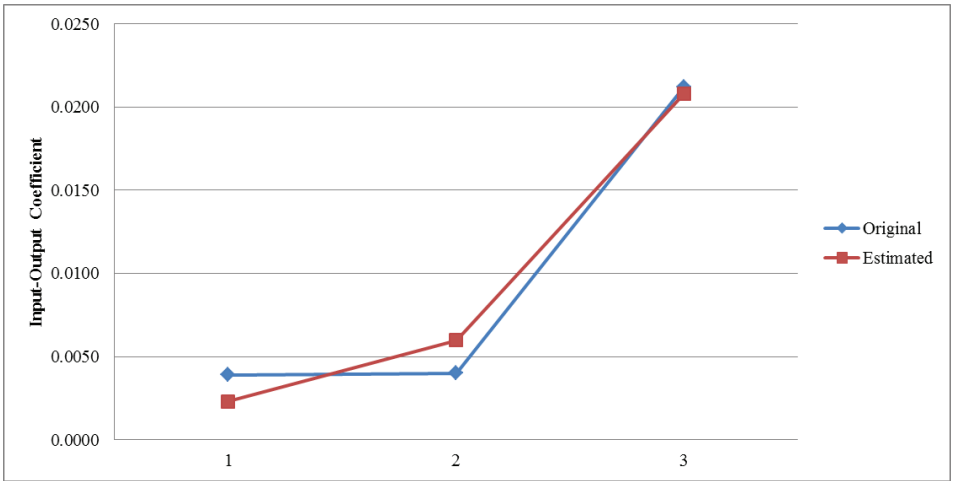

Figure 5.15. Changes in $a_{146,158}$ from 1990-2005, which were influenced by the telephone lines per 100 people (Source: Zuhdi et al., 2014a, with the slight modifications)

Table 5.31. The variation coefficients of the original and estimated values of $a_{146,158}$ which were influenced by the telephone lines per 100 people, and the correlation (R) of both values, (1990-2005)

The coefficients of the variation		Correlation
Original	Estimated	
1.027	1.010	0.983

(Source: Zuhdi et al., 2014a, with the slight modifications)

5.5 Findings

The results show that, in the analysis period, the explanatory variables used in Japanese case, separately and jointly, had the significant influences on the structural changes of Japanese industrial sectors, including the ICT-influenced sectors. From the information of the statistical significances of the analyzed sectors on the period of the analysis, the structural change of the commerce sector was more strongly influenced by telecommunications equipment than by computers. An opposite phenomenon could be seen on the structural change of the business services and office supplies sector. The structural change of the personal services sector, in contrast, was equally influenced by both explanatory variables.

Meanwhile, in the analysis period, the patterns which illustrate the influences of explanatory variables were different among the analyzed sectors. This difference is clearly observed in the input from the value added sector. I believe that the implementation of ICT devices in the business activities of the sectors, and the economic conditions, such as the unemployment rate, on the period of the analysis caused this difference. These phenomena support the conclusion that, in 1985-2005, the business circumstances of the analyzed sectors were dissimilar.

The results also show that the combination of explanatory variables, in the analysis period, gave the significant influences on the structural changes of all Japanese energy sectors. More specifically, on the period of the analysis, the biggest influence was received by the coal products sector while the petroleum refinery products industry had the lowest value of the influence. Besides, the results also describe that, in the micro analysis, ICT instruments have strengthened the relationship between analyzed and other sectors from 1985-2005. In other words, in this period, the business activities between these industries became more robust because of the improvement of these instruments.

On Indonesian case, the results show that the explanatory variables, in the analysis period, gave the significant influences on the structural changes of Indonesian ICT-influenced sectors. Based on the statistical significance values, on the period of the analysis, the structural changes of all analyzed sectors got the stronger influence from the telephone lines per 100 people than the GDP per capita growth. Besides, the influences given by explanatory variables to the IO coefficients of analyzed sectors generated the different patterns on the period of the analysis. More specifically, on this period, the influence of the growth of the GDP per capita produced the decreasing-increasing pattern while an increasing trend appeared after receiving the influence of the telephone lines per 100 people.

6. Discussions and Policy Recommendations

6.1 The relationship among the findings

Previous Chapters generated many findings. Each finding looks like independent, whereas one finding supports each other in describing the industrial structural changes happened in analyzed countries. This Chapter tries to explore the connection among the findings.

From the discussions in previous Chapters, I can say that the flow of this study was to apply static and dynamic IO analyses to describe the role of ICT sectors on the industrial structural changes of analyzed countries, and then to apply the new method to describe the influences of ICT penetration on these transformations. In other words, the main emphases of the discussions on the previous Chapters were to show the method shift from static to dynamic approaches as well as the new method for describing the ICT contributions. In this Chapter, I slightly modify this flow so I can naturally connect the findings. Consequently, I group the previous calculations into the three processes, namely (1) observation, (2) exploring, and (3) improvement.

6.1.1 The case of Japan

I did the observation process by using the simple output multiplier analysis and Structural Decomposition Analysis (SDA) in Chapters 3 and 4, respectively. The results of this process presented two different points of view. Firstly, I can argue that, from the point of view of SDA, Information and Communication Technology (ICT) sectors had an important role on the industrial structural changes of Japan from 1995-2005. Secondly, the opposite perspective appeared from the results of the calculation by using the simple output multiplier analysis.

Above difference is interesting. The results were coming from same data. In other words, the source of analysis for above methods was same. The difference happened because of the nature of methods. SDA is a method which focuses on the different of the gross outputs of sectors in two specific periods. In other words, from the point of view of this method, the word of “industrial structural changes” refers to the dynamic changes. On the other hand, the simple output multiplier analysis emphasizes the impacts of increasing of one unit in final demand on the sectoral outputs on the specific period. Therefore, this method views the words as the static changes. More specifically, the difference appeared because of the different point of view in looking the changes of industrial structure.

Both methods focus on the process of sighting the changes from the macroscopic view. Therefore, the effects of ICT itself in the industrial structural changes of Japan could not be seen from the methods. In other words, the causality between ICT and the changes could not be observed from the methods. I employed statistical analysis to fulfill this shortage on the next stage, the exploring process.

The results of statistical analysis showed that the penetration of ICT, I used computers and telecommunication equipment in describing this technology in Japanese case, separately and jointly, gave significant influences on Japanese industrial structural changes from 1985-2005. The results of microscopic level analysis emphasized this phenomenon.

The improvement process was conducted on the next stage. This process used demand-pull Input-Output (IO) quantity model as a tool of analysis. The use of this model was based on the idea that the proper way to improve the ICT aspects of one country is to improve its ICT sectors. In other words, the model was employed to achieve the continuous improvement on these aspects. This improvement is also needed by Japan to make sure that the aspects remain significant on their national economy.

The model was chosen because the point of view of this model is to know the effect of final demand changes on the total output of industrial sectors of specific country. In other words, this model will be useful in doing the forecast process to know the specific ways to improve these sectors. Obviously, I focused on ICT sectors when applying the model. I used several scenarios in doing the process. These scenarios were varied from the modification of domestic aspect through the foreign environment changes. The results showed that, on Japanese case, export and outside households consumption modifications gave positive impact to the total output of Japanese ICT sectors while the opposite effect was delivered by the import change. The summary of results of Japanese case is described in Table 6.1.

6.1.2 The case of Indonesia

In the observation process, the results of SDA calculation on Indonesian case showed that ICT sectors did not have an important role on the industrial structural changes of Indonesia from 1990-2005. This phenomenon indicates that, during this period, ICT sectors were not prioritized by Indonesian government. The similar facts were also shown by the outcomes of the calculation by using the simple output multiplier analysis.

Above similarity is interesting. This similarity asserts that the ICT sectors did not play an important role on Indonesian industrial structural changes during the period of analysis. I would like to give a note that above methods use the same point of view, namely the macroscopic view. In other words, this view should also be used when digesting the affirmation.

However, the influences of the penetration of ICT on the industrial structural changes of Indonesia could not be analyzed by above methods. In other words, the causality between ICT and the changes could not be seen from the methods. I did the statistical analysis to investigate the influences on the next stage, the exploring process. I used the GDP per capita growth and telephone lines per 100 people as explanatory variables when conducting this analysis. ICT aspect was represented by the latter variable.

In contrast to the case of Japan, I did not conduct the joint-explanatory variable calculations in Indonesian case. In other words, in this case, the investigations were separately conducted for each explanatory variable and only focused on the analyzed sectors. I did not conduct the calculation because the variables had a negative correlation value. Besides, I only focused on the discussed sectors because some errors appeared when the main consideration in the calculation was ICT-explanatory variable.

The results of statistical analysis showed that the explanatory variables, in the analysis period, gave significant influences on the structural changes of Indonesian ICT-influenced sectors. Based on the statistical significance values, on the period, the structural changes of all analyzed sectors got stronger influence from the telephone lines per 100 people than GDP per capita growth. The results of microscopic level analysis explained that, during the analysis period, the influences given by explanatory variables to the IO coefficients of analyzed sectors generated the different patterns. However, in contrast to the case of Japan, the general results regarding the influences of ICT on the changes of industrial structure could not be achieved on Indonesian case. I argue that this phenomenon happened because the points of analysis period in this case were too few (only three periods; 1990, 1995, and 2005). Besides, I also argue that the negative value of correlation of explanatory variables used in this case also gave the contribution into the phenomenon.

The calculation using demand-pull IO quantity model was also conducted in this case on the third process. As with previous explanation, the motivation of using this model was based on the argument that improving ICT sectors of one country is an effort to improve its ICT aspects. I also used several scenarios which included domestic and international aspects when conducting the calculation. The results showed that the biggest positive effect to the total output of Indonesian ICT sectors was delivered by the change of households and non-profit private institutions consumptions. Contrarily, the modification of import gave the negative impact. The summary of results of Indonesian case can be seen in Table 6.2.

6.2 Policy recommendations

6.2.1 The case of Japan

I argue that previous phenomena in Japanese case are supported by the policies or strategies regarding ICT which was made by Japanese government. In other words, these policies or strategies had an important role in endorsing the significance of ICT toward the industrial structural changes of Japan on the analysis period. Obviously, the implementation of regulations is also an important thing. The ICT regulations of Japan and Indonesia were comprehensively described in Chapter 2. The explanation in Chapter 2 confirms my argument. The following explanation gives the information which sharpening previous description about the regulations.

Table 6.1. The summary of results of Japanese case

	Outcome(s)	Description
Using simple output multiplier	Communication	ICT sectors did not have an important role in Japanese industrial structural changes from 1995-2005
	-. Value on 1995: 1.45 (not included in the top five sectors) -. Value on 2000: 1.64 (not included in the top five sectors) -. Value on 2005: 1.63 (not included in the top five sectors)	
	Broadcasting and information services	
	-. Value on 1995: 1.93 (not included in the top five sectors) -. Value on 2000: 1.98 (not included in the top five sectors) -. Value on 2005: 1.86 (not included in the top five sectors)	
	Advertising, survey, and information services	
	-. Value on 1995: 1.97 (not included in the top five sectors) -. Value on 2000: 1.90 (not included in the top five sectors) -. Value on 2005: 2.28 (not included in the top five sectors)	
Using demand-pull IO quantity model	Communication	Export and outside households consumption modifications give positive impact to the total output of Japanese ICT sectors while the opposite effect is delivered by the import change
	-. Total value on future period using scenario 1 (100 million Yen): Condition A: ¥ 167,969.65 Condition B: ¥ 163,875.13 -. Total value on future period using scenario 2 (100 million Yen): Condition A: ¥ 158,989.08 Condition B: ¥ 163,204.22 -. Total value on future period using scenario 3 (100 million Yen): Condition A: ¥ 165,040.06 Condition B: ¥ 164,013.34	
	Broadcasting and information services	
	-. Total value on future period using scenario 1 (100 million Yen): Condition A: ¥ 305,626.75 Condition B: ¥ 296,856.35	

	-. Total value on future period using scenario 2 (100 million Yen): Condition A: ¥ 285,514.21 Condition B: ¥ 293,299.36 -. Total value on future period using scenario 3 (100 million Yen): Condition A: ¥ 297,980.65 Condition B: ¥ 296,092.46	
	Advertising, survey, and information services	
	-. Total value on future period using scenario 1 (100 million Yen): Condition A: ¥ 96,221.67 Condition B: ¥ 91,239.76 -. Total value on future period using scenario 2 (100 million Yen): Condition A: ¥ 85,652.04 Condition B: ¥ 90,088.38 -. Total value on future period using scenario 3 (100 million Yen): Condition A: ¥ 91,992.82 Condition B: ¥ 90,855.02	
Using SDA	Communication	ICT sectors had an important role in Japanese industrial structural changes from 1995-2005
	-. Change on gross output, 1995-2000 (100 million Yen): ¥ 70,072.69 (included in the top five sectors) -. Change on gross output, 2000-2005 (100 million Yen): - ¥ 21,872.84 (not included in the top five sectors)	
	Broadcasting and information services	
	-. Change on gross output, 1995-2000 (100 million Yen): ¥ 6,268.82 (not included in the top five sectors) -. Change on gross output, 2000-2005 (100 million Yen): ¥ 267,081.42 (included in the top five sectors)	
	Advertising, survey, and information services	
	-. Change on gross output, 1995-2000 (100 million Yen): ¥ 97,726.61 (included in the top five sectors)	

	-. Change on gross output, 2000-2005 (100 million Yen): - ¥ 147,642.02	
	The most influential decomposition factor	
	1995-2000: DD3 2000-2005: EE	
Using statistical analysis	Computers	The penetration of ICT, separately and jointly, gave significant influences on Japanese industrial structural changes from 1985-2005
	Number of sectors significantly influenced : 75 Number of sectors not significantly influenced : 0	
	Telecommunications equipment	
	Number of sectors significantly influenced : 75 Number of sectors not significantly influenced : 0	
	Combination of both explanatory variables	
	Number of sectors significantly influenced : 78 Number of sectors not significantly influenced : 0	

Table 6.2. The summary of results of Indonesian case

	Outcome(s)	Description
Using simple output multiplier	Construction and installation on electricity, gas, water supply, and communication	ICT sectors did not have an important role in Indonesian industrial structural changes from 1990-2005
	-. Value on 1990: 2.48 (not included in the top five sectors) -. Value on 1995: 2.34 (not included in the top five sectors) -. Value on 2005: 2.49 (not included in the top five sectors)	
	Communication services	
	-. Value on 1990: 1.52 (not included in the top five sectors) -. Value on 1995: 1.53 (not included in the top five sectors) -. Value on 2005: 1.41 (not included in the top five sectors)	
Using demand-pull IO quantity model	Construction and installation on electricity, gas, water supply, and communication	The biggest positive effect to the total output of Indonesian ICT sectors is delivered by the change of households and non-profit private institutions consumptions. Contrarily, the modification of import give the negative impact
	-. Total value on future period using scenario 1 (100 million Rupiah): Condition A: Rp. 275,221.51 Condition B: Rp. 273,897.03 -. Total value on future period using scenario 2 (100 million Rupiah): Condition A: Rp. 271,977.86 Condition B: Rp. 273,322.99 -. Total value on future period using scenario 3 (100 million Rupiah): Condition A: Rp. 278,519.44 Condition B: Rp. 275,482.78	
	Communication services	
	-. Total value on future period using scenario 1 (100 million Rupiah): Condition A: Rp. 1,013,589.60 Condition B: Rp. 980,943.17 -. Total value on future period using scenario 2 (100 million Rupiah): Condition A: Rp. 904,989.28	

	Condition B: Rp. 934,113.66 -. Total value on future period using scenario 3 (100 million Rupiah): Condition A: Rp. 1,179,095.48 Condition B: Rp. 1,110,306.53	
Using SDA	Construction and installation on electricity, gas, water supply, and communication	ICT sectors did not have an important role in Indonesian industrial structural changes from 1990-2005
	-. Change on gross output, 1990-1995 (100 million Rupiah): Rp. 43,999.56 (not included in the top five sectors) -. Change on gross output, 1995-2005 (100 million Rupiah): Rp. 209,140.23 (not included in the top five sectors)	
	Communication services	
	-. Change on gross output, 1990-1995 (100 million Rupiah): Rp. 58,958.32 (not included in the top five sectors) -. Change on gross output, 1995-2005 (100 million Rupiah): Rp. 870,927.09 (not included in the top five sectors)	
	The most influential decomposition factor	
	1990-1995: DD1 1995-2005: DD1	
Using statistical analysis	Growth of GDP per capita	The explanatory variables, in the analysis period, gave significant influences on the structural changes of Indonesian ICT-influenced sectors
	Influence on trade sector: Significant Influence on business services sector: Significant Influence on personal and household services sector: Significant	
	Telephone lines per 100 people	
	Influence on trade sector: Significant Influence on business services sector: Significant Influence on personal and household services sector: Significant	

Figure 6.1 describes the footsteps of ICT strategies in Japan from 2001-2010. Figure 6.2 shows the evolution of real ICT investment in Japan from 1980-2004. On the other hand, Figure 6.3 gives the information regarding the trend of Research & Development (R & D) in the four prioritized research areas in Japan from 2001-2004. These Figures, once again, explain to us about the seriousness of Japanese government in managing the ICT aspects.

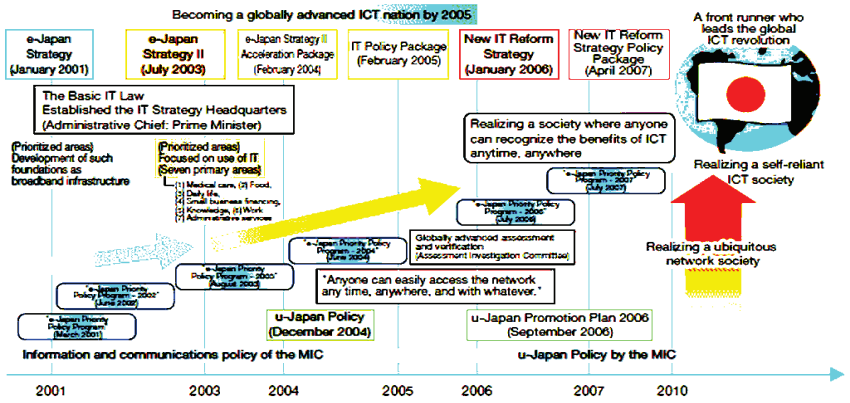

Figure 6.1. The footsteps of ICT strategies in Japan (Source: Japanese Ministry of Internal Affairs and Communications, 2008a)

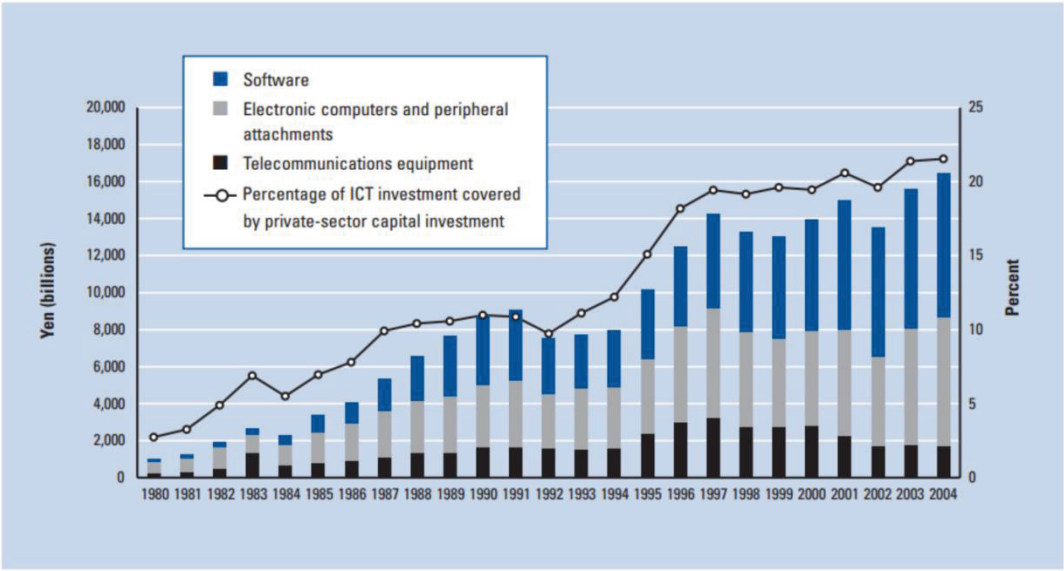

Figure 6.2. The evolution of real ICT investment in Japan, 1980-2004 (Source: Do Research Institute, 2006, in Shimizu et al., n.d.)

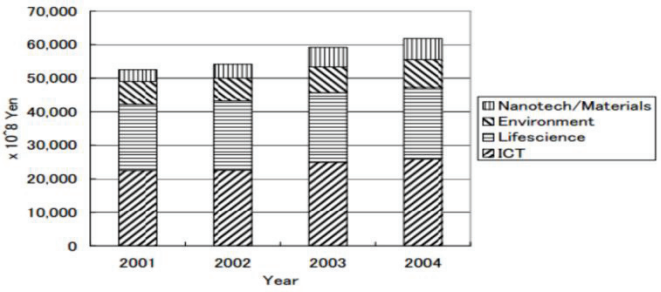

Figure 6.3. The trend of R & D in the four prioritized research areas in Japan, 2001-2004 (Source: MIC, White Paper Information and Communication (Year 2005), n.d., in Myoken, 2008)

6.2.2 The case of Indonesia

Table 6.3 shows the ICT policies of Indonesia on 2000s. I previously argued that, during the analysis period, the phenomena happened on Japanese case was impacted by the ICT policies or strategies. From the information in Chapter 2, and Table 6.3 I can say that the phenomena happened on the case of Indonesia on the period analysis was more affected by the lack of implementation of ICT strategies.

Table 6.4 shows the comparison of the ICT regulations of Japan and Indonesia which focuses on 2000s. From this Table I can affirm that Japanese government seriously managed the aspects of ICT. I use the information in this Table as a base to give the recommendations regarding the ICT strategies with respect to the domestic and foreign environment aspects. These strategies are also based on the calculation results using demand-pull IO quantity model. These suggestions focus on Indonesian case.

Table 6.3. ICT policies of Indonesia, 2000s

No.	Issue	Action plan	Time schedule	Priority	Implementing agency
1	Telecommunication	-. Improve telecommunications regulatory framework in Indonesia including licensing, tariff, interconnection, standardization, and frequency spectrum management	2001-2002*)	A	Ministry of Communications, Indonesian Telematics Coordinating Team (*TKTI*)
		-. Accelerate the enactment of telecommunication-related ministerial decrees	2001*)	A	Ministry of Communications
		-. Define universal access policy and targets	2001-2002*)	A	Ministry of Communications, *TKTI*, Telecommunication Operators
		-. Remove barriers to competition in the telecommunications market and facilitate faster integration service safeguards and roll out of telecommunication and internet technologies, including high capacity, broadband services and peer group radio networks	2001-2003*)	A	Ministry of Communications
		-. Accelerate the resolution of Cooperation of Operation (*KSO*) problem	2001-2002*)	A	Ministry of Communications, Telkom Company, *KSO*s
		-. Empower independent regulatory body	2001	A	Ministry of Communications
		-. Complete broadcasting bill	2001-2002*)	A	Ministry of Communications, Television of Republic of Indonesia (TVRI), Radio of Republic of Indonesia (RRI)
2	Information technology	-. Develop awareness and educational campaign on ICT for Government of Indonesia (GoI) officials and legislators	2001-2005	A	*TKTI*, all Ministries, Parliament
		-. Prepare regulation for intra government communication and disclosure	2001-2003	B	Ministry of Administrative Reforms, *TKTI*

	-. Prepare regulations for prescribing public information access and on-line services /procedures to improve service levels, transparency and good governance in government and public institutions	2002	B	*TKTI*
	-. Prepare regulation accommodating ICT local industry access to the government procurement	2001-2003	B	Ministry of Industry and Trade
	-. Adopt, adapt, and apply common data interchange standards and common content specification to support interoperability of data integration for common public sectors and interacting business sector needs	2001-2002	B	Ministry of Communications, National Standardization Agency, National Coordinating Agency for Surveys and Mapping (*Bakosurtanal*), National Cataloging Agency, ICT-related Associations
	-. Eliminate any restrictions on ICT investment and reduce burdensome bureaucratic procedures imposed on domestic and foreign investors	2001-2002	B	Ministry of Finance
	-. Remove luxury sale tax, as well as other taxes and charges, imposed on an expanded range of ICT products and services	2001*)	A	Ministry of Industry and Trade, Ministry of Finance, Ministry of Home Affairs, Local Government, ICT-related Association
	-. Remove regulatory and institutional barriers to applying innovative technologies such as wireless, high speed data transfer, and Voice over Internet Protocol (VoIP) from standard phones to provide an additional low cost service	2001	B	Ministry of Communications
	-. Reinforce and update intellectual property definition, protection, and compliance assurance measures	2001-2003	B	Ministry of Justice, National Police, Attorney Office

		-. Enhance the development of information content and application industries including the use of open source software	2001-2003	A	*TKTI*, Ministry of Industry and Trade, Agency for the Assessment and Application of Technology (*BPPT*), Private Sectors
		-. Build partnerships and alliances among private sector participants to build government online platform based on competitive bids	2001-2002	B	Ministry of Industry and Trade, Agency for the Assessment and Application of Technology (*BPPT*), Private Sectors
3	E-commerce	-. Adopt minimalist e-commerce law, including resolution of web-contract issues such as e-signatures, encryption security, legal validity of electronic information and messages with references to UNCITRAL, ASEAN, and APEC model laws	2001	A	Ministry of Justice, Ministry of Industry and Trade, Ministry of Communications, National Code Institution, *TKTI*, Agency for National Legal Development (*BPHN*)
		-. Develop measures to support Small and Medium Enterprises (SMEs) participation in ICT development, applications, and e-commerce	2001-2003	B	Ministry of Industry and Trade

*): On-going program
A: First priority (urgent)
B: Second priority (important)

(Source: Indonesian Telematics Coordinating Team (*TKTI*), 2001, with slight modifications)

Table 6.4. The comparison of the ICT regulations of Japan and Indonesia (2000s)

Attributes	Definition (Ehrhardt et al., 2007)	Sub attributes	Japan	Indonesia
Coherence	"*The regulatory system should be able to select, and settle on the right combination of tariffs and subsidies, and service standards and coverage, such that providers are able to recover their costs, and people receive the services they are willing to pay for.*"	The regulatory system should be able to select	V	V
		The regulatory system should settle on the right combination of tariffs and subsidies	V	X
		The regulatory system should settle on the right combination of service standards and coverage	V	V
Predictability and credibility	"*Regulatory decisions should be time-consistent, and made on clear precedents and rules.*"	Regulatory decisions should be time-consistent	V	V
		Regulatory decisions should be made on clear precedents and rules	V	X
Legitimacy, transparency, and accountability	"*Regulatory decisions need to be clear, widely accepted, and publicly accessible.*"	Regulatory decisions need to be clear	V	X
		Regulatory decisions need to be widely accepted	V	V
		Regulatory decisions need to be publicly accessible	V	V

(Source: Zuhdi, 2011, with slight modifications)

The motivation of giving the recommendations regarding ICT strategies for the Indonesian government is to support the enhancement of total output of Indonesian ICT sectors in future time. In other words, the motivation is to improve these sectors. The recommendations, based on the explanation in Chapter 3 and Table 6.4, are described as follows:

- To implement broadband internet service especially on the dense area.
- To improve the mobile telecommunication access quality.
- To improve the national postal service.

- To improve the broadcasting services.
- To improve the activities related to the ICT commodities export.
- To construct the import restriction policy regarding ICT products. This policy should focus on the products which the Indonesian ICT sectors have an ability to produce.
- To settle the regulatory system on the right combination of tariffs and subsidies.
- To make clear the precedents and rules of regulatory decisions.
- To make clear the regulatory decisions.

7. Conclusions and Suggestions

7.1 Industrial structural changes and the international comparison: The conclusions

This study deeply and comprehensively analyzed the industrial structural changes of developed and developing countries which the focuses were the role of Information and Communication Technology (ICT) and influences of it penetration. The former country was represented by Japan while Indonesia described the latter one. This study employed Input-Output (IO) and statistical analyses as instruments of the analysis. The originality of this study was to develop the new model that facilitates IO and statistical analyses in describing the changes, namely the Constrained Multivariate Regression (CMR) model, as well as the deep and comprehensive analysis itself. The conclusions of this study are described as follows.

I did the observation process by using the simple output multiplier analysis and Structural Decomposition Analysis (SDA). The former tool has a static point of view while the dynamic perspective is owned by the latter one. The analysis period for Japanese case in the processes was from 1995-2005 while for the case of Indonesia was from 1990-2005.

The results showed that, from the view point of SDA, ICT sectors had an important role on the industrial structural changes of Japan during the analysis period. The opposite perspective, however, appeared from the results of the calculation by using the simple output multiplier analysis. On the other hand, on the case of Indonesia, by using both methods, the results showed that ICT sectors did not have an important role on the industrial structural changes of Indonesia from 1990-2005.

I conducted the exploring process on the next stage. This process focused on the investigation in order to know the influences of ICT penetration on above changes during the period of analysis. I employed the CMR model as an instrument of the analysis of this stage. In this stage, a slight modification was made on the analysis period of Japanese case, namely from 1995-2005 to 1985-2005.

The results of statistical analysis showed that the penetration of ICT, separately and jointly, gave a significant influence on the Japanese industrial structural changes during the analysis period. I used computers and telecommunication equipment in describing this technology in the case of Japan. The results of microscopic level analysis emphasized this phenomenon.

In contrast to the case of Japan, I did not conduct the joint-explanatory variable calculations in Indonesian case. In other words, in this case, the investigations were separately conducted for each explanatory variable and only focused on the Indonesian ICT-influenced sectors. I used GDP per capita growth and telephone lines per 100 people as explanatory variables in this case. ICT aspect was represented by the latter variable.

The results of statistical analysis showed that the explanatory variables, during the analysis period, gave significant influences on the structural changes of analyzed sectors. Based on the statistical significance values, on the period, the structural changes of all analyzed sectors got stronger influence from the telephone lines per 100 people than GDP per capita growth. The results of microscopic level analysis described that, during the analysis period, the influences given by explanatory variables to the IO coefficients of analyzed sectors generated the different patterns. However, in contrast to the case of Japan, the general results regarding the influences of ICT on the changes of industrial structure could not be achieved on the Indonesian case. As explained in Chapter 6, I argued that this phenomenon was happened because the points of analysis period in this case were too few, and the negative correlation value of explanatory variables used in this case.

I also conducted the improvement process. This stage aimed to know the way to improve the ICT sectors of analyzed countries in future time. In other words, the motivation of conducting this stage was to improve these sectors. Demand-pull IO quantity model was employed in the process. The analysis period of the process was same with the observation stage. I used several scenarios which included domestic and international aspects when conducting the calculation of the process.

The results showed that, on Japanese case, export and outside households consumption modifications gave positive impact to the total output of Japanese ICT sectors while the opposite effect was delivered by the import change. On the other hand, on Indonesian case, the biggest positive effect to the total output of Indonesian ICT sectors was delivered by the change of households and non-profit private institutions consumptions. Contrarily, the modification of import gave the negative impact. This study also gave the policy recommendations based on the calculation results of the third process and Table 6.4. These recommendations focused on Indonesian case. These recommendations were (1) to implement broadband internet service especially on the dense area, (2) to improve the mobile telecommunication access quality, (3) to improve the national postal service, (4) to improve the broadcasting services, (5) to improve the activities related to the ICT commodities export, (6) to construct the import restriction policy regarding ICT products (this policy should focus on the products which the Indonesian ICT sectors have an ability to produce), (7) to settle the regulatory system on the right combination of tariffs and subsidies, (8) to make clear the precedents and rules of regulatory decisions, and (9) to make clear the regulatory decisions.

7.2 The limitation(s) of the study

As described in Chapter 6, the general results regarding the influences of ICT on the changes of industrial structure could not be achieved on Indonesian case. I argued that the lack of period of

analysis is a possible reason why this phenomenon happened. Further, this shortage was caused by the lack of data for the analysis. Based on these explanations, the limitation of this study is the lack of analysis period for the case of Indonesia.

7.3 Future research suggestions

The suggestions for future research from this study are:

- To add the analyzed countries.

This study has investigated Japan and Indonesia which represents developed and developing countries. The amount of analyzed countries, however, needs to be added. This addition aims to achieve deeper understanding regarding the industrial structural changes on the countries in the world which the focus is a penetration of ICT. Some potential countries are China, United Kingdom, United States, India, Scotland, Malaysia, and Brazil.

- To conduct other multiplier analysis.

This study only conducted simple output multiplier analysis. The use of other multiplier, such as income multiplier, will be an interesting discussion on the future research. This analysis will give another point of view regarding the industrial structural changes of analyzed countries.

- To modify the explanatory variables.

In this study, ICT was represented by computers and telecommunication equipment on the case of Japan while on the Indonesia case was telephone lines per 100 people. Modifying the explanatory variables which explaining ICT will be an interesting subject on the future research. This modification will show to us the other perception about the influences of ICT penetration on the industrial structural changes of analyzed countries. Further, for Indonesian case, this modification opens the possibility to get the general results regarding the influences of ICT on the changes of industrial structure.

- To add the period of analysis.

This suggestion is especially addressed to the case of Indonesia. This addition aims to get the statistically better results. Besides, this addition is expected to generate the general results for the case.

- To discuss the international trading issues

This study focused on the penetration of ICT on the industrial structural changes of Japan and Indonesia. Besides influencing these changes, this penetration, directly and indirectly, opens the

opportunity to conduct the international trading activities. I propose these issues as one of the suggested further researches.

- To conduct the analysis in global level

This study focused on the analysis of influences of ICT penetration on the industrial structural changes of specific countries. The analysis in broader level, such as global level, however, was not conducted in this study. This analysis can explain the influences on the global level. More specifically, the general impacts of penetration of ICT on the global level can be observed through the analysis. I propose this discussion as other further research. I argue that Multi-Regional Input-Output (MRIO) model can be applied in the discussion.

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Appendices

Appendix 1. The General Algebraic Modeling System (GAMS) program used in the analysis (Japanese case, using the joint explanatory variables)

```
* Multivariate Least Square Analysis for IO coefficients
* 2012 11 16 by S.Mori
* revised -- input data for tables

set T period /1*5/;

* row sectors -- intermediate input and value added
* column sectors -- intermediate input and final demand

set i row sectors            /1*79/;
set j0 column sectors        /1*78/;

set j(j0);

set k0 explanatory variables /1*3/;
set k(k0)            /1*3/;

* Input Data -- using IO_data from 1985 through 2005

Table IO_DATA(t,i,j0)
;

* explanatory variable data -- Computer (main parts & accessory) and Telecommunication equipment

Table Ex_Var(k0,t)

          1          2          3          4          5
1      2845       6752       7746      10732      15248
2      1788       3825       5304       7969       5159
3         1          1          1          1          1
```

```
;
* normalization

parameter IOCHK(t,j0);

IO_DATA(t,i,j0)$(IO_DATA(t,i,j0) le 0.0)=0.0;

IOCHK(t,j0)=sum(i, IO_DATA(t,i,j0));
IO_DATA(t,i,j0)=IO_DATA(t,i,j0)/IOCHK(t,j0);

parameter IO_DATC(t,i,j0);
IO_DATC(t,i,j0)=IO_DATA(t,i,j0);
IO_DATC(t,i,j0)$(IO_DATA(t,i,j0) le 1.0e-4)=1.0;

IO_DATC(t,i,j0)=1.0;

Parameters OBJ_LR(j0);

positive variables
   IO_DATR(t,i,j0)
;

variable
   RGR_EST(j0,i,k)
   IO_ERR(t,i,j0)
   OBJ
;

Equations
   IO_DATR_DEF(t,i,j0)
   IO_ERR_DEF(t,i,j0)
   IO_CNST_DEF(t,j0)
   OBJ_DEF
;

   IO_DATR_DEF(t,i,j)..
```

```
            IO_DATR(t,i,j)=E= sum(k, RGR_EST(j,i,k)*Ex_Var(k,t));
* IO_ERR(t,i,j) relative error

IO_ERR_DEF(t,i,j)..
     IO_ERR(t,i,j)=E=(IO_DATA(t,i,j)-IO_DATR(t,i,j))/IO_DATC(t,i,j);

IO_CNST_DEF(t,j).. sum(i, IO_DATR(t,i,j) )=E=1.0;

OBJ_DEF.. OBJ=E=sum(j, sum(i, sum(t, IO_ERR(t,i,j)*IO_ERR(t,i,j))));

Model MulVR /all/;

FILE FSAVE /Trial 6 (1x3).CSV/;
PUT FSAVE;
FSAVE.PC=5;

loop(j0,
   j(j0)=no;
);

loop(j0,
   j(j0)=yes;

   Solve MulVR minimizing OBJ using nlp;

   OBJ_LR(j)=OBJ.L;

   j(j0)=no;

);

loop(j0,
   j(j0)=yes;
);

Put "Estimators"/;
```

```
Loop(j,
   Put "",j.TL,"column sector"/;
   Put "","",""; loop(k, put k.tl); put /;
   Loop(i,
        Put "","",i.tl;
        Loop(k, Put RGR_EST.L(j,i,k):15:6);
        Put /;
   );
   Put "",OBJ_LR(j)/;
   Put //;
);

Put "Original IO coeff. data"/;
Loop(j,
   Put "",j.TL,"column sector"/;
   Put "","","";loop(t, put t.tl);put /;
   Loop(i,
        Put "","",i.tl;
        Loop(t, Put IO_DATA(t,i,j):15:6);
        Put /;
   );
   Put //;
);

Put "Estimated IO coeff. data"/;
Loop(j,
   Put "",j.TL,"column sector"/;
   Put "","","";loop(t, put t.tl);put /;
   Loop(i,
        Put "","",i.tl;
        Loop(t, Put IO_DATR.L(t,i,j):15:6);
        Put /;
   );
   Put //;
);
```

```
Put "Comparison -- Historical and Estimated"/;
Loop(j,
   Put "",j.TL,"column sector"/;
   Put "","","";loop(t, put t.tl); put /;
   Loop(i,
        Put "","",i.tl;
        Loop(t, Put IO_DATA(t,i,j):15:6); put /;

        Put "","","estimated";
        Loop(t, Put IO_DATR.L(t,i,j):15:6); put //;
   );
   Put /;
);
```

Appendix 2. The results of the Likelihood Ratio Test (LRT) calculation, Japanese case

No.	Sector	Computers (main parts and accessory)	Results (for Computers (main parts and accessory))	Telecommunication equipment	Results (for Telecommunication equipment)	Statistical significance ($\chi 2$), Combination	Results (for Combination)
1	Crop cultivation	1471.09	Significant	282.87	Significant	1767.10	Significant
2	Livestock	233.28	Significant	454.54	Significant	613.07	Significant
3	Agricultural services	1310.00	Significant	435.54	Significant	1511.37	Significant
4	Forestry	1551.08	Significant	837.02	Significant	2088.97	Significant
5	Fisheries	403.55	Significant	254.05	Significant	1095.17	Significant
6	Metallic ores	901.81	Significant	1001.39	Significant	1514.37	Significant
7	Non-metallic ores	229.17	Significant	65.13	Not Significant	446.37	Significant
8	Coal mining, crude petroleum and natural gas	571.90	Significant	457.20	Significant	943.20	Significant
9	Foods	1046.29	Significant	1184.03	Significant	2173.71	Significant
10	Beverage	673.25	Significant	759.51	Significant	1194.05	Significant
11	Feeds and organic fertilizer, n.e.c.	1277.59	Significant	598.03	Significant	1719.68	Significant
12	Tobacco	781.00	Significant	1192.83	Significant	1876.18	Significant
13	Textile products	615.34	Significant	1063.36	Significant	1460.01	Significant

14	Wearing apparel and other textile products	510.84	Significant	831.15	Significant	1277.75	Significant
15	Timber and wooden products	1215.40	Significant	928.24	Significant	1796.14	Significant
16	Furniture and fixtures	880.96	Significant	485.35	Significant	1108.23	Significant
17	Pulp and paper	536.22	Significant	756.00	Significant	998.32	Significant
18	Paper products	547.59	Significant	533.60	Significant	853.92	Significant
19	Publishing and printing	844.67	Significant	134.66	Significant	1502.66	Significant
20	Chemical fertilizer	233.30	Significant	449.34	Significant	685.15	Significant
21	Basic industrial inorganic chemicals	370.17	Significant	508.77	Significant	650.64	Significant
22	Basic and intermediate chemical products	124.82	Significant	90.02	Not Significant	630.82	Significant
23	Synthetic resins	129.39	Significant	170.62	Significant	600.47	Significant
24	Synthetic fibers	176.28	Significant	430.33	Significant	685.33	Significant
25	Final chemical products, n.e.c.	971.27	Significant	831.49	Significant	1657.81	Significant
26	Petroleum refinery products	10.02	Not Significant	215.19	Significant	519.86	Significant
27	Coal products	69.89	Not Significant	637.48	Significant	1581.89	Significant
28	Plastic products	1260.09	Significant	320.32	Significant	1450.61	Significant

29	Rubber products	591.90	Significant	505.63	Significant	927.55	Significant
30	Leather, fur skins and miscellaneous leather products	787.50	Significant	586.13	Significant	1133.72	Significant
31	Glass and glass products	666.91	Significant	649.92	Significant	1117.64	Significant
32	Cement and cement products	1240.98	Significant	771.90	Significant	1726.98	Significant
33	Pottery, china and earthenware	757.23	Significant	391.76	Significant	989.68	Significant
34	Other ceramic, stone and clay products	697.97	Significant	723.87	Significant	1127.42	Significant
35	Pig iron and crude steel	283.72	Significant	756.90	Significant	1166.39	Significant
36	Steel products	84.72	Not Significant	561.09	Significant	983.02	Significant
37	Steel castings and forgings, and other steel products	195.57	Significant	979.36	Significant	1503.36	Significant
38	Non-ferrous metals	454.01	Significant	219.42	Significant	1257.39	Significant
39	Non-ferrous metal products	139.50	Significant	848.26	Significant	1968.78	Significant
40	Metal products for construction and architecture	407.81	Significant	307.68	Significant	1234.13	Significant

41	Other metal products	533.35	Significant	1346.75	Significant	1894.34	Significant
42	General industrial machinery	614.39	Significant	614.39	Significant	1033.58	Significant
43	Special industrial machinery	1038.31	Significant	387.99	Significant	1502.66	Significant
44	Other general machines	419.20	Significant	478.85	Significant	690.78	Significant
45	Machinery for office and service industry	1252.65	Significant	424.45	Significant	1561.43	Significant
46	Electrical appliance	1298.86	Significant	371.30	Significant	1718.05	Significant
47	Motor vehicles and repair of motor vehicles	1544.29	Significant	449.12	Significant	1595.28	Significant
48	Ships and repair of ships	1095.17	Significant	659.04	Significant	1491.83	Significant
49	Other transportation equipment and repair of transportation equipment	184.56	Significant	242.04	Significant	425.81	Significant
50	Precision instruments	1390.25	Significant	210.35	Significant	2160.15	Significant
51	Miscellaneous manufacturing products	399.83	Significant	498.70	Significant	1123.70	Significant
52	Building construction	429.46	Significant	573.49	Significant	749.77	Significant
53	Repair of construction	809.97	Significant	885.27	Significant	1246.11	Significant
54	Civil	558.19	Significant	750.65	Significant	1005.64	Significant

55	Electricity	229.14	Significant	311.96	Significant	688.27	Significant
56	Gas and heat supply	279.67	Significant	72.94	Not Significant	871.84	Significant
57	Water supply	628.23	Significant	388.15	Significant	848.15	Significant
58	Waste management service	770.25	Significant	590.30	Significant	979.36	Significant
59	Commerce	216.81	Significant	458.06	Significant	807.10	Significant
60	Finance and insurance	1237.83	Significant	403.55	Significant	1722.19	Significant
61	Real estate agencies and rental services	1490.79	Significant	666.18	Significant	2007.39	Significant
62	House rent	114.69	Significant	165.68	Significant	192.46	Significant
63	Railway	406.67	Significant	300.70	Significant	858.61	Significant
64	Road transport (except transport by private cars)	517.39	Significant	537.39	Significant	799.16	Significant
65	Self-transport by private cars	406.96	Significant	525.64	Significant	667.51	Significant
66	Water transport	535.01	Significant	143.19	Significant	924.83	Significant
67	Air transport	562.75	Significant	498.10	Significant	1327.46	Significant
68	Storage facility service	496.60	Significant	521.68	Significant	757.49	Significant
69	Services relating to transport	834.28	Significant	834.28	Significant	1609.14	Significant
70	Communication	744.74	Significant	1140.04	Significant	1618.89	Significant

71	Broadcasting	242.79	Significant	140.97	Significant	1431.01	Significant
72	Public administration and activities not elsewhere classified	588.11	Significant	801.64	Significant	1725.99	Significant
73	Education	357.07	Significant	478.85	Significant	622.88	Significant
74	Research	441.51	Significant	845.61	Significant	941.93	Significant
75	Medical service, health and social security	568.11	Significant	383.55	Significant	655.98	Significant
76	Other public services	555.77	Significant	379.49	Significant	901.17	Significant
77	Business services and office supplies	769.50	Significant	414.37	Significant	1431.78	Significant
78	Personal services	616.33	Significant	616.33	Significant	973.39	Significant

Appendix 3. The GAMS program used in the analysis (Indonesian case, using the separate explanatory variables)

```
* Multivariate Least Square Analysis for IO coefficients
* 2012 11 16 by S.Mori
* revised -- input data for tables

set T period /1*3/;

* row sectors -- intermediate input and value added
* column sectors -- intermediate input and final demand

set i row sectors             /1*160/;
set j0 column sectors         /1*159/;

set j(j0);

set k0 explanatory variables /1*3/;
set k(k0)             /1,3/;

* Input Data -- using IO_data from 1985 through 2005

Table IO_DATA(t,i,j0)

;

* explanatory variable data -- Growth of GDP per capita (annual, using current US$) and
Telephone lines (per 100 people)

Table Ex_Var(k0,t)

             1           2           3
1            0.1078   0.1249   0.0972
2            0.5784   1.6504   5.9426
3            1           1           1
```

```
;


* normalization

parameter IOCHK(t,j0);

IO_DATA(t,i,j0)$(IO_DATA(t,i,j0) le 0.0)=0.0;

IOCHK(t,j0)=sum(i, IO_DATA(t,i,j0));
IO_DATA(t,i,j0)=IO_DATA(t,i,j0)/IOCHK(t,j0);

parameter IO_DATC(t,i,j0);
IO_DATC(t,i,j0)=IO_DATA(t,i,j0);
IO_DATC(t,i,j0)$(IO_DATA(t,i,j0) le 1.0e-4)=1.0;

IO_DATC(t,i,j0)=1.0;

Parameters OBJ_LR(j0);

positive variables
   IO_DATR(t,i,j0)
;

variable
   RGR_EST(j0,i,k)
   IO_ERR(t,i,j0)
   OBJ
;

Equations
   IO_DATR_DEF(t,i,j0)
   IO_ERR_DEF(t,i,j0)
   IO_CNST_DEF(t,j0)
   OBJ_DEF
;
```

```
   IO_DATR_DEF(t,i,j)..
      IO_DATR(t,i,j)=E= sum(k, RGR_EST(j,i,k)*Ex_Var(k,t));

* IO_ERR(t,i,j) relative error

   IO_ERR_DEF(t,i,j)..
        IO_ERR(t,i,j)=E=(IO_DATA(t,i,j)-IO_DATR(t,i,j))/IO_DATC(t,i,j);

   IO_CNST_DEF(t,j).. sum(i, IO_DATR(t,i,j) )=E=1.0;

   OBJ_DEF.. OBJ=E=sum(j, sum(i, sum(t, IO_ERR(t,i,j)*IO_ERR(t,i,j))));

Model MulVR /all/;

FILE FSAVE /Indonesia (1,3).CSV/;
PUT FSAVE;
FSAVE.PC=5;

loop(j0,
   j(j0)=no;
);

loop(j0,
   j(j0)=yes;

   Solve MulVR minimizing OBJ using nlp;

   OBJ_LR(j)=OBJ.L;

   j(j0)=no;

);


loop(j0,
```

```
   j(j0)=yes;
);

Put "Estimators"/;
Loop(j,
   Put "",j.TL,"column sector"/;
   Put "","","; loop(k, put k.tl); put /;
   Loop(i,
        Put "","",i.tl;
        Loop(k, Put RGR_EST.L(j,i,k):15:6);
        Put /;
   );
   Put "",OBJ_LR(j)/;
   Put //;
);

Put "Original IO coeff. data"/;
Loop(j,
   Put "",j.TL,"column sector"/;
   Put "","","";loop(t, put t.tl);put /;
   Loop(i,
        Put "","",i.tl;
        Loop(t, Put IO_DATA(t,i,j):15:6);
        Put /;
   );
   Put //;
);

Put "Estimated IO coeff. data"/;
Loop(j,
   Put "",j.TL,"column sector"/;
   Put "","","";loop(t, put t.tl);put /;
   Loop(i,
        Put "","",i.tl;
        Loop(t, Put IO_DATR.L(t,i,j):15:6);
        Put /;
```

```
    );
    Put //;
);

Put "Comparison -- Historical and Estimated"/;
Loop(j,
    Put "",j.TL,"column sector"/;
    Put "","","";loop(t, put t.tl); put /;
    Loop(i,
        Put "","",i.tl;
        Loop(t, Put IO_DATA(t,i,j):15:6); put /;

        Put "","","estimated";
        Loop(t, Put IO_DATR.L(t,i,j):15:6); put //;
    );
    Put /;
);
```

Appendix 4. The results of the Likelihood Ratio Test (LRT) calculation, Indonesian case

No.	Sector	Growth of GDP per capita	Results (for Growth of GDP per capita)	Telephone lines	Results (for Telephone lines)
1	Paddy	546.10	Significant	3661.48	Significant
2	Maize	879.64	Significant	3541.32	Significant
3	Cassava	949.84	Significant	3127.77	Significant
4	Other root crops include sweet potatoes	1005.43	Significant	2826.66	Significant
5	Groundnut	627.77	Significant	#NUM!	#NUM!
6	Soybeans	941.60	Significant	3050.93	Significant
7	Other beans	904.90	Significant	2839.21	Significant
8	Vegetables	1370.03	Significant	2035.45	Significant
9	Fruits	317.03	Significant	3327.11	Significant
10	Cereals and other food crops	678.66	Significant	991.07	Significant
11	Rubber	944.38	Significant	2687.06	Significant
12	Sugarcane	2126.95	Significant	683.04	Significant
13	Coconut	320.65	Significant	3164.00	Significant
14	Oil palm	1000.95	Significant	2017.21	Significant
15	Fibre crops	879.64	Significant	879.64	Significant
16	Tobacco	665.42	Significant	1568.77	Significant
17	Coffee	271.80	Significant	356.92	Significant
18	Tea	624.56	Significant	3675.50	Significant

19	Clove	512.72	Significant	#NUM!	#NUM!
20	Other estate crops	586.78	Significant	4895.87	Significant
21	Other agriculture	67.79	Not Significant	840.45	Significant
22	Livestock and livestock product except fresh milk	636.76	Significant	756.92	Significant
23	Fresh milk	516.90	Significant	1886.93	Significant
24	Poultry and its product	2547.11	Significant	827.02	Significant
25	Other livestock raising	436.86	Significant	558.10	Significant
26	Wood	524.68	Significant	226.93	Significant
27	Other forest product	926.48	Significant	2922.74	Significant
28	Sea fish and other sea products	599.19	Significant	2533.50	Significant
29	Inland water fish and its product	206.51	Significant	1888.94	Significant
30	Coal	451.20	Significant	941.60	Significant
31	Crude oil	758.70	Significant	3440.18	Significant
32	Natural gas and geothermal	816.75	Significant	2836.71	Significant
33	Tin ore	1024.19	Significant	539.82	Significant
34	Nickel ore	929.52	Significant	2649.61	Significant
35	Bauxite ore	780.83	Significant	122.44	Not Significant
36	Copper ore	620.99	Significant	4371.72	Significant
37	Gold and silver ore	593.35	Significant	1408.77	Significant
38	Other mining	730.16	Significant	3010.07	Significant
39	Crude salt	873.43	Significant	2967.40	Significant

40	Quarrying, all kinds	712.26	Significant	712.26	Significant
41	Meat and entrails of slaughtered animal	33.93	Not Significant	1213.83	Significant
42	Processed and preserved meat	609.84	Significant	2948.51	Significant
43	Dairy products	485.33	Significant	728.39	Significant
44	Canning and preserving of fruits and vegetables	359.01	Significant	1471.18	Significant
45	Drying and salting of fish	172.23	Not Significant	825.16	Significant
46	Processed and preserved fish	117.13	Not Significant	1080.97	Significant
47	Copra, animal oil and vegetables oil	452.43	Significant	2002.40	Significant
48	Rice	267.68	Significant	2942.14	Significant
49	Wheat flour	1500.86	Significant	1409.36	Significant
50	Other flour	555.50	Significant	740.69	Significant
51	Bakery product and the like	758.10	Significant	1879.93	Significant
52	Noodle, macaroni and the like	1877.49	Significant	530.23	Significant
53	Sugar	1328.51	Significant	1800.44	Significant
54	Peeled grain, chocolate and sugar confectionery	29.77	Not Significant	946.84	Significant
55	Milled and peeled coffee	98.68	Not Significant	1067.09	Significant
56	Processed tea	431.23	Significant	859.89	Significant
57	Soya bean products	267.43	Significant	2248.89	Significant
58	Other foods	896.94	Significant	2144.25	Significant
59	Animal feeds	558.42	Significant	458.78	Significant

60	Alcoholic beverages	741.39	Significant	3675.50	Significant
61	Non-alcoholic beverages	843.88	Significant	2319.28	Significant
62	Tobacco products	731.65	Significant	853.34	Significant
63	Cigarettes	211.07	Significant	1437.62	Significant
64	Yarn and cleaning kapok	306.01	Significant	1471.71	Significant
65	Textile	388.08	Significant	2581.27	Significant
66	Made up textile goods except wearing apparel	792.80	Significant	3379.64	Significant
67	Knitting mills	633.94	Significant	2486.66	Significant
68	Wearing apparel	872.81	Significant	2035.45	Significant
69	Manufacture of carpet, rope, twine and other textile	564.81	Significant	2528.21	Significant
70	Leather tanneries and leather finishing	583.92	Significant	2033.43	Significant
71	Manufacture of footwear and leather products	729.88	Significant	743.30	Significant
72	Sawmill and preserved wood	746.00	Significant	260.04	Significant
73	Manufacture of plywood and the like	1348.37	Significant	955.76	Significant
74	Wooden building components	677.57	Significant	2756.81	Significant
75	Manufacture of furniture and fixtures mainly made of wood, bamboo and rattan	491.94	Significant	1068.68	Significant
76	Manufacture of other products mainly made of wood, bamboo, rattan and cork	422.83	Significant	835.66	Significant

77	Manufacture of non-plastic plait	635.31	Significant	2419.61	Significant
78	Pulp	839.60	Significant	2527.14	Significant
79	Paper and cardboard	1090.13	Significant	322.02	Significant
80	Paper and cardboard products	747.52	Significant	2743.79	Significant
81	Printing and publishing	870.30	Significant	369.13	Significant
82	Basic chemical except fertilizer	911.65	Significant	2602.69	Significant
83	Fertilizer	961.87	Significant	2796.73	Significant
84	Pesticides	394.65	Significant	3106.44	Significant
85	Synthetic resins, plastic and fibre	1068.84	Significant	2413.29	Significant
86	Paints, varnishes and lacquers	922.04	Significant	2459.39	Significant
87	Drugs and medicine	682.41	Significant	2244.77	Significant
88	Native medicine	1348.79	Significant	1443.91	Significant
89	Soap and cleaning preparation	960.61	Significant	1588.38	Significant
90	Cosmetics	809.69	Significant	2341.87	Significant
91	Other chemical products	75.20	Not Significant	991.07	Significant
92	Petroleum refineries products	389.97	Significant	3573.77	Significant
93	Liquefied of natural gas	297.75	Significant	1155.81	Significant
94	Smoked and crumb rubber	72.55	Not Significant	978.76	Significant
95	Tire	272.52	Significant	1092.76	Significant
96	Other rubber products	476.49	Significant	468.16	Significant
97	Plastic products	129.50	Not Significant	536.77	Significant
98	Ceramic and earthenware	609.26	Significant	1940.11	Significant

99	Glass products	947.89	Significant	723.62	Significant
100	Clay and ceramic structural products	225.45	Significant	672.89	Significant
101	Cement	570.50	Significant	1913.47	Significant
102	Other non-ferrous products	938.55	Significant	1641.14	Significant
103	Basic iron and steel	541.42	Significant	2414.86	Significant
104	Basic iron and steel products	1955.92	Significant	481.28	Significant
105	Non-ferrous basic metal	267.92	Significant	2118.08	Significant
106	Non-ferrous basic metal products	626.23	Significant	607.22	Significant
107	Kitchen wares, hand tools and agricultural tools	793.61	Significant	1069.79	Significant
108	Furniture and fixed primarily made of metal	772.48	Significant	730.28	Significant
109	Structural metal products	742.07	Significant	2544.08	Significant
110	Other metal products	609.26	Significant	914.98	Significant
111	Prime movers engine	317.66	Significant	2599.73	Significant
112	Machinery and apparatus	110.47	Not Significant	1465.01	Significant
113	Electric generator and electrical motor	128.85	Not Significant	1802.36	Significant
114	Electrical machinery and apparatus	747.93	Significant	1899.65	Significant
115	Communication, electronical equipment and apparatus	922.46	Significant	1193.04	Significant
116	Household electronics appliances	1321.80	Significant	1286.46	Significant
117	Other electrical appliances	704.26	Significant	1532.46	Significant

118	Battery and storage battery	212.06	Significant	1470.22	Significant
119	Ship and its repair	919.60	Significant	1082.70	Significant
120	Train and its repair	157.81	Not Significant	491.96	Significant
121	Motor vehicle except motor cycle	359.71	Significant	941.60	Significant
122	Motor cycle	189.91	Significant	742.26	Significant
123	Other transport equipment	300.44	Significant	758.61	Significant
124	Aircraft and its repair	762.72	Significant	828.95	Significant
125	Measuring, photographic and optical equipment	594.28	Significant	439.78	Significant
126	Jewelry	26.89	Not Significant	1084.29	Significant
127	Musicals instruments	347.63	Significant	2429.92	Significant
128	Sporting and athletics goods	900.74	Significant	1023.09	Significant
129	Other manufacturing industries	674.97	Significant	2496.21	Significant
130	Electricity and gas	2231.58	Significant	336.46	Significant
131	Water supply	263.23	Significant	2407.48	Significant
132	Residential and non residential buildings	517.44	Significant	1720.09	Significant
133	Construction on agriculture	1729.46	Significant	732.99	Significant
134	Public work on road, bridge and harbor	766.57	Significant	821.44	Significant
135	Construction and installation on electricity, gas, water supply and communication	321.98	Significant	729.45	Significant
136	Other construction	879.64	Significant	550.41	Significant

137	Trade	403.47	Significant	3560.33	Significant
138	Restaurant	1746.39	Significant	499.08	Significant
139	Hotel	964.40	Significant	1124.77	Significant
140	Railway transport	933.93	Significant	2061.08	Significant
141	Road transport	1402.65	Significant	2022.57	Significant
142	Sea transport	1308.25	Significant	2067.41	Significant
143	River and lake transport	1111.15	Significant	2462.35	Significant
144	Air transport	1063.52	Significant	2201.71	Significant
145	Services allied to transport	1149.17	Significant	2171.29	Significant
146	Communication services	1187.29	Significant	1965.79	Significant
147	Banking and other financial intermediaries	887.00	Significant	3349.35	Significant
148	Insurance and pension fund	964.40	Significant	53.62	Not Significant
149	Building and land rent	813.41	Significant	#NUM!	#NUM!
150	Business services	441.15	Significant	1161.44	Significant
151	General government	31.10	Not Significant	1185.59	Significant
152	Education services	637.59	Significant	3774.55	Significant
153	Health services	842.25	Significant	500.92	Significant
154	Other community services	532.14	Significant	1641.68	Significant
155	Private motion picture and its distribution	812.21	Significant	576.53	Significant
156	Amusement, recreational and cultural services (private)	275.36	Significant	658.12	Significant

157	Repair shop n.e.c	323.01	Significant	676.03	Significant
158	Personal and household services	379.50	Significant	1868.07	Significant
159	Other goods and services n.e.c	100.38	Not Significant	583.18	Significant