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Research on the Granger Causality of ICT Trade and GDP

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Abstract

This study is to determine the impact of the ICT industry ofthe economic aspects - though it occupies a significant percentage of the global economy, the ICT industry has been largely unnoticed in other industrial researches in the meantime. In other words, from the perspective of a single country's ICT industry, this study identifies the global ICT industry's latest trends and proposes a strategy through the relevance between the global ICT industry environment and economic indicators in a macroscopic point of view. This study determines the causal relationship between GDP and recent ICT trade due to theglobalization of the ICT industry and derives a strategy for GDP increase. The results of this study suggest two important points: (1)the ICT industry is experiencing specialization through the selection and focus within the global economic environment to ensure the country-specific ICT industry and for increase in GDP;(2) the fusion service capacity needs to be expanded through ICT business-to-M&A guided, and national focus on fundamental technology in the ICT industry are major strategies.

Keywords: Granger Causality, ICT Trade, GDP, ICT Industry, China

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1 Introduction

According to the globalization trend of the ICT industry, the ICT industry's main target market is the overseas market rather than the domestic market [1]. The ICT industry's latest trend shows the need for ICT industrial research with economic

indicators to beimproved. In other words, since the ICT industry occupies a significant percentage of the global economic environment, the importance of understandingthe meaning of terms in an economic aspect may be growingwhile interdependence is increasing among countries.

However, meantime ICT researchers placed the main attention onmicro technological innovation. That is, rather than considering the trend of globalization in terms of macro-economic research topics, ICT researchershave had a lot of interest in the topics related to micro-economic aspects such as information technology or organization management. Therefore, this study tries to find an answer to the following questions that mention economic changes by the recent globalization of the ICT industry.

What types of relationship between ICT industry and economic indicators exists due to the globalization of the ICT industry? What is the corresponding ICT industry strategy?

Some questions about the relevance between the ICT industry and economic indicators are very interesting to ICT researchers, investors and policy makers alike, because the procedure that tried to find answer to these questions requiresa new point of view different from those of meantime researches. Also, if we can find the answer, it can be the most important evidence for investment onICT industry and policy decision on= the industry. Therefore, at first, this study tries to understand the relationships between economic indicators and ICT trade using both GDP data which is important as an economic indicator and ICT trade data in some major countries. And then, this study suggeststhe optimal strategy for ICT industry.In other words, through understanding the causal relationship and mutual influence between ICT trade and GDP,this study is aimed to draw some implications about national ICT strategy and to understand recent ICT industry environment after experiencing globalization. .

2Research Hypothesis

In the meantime, the discussions about the economic impact of ICT industry focused mainly on micro productivity improvements, expansion of employment, enterprise competitiveness and improvement of yields [2]. However, economics has understood the impact ofthe relationship between overseas production and export in the macro-scope perspective [3]. As a result, it has been interested in examining the complementary relationship between imports of intermediate goods and exports of final goods by analyzing mutual influence among them through transfer of some producing basis [4]. Complementary relationship of these exports and imports has become a major trend of the ICT industry in recent years [5]. For example, in the United States, the process whose labor productivity in the production is lower is transferred to other countries that only focused on high value-added industry; but in China, the ICT component manufacturing industry has emerged as a large axis of the national economic growth [6]. This complementary relationship can be connected to the differences between national economies. In addition, the precedence relationship between trade and economic growth was also a major concern of researchers in the meantime. In other words, unlike the ICT industry in the past, the trend of recent ICT

industry turned mainly into trade between two countries so that understanding the precedence relationship can significantly affect policy decisions on the ICT industry [7]. Eventually, the causal relationship between ICT trade and GDP is necessary to be first understood in order to determine the precedence relationship among ICT industry and economic indicators in global economy environment [8]. If it is possible to understand what relationship between ICT trade and GDP can be formed, such as causal or mutual influence, we can identify that the globalization of the ICT industry affects all national changes in the ICT industry and economic indicator. Therefore,we propose the following hypotheses on ICT trade and economic indicators to examine whether the relationship is causal.

Hypothesis 1: A causal relationship exists between the level of ICT trade andGDP.

Hypothesis 2: A causal relationship exists betweenGDP and the level of ICT trade.

3Analysis

3.1Data Collection

ICT trade and GDP data are used for analysis of the causal relationship, as shown in Table 1.Data acquisition targets adopted by the 1988 International Convention on the international Harmonized Commodity Description System (Harmonized Commodity Description and Coding System), 85 types of data associated with the flow of the ICT industry (electrical equipment, TV, VTR) were collected. For analysis, ICT exports, ICT imports and the increase of GDP by year was used. However, if the material available in China is different from that, it is because it has done since 1998.

Table 1.Analyzed data

	US	Japan	Korea	China
Analyzing period	1990~2010	1990~2010	1990~2010	1999~2010
Data source	Department of Commerce	Tariff Association of Japan	Korea Customs Service Communist	Chinese Customs house

3.2Analysis Procedures

Figure 1 shows the analytical procedures performed to analyze the relationship betweenGDP and ICT trade. First, the time series data for the stability of the difference (difference) must be selected for the planned amount; it was conducted for the unit root test and was carried out until you are satisfied with the difference. Second, the time lag test is conducted to estimate the time lag,and then the granger causality test is conducted in order to select the optimal level for analysis of the causes and consequences (interaction) between ICT exports, ICT imports and GDP.

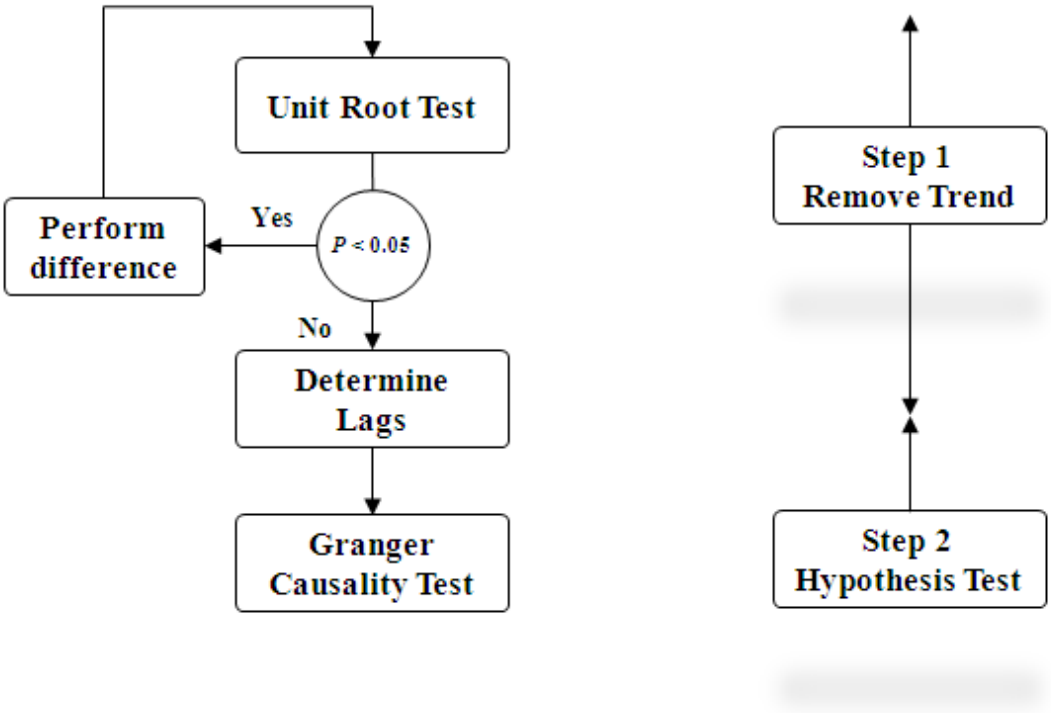

Fig 1. Analysis procedures

3.3Empirical Model

In this section, we introduce an empirical model which uses the unit root test and then the optimum parallax granger causality test to ensure the stability of time-series data. To determine the causal relationship between ICT exports, ICT imports and GDP, we establish the model as follows. Through this model, we determine that if, in each expression, α, β, γ =0 is adopted by test, there is no granger causality for the corresponding parameters.

$$GDP_t = \alpha + \alpha_1 GDP_{t-1} + \cdots + \alpha_p GDP_{t-p} + \beta_1 ICTimport_{t-1} + \cdots + \beta_q ICTimport_{t-q} + \gamma_1 ICTexport_{t-1} + \cdots + \gamma_r ICTexport_{t-r} + \varepsilon_t$$

$$ICTimport_t = \alpha + \alpha_1 GDP_{t-1} + \cdots + \alpha_p GDP_{t-p} + \beta_1 ICTimport_{t-1} + \cdots + \beta_q ICTimport_{t-q} + \gamma_1 ICTexport_{t-1} + \cdots + \gamma_r ICTexport_{t-r} + \varepsilon_t$$

$$ICTexport_t = \alpha + \alpha_1 GDP_{t-1} + \cdots + \alpha_p GDP_{t-p} + \beta_1 ICTimport_{t-1} + \cdots + \beta_q ICTimport_{t-q} + \gamma_1 ICTexport_{t-1} + \cdots + \gamma_r ICTexport_{t-r} + \varepsilon_t$$

If none of the three expressions is zero, the unit root test and the optimum parallax granger causality test are conducted to examine the influence between ICT

exports, ICT imports and GDP, and each dependent variable and other variables in their observations of the explanatory variables are set to the past.

$$GDP_t = \alpha_1 + \delta_1 t + \alpha_{11} GDP_{t-1} + \cdots + \alpha_{1p} GDP_{t-p} + \beta_{11} ICTimport_{t-1} + \cdots + \beta_{1p} ICTimport_{t-p} + \gamma_{11} ICTexport_{t-1} + \cdots + \gamma_{1p} ICTexport_{t-p} + \varepsilon_{1t}$$

$$ICTimport_t = \alpha_2 + \delta_2 t + \alpha_{21} GDP_{t-1} + \cdots + \alpha_{2p} GDP_{t-p} + \beta_{21} ICTimport_{t-1} + \cdots + \beta_{2p} ICTimport_{t-p} + \gamma_{21} Z_{t-1} + \cdots + \gamma_{2p} Z_{t-p} + \varepsilon_{2t}$$

$$ICTexport_t = \alpha_3 + \delta_3 t + \alpha_{31} GDP_{t-1} + \cdots + \alpha_{3p} GDP_{t-p} + \beta_{31} ICTimport_{t-1} + \cdots + \beta_{3p} ICTimport_{t-p} + \gamma_{31} ICTexport_{t-1} + \cdots + \gamma_{3p} ICTexport_{t-p} + \varepsilon_{3t}$$

Using the above model represents the granger causality by using granger causality function. Assuming that all the orthogonal error terms are fixed, when the error term increases at time t, that t + s point affects the explanatory variables are measured. In addition, by using the above model, variables can be decomposed, such that the fluctuation of certain variables in the model can be separated into several variables, andits impact is then identified due to that change.

4 Results and Discussion

If the uncertainty of cause and effect exists, Granger Causality Tests can be a method tolet us know the cause and effect of an event, using the differential distribution model. The results of substituting previously verified time difference to variables areshown in table 2.

Table 2. Result of granger causality test

From	GDP		Import		Export	
To	Import	Export	GDP	Export	GDP	Import
U.S	0.009	0.085	0.109	0.023	0.030	0.005
Japan	0.628	0.757	0.500	0.514	0.363	0.458
Korea	0.000	0.000	0.000	0.000	0.000	0.000
China	0.000	0.000	0.237	0.000	0.092	0.000

Depending on the results of Table 2, the causal relationships between ICT exports, ICT imports and GDP are arranged by country. According to the results, causal relationshipswere confirmed to exist between the ICT imports, the ICT exports and GDP in all countries except Japan, and the causal relationships differ from on country to another. In the United States, in the form of which ICT export affects GDP and GDP affects the ICT import, ICT exports, GDP, ICT imports werefound to be in a

cyclical relationship. In Japan, there isno causal relationship at all amongthose three factors. In other words, the GDP of Japan does not have a significant impact on ICT exports and imports. On the other hand, South Korea and China have somewhat different causal relationships than the U.S. Korea's ICT exports, ICT imports and GDP growth are relatedclosely with each other, forming a causal relationship, which is the same in China.

5 Conclusion

Identifying the causal relationship between ICT trade and GDP, the mutual influence of national ICT industry and GDP can be significant contributions to industrial research for determining global changes in the ICT industry and strategy for the ICT industrial growth. However, previous ICT researches have mainly focused on development strategies by the national factors and has not been interested in factors about ICT trade. In other words, as the growthage of the global ICT comes, it could not reflect the trend that ICT trade between countries becomes more important. In addition, previous studies used statistical analysis of questionnaires have problem that they didnot consider real environment. In other words, they have limits onexplaining real market trend because the sample has almost no representativeness. In real environment and market, so many factors are giving and taking their mutual influence, but the survey-based, statistical analysis cannot reflect this situation perfectly. Thus, when taking into account the rapidly changing ICT environment, many limits for ICT strategy in somewhat unrealistic aspects are found. It may be possible to say that this study overcomes these limits since it is based on data which reflects real situations and trends. Through this study, we can find causal relationship and mutual influence between ICT trade and GDP due to recent globalization of the ICT industry in four major countries. In other words, this study shows that there are specialization by selection and focus in the ICT industry, and it is helpful to understand the causal relationship and mutual influence between ICT trade and GDP. That means, the cases of the United States, Korea, and China, excluding Japan, support our hypothesis about the existence of causal relationship between two factors. In US, we can confirm the ICT import's significant impact and in China and South Korea, GDP is the most relevant. In Japan, there's no causal relationship on any factors, though. In addition, ICT trade changes due to the growth of GDP and it has different effects on each countries. In the US, it was short term in contrary to that in China and Korea. ICT import in the US was the only factor for the ICT trade changes or GDP, while in Korea not only ICT import but export can affect. Finally, as a feature of global ICT environment, ICT import has great impact on market, implying that each country chooses to focus on ICT industry through ICT trade. For example, in China, since there is abundant cheap labor, it mainly focuses on ICT component manufacturing for stability of employment. On the other hand, the US focuses only on high value industry based on its excellent human resources and economic power.

The strategies that can be derived from the results of this study for ICT industry, experiencing globalization are as follows. First, according to the national economic environment, the configuration of the appropriate form of ICT industry will

be needed. In other words, because the global ICT industry environment has a circular structure that ICT imports and exports have mutual influence, industrial positioning can be important according to national economic environment. Second, for GDP growth, it is needed to provide converged service through ICT M&A. Even though China's ICT trade is more than that in the US, ICT trade in the US is causing immediate growth of GDP. Thus, who can provide convergence service rather than manufacturing components is crucial to success of ICT business and GDP growth. Finally, the current regional specialization in the global ICT industry is so sure that ensuring =secure core technology is very significant. This is because it cannot be possible even to enter the competition without getting competitiveness through the core technologyin the fast-paced ICT trade loop.

Through this study, it is possible to determine the causal relationship between GDP and ICT trade, the mutual influence and, consequently, the globalization of the ICT industry as a recent trend. However, the situation of a small number of countries cannot be positive proof for the entire global ICT market trends. Therefore, the limitations of this study are as follows: First, because this study has only analyzed data from four major countries, more explain can be made for the entire global ICT market,and it is needed to analyze more countries. Second, it can be lack of description on causal relationship in certain countries' ICT trade data because it is only focusing on all countries' data of ICT trade- more detailed data is missing for some countries. Thuswe need to do more researches based on detailed ICT trade data in many countries. If future researches consider the limitations given above, a clearer understanding of the global ICT industry is possible to be identified to provide a more specific indicators of ICT trade and economic relations.

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