

# Analyzing the Role of ICT Sector to the National Economic Structural Changes: the Case of Indonesia

Ubaidillah Zuhdi  
School of Business and Management  
Institut Teknologi Bandung

Dhanan Sarwo Utomo  
School of Business and Management  
Institut Teknologi Bandung

Dini Turipanam Alamanda  
School of Management in Telecommunication and Media  
Institut Manajemen Telkom

## Abstract

*The one of technology which has the most significant role in human lives is Information and Communication Technology (ICT). This study is conducted to analyze the role of ICT in economic aspect of Indonesia from 1990 through 2005. The term of economic aspect used in this study is refers to the national economic structural changes. Structural decomposition analysis, the one of input-output analysis method, is used in this study. Analysis from macroscopic view shows that ICT sectors had not significant role in national economic structure changes of Indonesia between 1990 and 2005. In order to enhance economic growth of Indonesia, Indonesia government should improve the coherence and predictability and credibility aspect of ICT regulations.*

*Keywords: ICT, structural decomposition analysis, macroscopic view, ICT regulations.*

## Abstrak

*Salah satu teknologi yang memiliki peran yang paling signifikan di dalam kehidupan manusia adalah Teknologi Informasi dan Komunikasi (TIK). Studi ini dilakukan untuk menganalisa peran TIK di dalam aspek ekonomi Indonesia dari tahun 1990 hingga 2005. Istilah aspek ekonomi yang digunakan dalam studi ini merujuk pada perubahan struktural ekonomi nasional. Analisa dekomposisi struktural, salah*

*satu metode di analisa Input-Output, digunakan di dalam studi ini. Analisa dari sudut pandang makroskopik menunjukkan bahwa sektor TIK tidak memiliki peran yang signifikan di dalam perubahan struktural ekonomi nasional Indonesia di antara tahun 1990 dan 2005. Untuk meningkatkan pertumbuhan ekonomi Indonesia, pemerintah Indonesia sebaiknya memperbaiki aspek coherence dan predictability and credibility pada peraturan-peraturan yang terkait dengan TIK.*

*Kata kunci: TIK, analisa dekomposisi struktural, sudut pandang makroskopik, regulasi TIK.*

## 1. Introduction

According to Langmia (2005), in recent times, the role of technology in improving the lives of the people cannot be underestimated. In other words, the role of technology in human lives is significant. As evidence, many aspects of human lives use technology such as energy, agricultural, and educational aspect. The one of technology which has the most significant role in human lives is ICT. In recent times, almost all of people in the world use ICT. They use ICT not only on their work, but also on their daily activities. Therefore, it can be said that ICT can not be locked out of human activities. ICT also has a potential in drumming up the economic growth of one country. According to Nasab & Aghaei (2009), economic growth theories predicted that the growth of economy of one country is driven by investments in ICT. In other words, if countries want to increase their economic growth, they should do the investment in ICT sector.

This study is conducted to analyze the role of ICT in economic aspect of Indonesia from 1990 through 2005. The term of economic aspect used in this study is refers to the national economic structural changes. Two research questions want to be answered in this study. Those are (1) what the national economic structural changes in Indonesia, from macroscopic view, are like? And (2) what are the recommendations that can be given from this study? The authors believe that the recommendations given from this study, regarding ICT sector in Indonesia, can enhance economic growth of Indonesia.

This paper consists of six chapters. Section 1 discusses the background of this study. Section 2 briefly discusses the literature review which has relationship with this study. Section 3 provides the methodology used in this study. Section 4 points to the result and analysis of this study. Section 5 provides some conclusions of this study. Section 6 discusses the potential of future research which can be conducted after this.

## 2. Literature Review

### 2.1. ICT

According to Santibanez & Castillo (2011), ICT usually defined as computer hardware, software and telecommunications equipment. They said also that countries with higher growth rates in ICT investment achieved consistently higher growth rates of GDP and productivity, confirming the hypothesis of ICT-led development. OECD member countries agreed to define the ICT sector as a combination of manufacturing and services industries that capture, transmit, and display data and information electronically (Viitanen, 2003).

ICT has a contribution to aggregate labor productivity growth. Figure 1 explains about that.

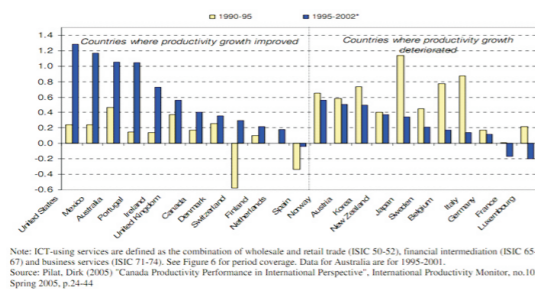


Figure 1. Contribution of ICT-Using Services to Aggregate Labor Productivity Growth, 1990 – 1995 and 1996 – 2002 (Total Economy, Value Added per Person Employed, Contributions in Percentage Points)  
Source: Sharpe, 2006

## 2.2. Structural Changes

Structural changes defined as permanent or long-run change in the characteristics that define the framework of the economy (Baldwin & Rafiqzaman, 1994). Structural change also can be defined as the process by which an economy is progressively transformed over time. Change can occur across industries, within industries or at the level of the firm (Downes & Stoeckel, 2006). Moreover, structural change is associated with modifications in the relative importance of different sectors over time, measured by their share of output or employment (Memedovic, 2009).

## 2.3. Input-Output Analysis

According to Miller and Blair (2009), the basic Leontief input-output model is generally constructed from observed economic data for a specific geographic region (nation, state, country, etc.). One is concerned with the activity of a group of industries that both produce goods (outputs) and consume goods from other industries (inputs) in the process of producing each industry's own output. In practice, the number of industries considered may vary from only a few to hundreds or even thousands. For instance, an industrial sector title might read "manufactured products," or that same sector might be broken down into many specific products.

They also said that 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 inter-industry 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.

The additional columns, labeled Final Demand, record the sales by each sector to final markets for their production, such as personal consumption purchases and sales to the federal government. For example, electricity is sold to businesses in other sectors as an input to production (an inter-industry transaction) and also to residential consumers (a final-demand sale). The additional rows, labeled Value Added, account for the other (non-industrial) inputs to production, such as labor, depreciation of capital, indirect business taxes, and imports.

According to Miller and Blair (2009), the equation accounting for the way in which sector  $i$  distributes its product through sales to other sectors and to final demand (assume that the economy can be categorized into  $n$  sectors) can be seen in following statements.

$$X_i = Z_{i1} + \dots + Z_{ij} + \dots + Z_{in} + f_i = \sum_{j=1}^n Z_{ij} + f_i \quad (1)$$

where:

- $X_i$  = Total output (production) of sector  $i$
- $F_i$  = Total final demand for sector  $i$ 's product
- $Z_{ij}$  = Interindustry sales by sector  $i$  (also known as intermediate sales) to all sectors  $j$  (including itself, when  $j=i$ )

Since economic structural changes mentions about changes of economic condition on specific period, the tool which most appropriate in representing that is input-output analysis.

## 2.4. Structural Decomposition Analysis

This section discusses about the structural decomposition analysis, one tool in input-output analysis which can be used when analyzing the data in input-output table. According to Shikanwita, Tuhin and Debesh (2004), the definition of structural decomposition analysis is a tool which used to study and discusses changes over time. The main idea of this analysis is that the change in some variable is decomposed, usually in an additive way, into the changes in its determinant. Accordingly, quantifying the underlying source of the changes will become possible.

They used structural decomposition analysis in order to identify the sources of growth of the Indian information sector during the period 1983 – 1984 to 1993 – 1994 with 1989 – 1990. In other hand, Akita & Chu (2008) used this method in order to examine the sources of output growth in Vietnam during 1996 – 2000 and conducted a comparative analysis on Vietnam from 1996 – 2000, Indonesia from 1990 – 1995 and Malaysia from 1987 – 1991.

## 2.5. Previous Study on ICT Area

There have been several studies on ICT Area. Koomey and Sanstad (1994) focused on the empirical basis for skepticism about the effectiveness of the market mechanism in promoting cost-effective energy-efficiency improvements. Stratopoulos & Dehning (2000) strived to find a better way to study the impact of using IT successfully on a company's financial performance. Koomey (2007) estimated total electricity used by servers in the U.S. and the world by combining measured data and estimates of power used by the most popular servers with data on the server installed base. The study of ICT area on Indonesia, however, is still lack. This study is conducted to fulfill that shortage. In the same time, that is the originality of this study.

## 3. Methodology

Secondary data is used in this study. Secondary data used in this study is input-output table for Indonesia. Input-output tables of Indonesia for 1990, 1995, and 2005 are used in this study. The judgments in choosing those are data availability and because of newest period. The reason of using newest data is in order to get the latest analysis of condition in Indonesia.

Survey data is also used in this study. In this study interview with experts is done to get that data. The other purpose of conducting interview, besides to get survey data and information related to this study, is to get the proper argument in using secondary data in this study, especially for 2005 input-output table of Indonesia.

The data aggregation is done before conducting the data calculation. The data aggregation is done in order to get the equal sector for each input-output table so the calculation can be done. The Indonesia 1990 and 1995 tables consist of 161 and 172 sectors while 2005 table consists of 175 sectors. In this study, those tables are transformed or aggregated into 159 sectors. The ICT sectors for Indonesia are construction and installation on electricity, gas, water supply and communication (sector number 135) and communication services (sector number 146). The one of input-output analysis method, known as structural decomposition analysis, is used to calculate the data in this study. The equation of that method can be seen in following explanation.

$$X = AX + D + E - M \quad (2)$$

X, D, E, and M are vectors of gross output, domestic final demand, exports, and imports, respectively. A is a matrix of technical coefficients. After experiencing modification, equation (2) can be written as

$$\Delta X = DD + EE + IS + IO \quad (3)$$

Where  $\Delta X$ , DD, EE, IS, and IO are the change in gross outputs, effect of the expansion of domestic final demand, effect of export expansion, effect of the changes in import ratios (domestic supply ratios) or import substitution, and effect of the changes in technical coefficient, respectively (Akita & Chu, 2008). Since the domestic final demand, DD, consists of outside households, private expenditure, governmental expenditure and stock changes, the effects derived by the domestic final demand can be also disaggregated.

Accordingly, the expansion of domestic final demand can be decomposed into four factors. In this study those are (1) consumption expenditure of outside households, called DD1, (2) consumption expenditure of private, called DD2, (3) consumption expenditure of general government and social fixed capital depreciation, called DD3, and (4) capital formation and increase in stocks, called Dd4. After conducting calculation, the recommendations are generated based on the data calculation results and those analyses. Besides of that, those recommendations are generated based on the fact on filed. Those recommendations are about ICT policy recommendations on Indonesia.

#### 4. Result and Analysis

In order to properly know the national economic structural changes in Indonesia, from macroscopic view, between 1990 and 2005, that period time is divided into the two parts. First one, called first period, is between 1990 and 1995 while the other one, called second period, is between 1995 and 2005.

##### 4.1. First Period (1990 – 1995)

Table I shows the top five sectors which influential in Indonesia structural changes on first period. Based on the explanation of table I, there is no ICT sectors include in the top five sectors that Influential in Indonesia structural changes on first period.

Table I. The Top Five Sectors which Influential in Indonesia Structural Changes on First Period

No	Sector No.	Sector Name	Value (100 Million Rupiahs)
1	137	TRADE	487268.52
2	132	RESIDENTIAL AND NON RESIDENTIAL BUILDINGS	306269.37
3	150	BUSINESS SERVICES	238193.25
4	138	RESTAURANT	212883.49
5	147	BANKING AND OTHER FINANCIAL INTERMEDIARIES	202307.68

The information about value of each factors which influential in Indonesia structural changes on first period can be seen on table II. Based on the information in that table, the factor most influential in Indonesia structural changes on first period is DD2, consumption expenditure of private. In other words, between 1990 and 1995, the Indonesia private side was "very active" in doing their economic activity. In the other hand, the factor which had smallest value on first period is IS, import substitution. This phenomenon indicated that the import activity on Indonesia between 1990 and 1995 was "very sluggish".

Table II. Value of Each Factors which Influential in Indonesia Structural Changes on First period

No	Factor	Value (100 Million Rupiahs)
1	DD2	4414603.56
2	DD4	1910534.32
3	EE	1376896.92
4	DD3	261721.65
5	IO	59948.99
6	DD1	0
7	IS	-1767595

##### 4.2. Second Period (1995 – 2005)

Table III shows the top five sectors which influential in Indonesia structural changes on second period. Based on the explanation of that table, there is no ICT sector include in the top five sectors that Influential in Indonesia structural changes on second period.

Table III. The Top Five Sectors which Influential in Indonesia Structural Changes on Second Period

No	Sector No.	Sector Name	Value (100 Million Rupiahs)
1	137	TRADE	4289107.11
2	132	RESIDENTIAL AND NON RESIDENTIAL BUILDINGS	2369657.07
3	138	RESTAURANT	1599208.04
4	134	PUBLIC WORK ON ROAD, BRIDGE AND HARBOR	1437422.16
5	31	CRUDE OIL	1396709.27

The information about value of each factors which influential in Indonesia structural changes on second period can be seen on table IV. Based on the information in that table, the factor most influential in Indonesia structural changes on second period is DD2, consumption expenditure of private.

In other words, between 1995 and 2005, the Indonesia private side was "very active" in doing their economic activity. In the other hand, the factor which had smallest value on second period is IS, import substitution. This phenomenon indicated that the import activity on Indonesia between 1995 and 2005 was "very sluggish".

Table IV. Value of Each Factors which Influential in Indonesia Structural Changes on Second Period

No	Factor	Value (100 Million Rupiahs)
1	DD2	27534509.96
2	EE	16485082.16
3	DD4	13304316.77
4	DD3	3544379.13
5	IO	465733.05
6	DD1	0
7	IS	-14468174.20

### 4.3. ICT Regulations on Indonesia

Based on above explanations, from macroscopic view, ICT sectors had not significant role in national economic structure changes of Indonesia between 1990 and 2005. It is no surprised if the question "why that phenomenon is happened?" appear. This study tries to analyze that phenomenon from ICT regulations view. ICT regulations are chosen because those indicate seriousness of government in implementing ICT. In other words, if ICT regulations are better, implementation of ICT in one country is also better, then the ICT role to the economic aspects will also increase. According to Ehrhardt et al. (2007), good regulation should have the three attributes. Those are (1) Coherence, (2) Predictability and Credibility, and (3) Legitimacy, Transparency, and Accountability. The ICT regulations of Indonesia would be seen from those attributes. Each attributes are divided into the sub attributes. Coherence attribute is divided into the three sub attributes.

There are (1) the regulatory system should be able to select, (2) the regulatory system should settle on the right combination of tariffs and subsidies, and (3) the regulatory system should settle on the right combination of service standards and coverage. Predictability and credibility attribute is divided into the three sub attributes. There are (1) regulatory decisions should be time-consistent, (2) regulatory decisions should be made on clear precedents, and (3) regulatory decisions should be made on clear rules. Legitimacy, transparency, and accountability attribute is divided into the three sub attributes. There are (1) regulatory decisions need to be clear, (2) regulatory decisions is widely accepted, and (3) regulatory decisions is publicly accessible. In this study, The ICT regulations of Indonesia from 2004 through 2010 are used. Those periods used since relatively new then the actual condition can be seen. The information about condition of Indonesia ICT regulations can be seen in table V.

Table V. The Condition of Indonesia ICT Regulations

Attributes	Definition (Ehrhardt et al., 2007)	Sub Attributes	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	X
		The regulatory system should settle on the right combination of tariffs and subsidies	X
		The regulatory system should settle on the right combination of service standards and coverage	V
Predictability and Credibility	Regulatory decisions should be time-consistent, and made on clear precedents and rules	Regulatory decisions should be time-consistent	X
		Regulatory decisions should be made on clear precedents	V
		Regulatory decisions should be made on clear rules	V
Legitimacy, Transparency, and Accountability	Regulatory decisions need to be clear, widely accepted, and publicly accessible	Regulatory decisions need to be clear	V
		Regulatory decisions is widely accepted	V
		Regulatory decisions is publicly accessible	V

Based on the explanation in table V, it makes sense to say that implementation of ICT regulations in Indonesia still have a shortage. That table also explains the reason of why ICT sectors have not significant role in structural changes of Indonesia between 1990 and 2005.

### 4.4. Policy Recommendations

The ICT regulation / policy recommendations can be given, based on the explanation in table V, from this study are:

1. Indonesia government should improve the coherence aspect, especially on the sub attribute of "the regulatory system should be able to select". This is needed to increase awareness of people and all elements in the country aware about importance of ICT and to make sure that regulatory system can be accessed every time.
2. Indonesia government should improve the coherence aspect, especially on the sub attribute of "the regulatory system should settle on the right combination of tariffs and subsidies". This is needed to increase the role of government on ICT implementation.
3. Indonesia government should improve the predictability and credibility aspect, especially on the sub attribute of "regulatory decisions should be time-consistent". This is needed to make clear the time limit (deadline) of targets would be achieved so the consistency in achieving those targets appears.

### 5. Conclusion and Future Research

This section discusses about conclusions of this study. There are two conclusions in this study. The first conclusion in this study is analysis from macroscopic view shows that ICT sectors had not significant role in national economic structure changes of Indonesia between 1990 and 2005. Based on the analysis from macroscopic view, the sector which had the most significant role in national economic structure changes of Indonesia between 1990 and 2005 is trade sector. This phenomenon indicates that Indonesia government should more focus and active in investing on ICT sector since countries with higher growth rates in ICT investment achieved consistently higher growth rates of GDP and productivity. The second conclusion in this study is Indonesia government should improve the coherence and predictability and credibility aspect of ICT regulations. In more specific terms, second conclusion can be divided into the two aspects.

Those are (1) Indonesia government should improve the coherence aspect, especially on the sub attribute of "the regulatory system should be able to select" and "the regulatory system should settle on the right combination of tariffs and subsidies", and (2) Indonesia government should improve the predictability and credibility aspect, especially on the sub attribute of "regulatory decisions should be time-consistent". The authors believe that the recommendations given from this study can enhance economic growth of Indonesia.

The future researches suggested from this study are:

- (1) Considering other sector in analyzing national economic structural changes of Indonesia, such as energy sector.
- (2) Considering other aspects, not only ICT regulations, in order to describe the ICT phenomenon in Indonesia.
- (3) Considering the comparison with other ICT developed countries, such as Japan, in order to know the difference of ICT role in national economic structural changes.



## References

- Akita, T., & Chu, T.T.H. (2008). Inter-sectoral Interdependence and Growth in Vietnam: A Comparative Analysis with Indonesia and Malaysia. *Applied Input-Output Analysis*, 13 & 14 61-81.
- Baldwin, J., & Rafiqzaman, M. (1994). *Structural Change in the Canadian Manufacturing Sector; 19970-1990*. <http://www.google.co.id/url?sa=t&rct=j&q=structural+change+definition+pdf&source=web&cd=23&ved=0CCsQFjACOBQ&url=http%3A%2F%2Fciteseerx.ist.psu.edu%2Fviewdoc%2Fdownload%3Fdoi%3D10.1.1.196.4005%26rep%3Drep1%26type%3Dpdf&ei=UynvTpvSA4jLrQeoy835CA&usg=AFQjCNGkIHYYUpen6BVKgctz7ZpYy4hl0A&cad=rja>. [Retrieved December 19, 2011].
- Downes, P., & Stoeckel, A. (2006). *Drivers of Structural Change in the Australian Economy*. <http://www.theicie.com.au/content/publications/MASTER%20DITR%2026%20Feb.pdf>. [Retrieved December 19, 2011].
- Ehrhardt, D., et al. (2004). *Economic Regulation of Urban Water and Sanitation Services: Some Practical Lessons*. [http://www.waterfinancesite.org/1\\_%20Regulation%20of%20Urban%20Water%20and%20Sanitation%20Services\(4\).pdf](http://www.waterfinancesite.org/1_%20Regulation%20of%20Urban%20Water%20and%20Sanitation%20Services(4).pdf). [Retrieved June 25, 2011].
- Koomey, J.G. (2007). *Estimating Total Power Consumption by Servers in the U.S. and the World*. <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.87.5562&rep=rep1&type=pdf>. [Retrieved August 11, 2011].
- Koomey, J.G., & Sanstad, A.H. (1994). Technical Evidence for Assessing the Performance of Markets Affecting Energy Efficiency. *Energy Policy* 22 (10): 826-832.
- Langmia, K. (2005). The Role of ICT in the Economic Development of Africa: The Case of South Africa. *International Journal of Education and Development Using Information and Communication Technology* 2 (4): 144-156.
- Memedovic, O. (2009). *Structural Change in the World Economy: Main Features and Trends*. [http://www.unido.org/fileadmin/user\\_media/Publications/RSF\\_DPR/WP242009\\_Ebook.pdf](http://www.unido.org/fileadmin/user_media/Publications/RSF_DPR/WP242009_Ebook.pdf). [Retrieved December 19, 2011].
- Miller, R.E., & Blair, P.D. *Input-Output Analysis: Foundations and Extensions – 2<sup>nd</sup> Ed.* The Edinburgh Building, Cambridge: Cambridge University Press, 2009
- Nasab, E.H., & Aghaei, M. (2009). The Effect of ICT on Economic Growth: Further Evidence. *International Bulletin of Business Administration* 5: 46-56.
- Santibanez, A.L.V., & Castillo, O.N. (2011). Information and Communication Technologies (ICT) and Mexican Manufacturing Exports. *EJISDC* 48 (4): 1-18.
- Sharpe, A. (2006). *The Relationship between ICT Investment and Productivity in the Canadian Economy: A Review of the Evidence*. <http://www.csls.ca/reports/csls2006-05.pdf>. [Retrieved December 19, 2011].
- Shikanwita, J.R., Tuhin, D., & Debesh, C. (2004). Sources of Growth of Information Sector in India During 1983-84 to 1993-94. *Applied Input-Output Analysis* 10: 16-38.
- Stratopoulos, T., & Dehning, B. (2000). Does Successful Investment in Information Technology Solve the Productivity Paradox? *Information & Management* 38: 103-117.
- Viitanen, A.K. (2003). *The Role of ICT in Poverty Reduction*. [http://www.etla.fi/files/895\\_FES\\_03\\_1\\_role\\_of\\_ict.pdf](http://www.etla.fi/files/895_FES_03_1_role_of_ict.pdf). [Retrieved December 19, 2011].