

Comparative Research of Competitiveness and Influence Factors of Computer and Information Service Trade of South Korea, China and Japan

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Abstract

The paper chooses four trade competitiveness assessment indices to compare the international competitiveness of Computer and Information Service(C&IS) trade between South Korea, China and Japan. The results show that the competitiveness of China is the strongest, Japan secondary and Korea the weakest among the three countries. However, the competitiveness of Korea can be promoted the most quickly and it has exceeded Japan according to TC and NXRCA indices. Meanwhile, there was still a huge gap between the three countries and the two world strong countries—India and Ireland. The main findings of empirical research on influencing factors show that domestic market demand and trade opening degree are the two most important factors influencing the competitiveness of three-country C&IS trade. At the same time, improving the utilization of C&IS and realizing good interaction of C&IS trade and electronic information, communication and other relevant and auxiliary industries can also contribute to the competitiveness improvement.

▶ Keywords : Computer and Information Service Trade; International Competitiveness ; Influence factors

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I. Introduction

In the era of information economy, the increase of investment in information and computer technology can tremendously reduce the cost of the service sectors like finance, communication and education and the manufacturing industries like machinery manufacture (Sung-Bae Mun & M. Ishaq Nadiri (2002)) [1]. Through the technology spillover effect, C&IS can promote the spread of information and computer technological progress, is an important investment factor for other service and goods sectors, and has become an important driving force of global economic development (Leshner & Nordås (2007)) [2].

As important economies in Asia and future partner states of FTA, from 2000 to 2013, although the average annual increase of C&IS trade export of Japan was only 1%, the average annual export of South Korea and China had experienced average annual increases of 40.7% and 33.6% separately, far surpassing the average annual increase of 16.5% of the whole world. However, the export of C&IS trade of the three countries was all less than 10% of the service trade export, far less than that of the strong global exporter India which accounted for 30% of its service trade export. The value of C&IS trade of the three countries was all less than 1% of their GDP.

The objectives of this paper are to compare the international competitiveness of C&IS trade of the three countries and its influence factors. In order to do so, we first use several common trade competitiveness assessment indices to compare the competitiveness of C&IS trade of the three countries, then build an econometric model based on Michael Porter's "diamond model" theory to conduct an empirical analysis of factors influencing the competitiveness. While the three countries enhance their international competitiveness of C&IS trade internally, it is also good for them to strengthen their cooperation and improvement in

the field by taking effective advantage of FTA.

II. Comparative Analysis of the Competitiveness of C&IS Trade of South Korea, China and Japan

1. Selection of Evaluation Indices and Data Sources

In the following, four indices, which are the international market share (IMS), the trade competitive index (TC), the revealed comparative advantage index (RCA) and the revealed comparative advantage index of net export (NXRCA), are chosen for the comparative analysis of C&IS trade competitiveness of South Korea, China, Japan and the world other main countries. All data related to the calculation of indices are from UNCTADSTAT databases (**specific explanation of four indices are listed in Table 1**)

Table 1 Specific explanation of four indices

Index	Source	Formula	Explanation
IMS	Markusen (1992) (3)	$IMS_{ij} = X_{ij} / W_{ij}$, X_{ij} and W_{ij} represent the export of product j of country i and the whole world.	The greater the IMS value is, the stronger the industrial competitiveness is.
TC	AJ Ali (1992) (4)	$TC = (X_{ij} - M_{ij}) / (X_{ij} + M_{ij})$, X_{ij} and W_{ij} represent the total export and import of product j of country i.	The index value ranges between +1 and -1. The more the value approaches 0, the more the competitiveness is close to the average level.
RCA	Balassa (1965) (5)	$RCA = (X_{ij} / X_i) / (X_{wj} / X_w)$, X_{ij} and X_{wj} represent the export of product j of country i and the world; X_i and X_w represent the total export of country i	If the $RCA > 2.5$, it means the competitiveness is extremely strong; If $1.25 \leq RCA \leq 2.5$, it means competitiveness is relatively strong; If $0.8 \leq RCA \leq 1.25$, it

		and the world.	means competitiveness is moderate:
NXRCA	Balassa (1989) (6)	$NXRCA = \frac{(X_{ij}/X_i)/(M_{ij}/M_i)}{}$ X_{ij} and M_{ij} represent the export and import of product j of country i , X_i and M_i represent the total export and import of country i .	If $NXRCA > 0$, it means the country has competitiveness: If $NXRCA < 0$, it means the country at a competitive disadvantage; If $NXRCA = 0$, it means balanced trade.

2. Results of Indices

In view of the IMS index, the international market share of Japan in terms of C&IS trade had declined since 2000, experiencing a decrease of 81.8% in 2013 compared to 2000. Nevertheless, China, South Korea, Malaysia and the Philippines had enjoyed a constant increase of market share in terms of C&IS trade. Among them, South Korea ranks first with an average annual growth rate of 21.8%; and the average annual growth rates of China, the Philippines and Malaysia are respectively 14.6%, 12.9% and 8.6%. India, as a strong nation of C&IS trade, basically had growing market share in Asia from 2000 to 2013. However, since 2006, its market share has been growing slowly and keeping a relatively stable international market share of nearly 20%, almost on a par with that of Ireland. Compared to Asia, the US and Canada had declined at an average annual rate of 4% in terms of C&IS trade, experiencing decreases of 40.6% and 45.4% respectively in 2013 compared to 2000.

In view of the TC index, the TC indices of China, South Korea, Malaysia and the Philippines basically presented a trend of rapid growth. Among the four countries, the TC index of the Philippines increased most, a seven-fold increase in 2013 compared to 2000; and, compared to 2000, the TC indices of China, South Korea and Malaysia increased 2, 1.25 and 1.21 times respectively in 2013. Except the year

of 2002, the TC index of China was greater than 0 and gradually exceeded 0.5. The TC index of the Philippines had been greater than 0 since 2005, exceeded that of China, grew rapidly in 2007 and exceeded 0.8 in 2008. The TC index of South Korea was always less than 0, and, in most years, approached -0.8. However, the TC index of South Korea grew fast later, which was greater than 0 for the first time and approached 0.2 in 2013. The TC index of Malaysia had been a positive number since 2005, and then grew steadily to approach 0.2. This indicates that the competitiveness of C&IS trade of the four countries all exceeded the world's average level and became stronger and stronger. Although the TC indexes of most Asian countries experienced a trend of growth, the TC indexes of Japan, Canada and the US declined constantly. Among them, the TC index of Japan was always less than 0 and basically declined to be less than -0.5. The TC index of the US had been a negative number since 2005, and continued to decline and approach -0.2. Although the TC index of Canada was about 0.3, it had been declining. As world's leading countries, from 2000 to 2013, the TC indices of C&IS trade of Ireland and India grew slowly but maintained at high levels of 0.9 and 0.8 separately. This indicated that they had very strong competitiveness. According to the above analysis, China had already surpassed Japan and South Korea in terms of competitiveness, but South Korea increased quickly. Compared to Japan, C&IS trade of China and South Korea had already surpassed the world's average level in terms of TC index, but were still left far behind Ireland, India and the Philippines.

In view of the RCA index, from 2000 to 2013, indices of China, Japan, South Korea and the Malaysia were all below 0.8. The means the competitiveness of C&IS trade of the four countries were all weaker. However, except Japan, all other three countries had an increasing RCA index. Among the three countries, South Korea increased most, Malaysia took the second place and China took the

third place. However, during this period, the RCA indexes of C&IS trade of India and Ireland were always far greater than 2.5, showing the extremely strong international competitiveness of the two countries. Among them, the RCA of Ireland continued to grow and had surpassed that of India and ranked first since 2003. The RCA index of India had started to decline constantly since 2007 and was already less than 10. The RCA index of Canada declined slightly, and basically varied from 1 to 1.3. This means that Canada had relatively strong competitiveness in C&IS trade. The RCA index of the US had kept declining for 13 years but basically maintained at a level of above 1.25, which had been over 2.5 before 2007. This means that the US had stronger international competitiveness in C&IS trade but its competitiveness kept declining. The RCA index of the Philippines always maintained rapid growth, and increased rapidly from 0.8 in 2008 to 2. It means that the Philippines had developed from a country without the international competitiveness of C&IS trade to a country with extremely strong competitiveness. According to the above analysis, India and Ireland as strong countries of C&IS trade beat other countries. The US and Canada had relatively strong international competitiveness of C&IS trade but their international competitiveness were still declining. The competitiveness of the US declined most. Among other Asian countries, the international competitiveness of C&IS trade of the Philippines improved most significantly, which made the Philippine become a country with extremely strong international competitiveness. Except Japan, China, South Korea and Malaysia all had increasing international competitiveness of C&IS trade. Among them, the competitiveness of South Korea increased most but the competitiveness of C&IS trade of the four countries was still weaker.

In view of the NXRCA index, all countries investigated had certain international competitive advantages in C&IS trade as for their NXRCA

indices were greater than 0 from 2000 to 2013. The NXRCA indices of China, South Korea, Philippines, and Malaysia basically enjoyed a trend of growth. Among them, the index of the Philippines increased far more than that of the other Asian countries with its highest NXRCA index in 2012 22 times of its lowest index in 2000; the second one was South Korea, whose NXRCA index in 2013 was 12 times of that in 2000. This means that the competitiveness of C&IS trade of the two countries was improved significantly. Although the NXRCA index of China didn't increase so much, it was always higher than that of South Korea, Malaysia and Japan. Japan basically had a declining NXRCA index; and South Korean and Malaysia had obviously beaten Japan since 2006. The NXRCA indices of Ireland and India beat that of other countries. In particular, the NXRCA index of Ireland kept increasing fast, a four-fold increase from 2000 to 2013. During this period, the NXRCA index of Canada declined first and then increased. However, the NXRCA index of the US kept declining and declined most, a drop of 44.4% from 2000 to 2013. According to the above analysis, after both import and export were taken into account, Ireland and India had strongest competitiveness in terms of C&IS trade; the US and Canada had declining international competitiveness of C&IS trade; except Japan, four Asian countries, namely China, South Korea, the Philippines and Malaysia, all had increasing international competitiveness of C&IS trade; and among the five Asian countries, the Philippines was the strongest, China, Malaysia and South Korea came next, and Japan was the weakest.

According to the analysis of the four above indices, the international competitiveness of C&IS trade of China and South Korea kept improving; the competitiveness of C&IS trade of Japan was declining; and among the three countries, the competitiveness of China was strongest and the competitiveness of South Korea improved fastest. According to TC and NXRCA indices, the

competitiveness of C&IS trade of South Korea had already surpassed Japan since 2006. However, there was still a huge gap between the three countries and two world strong countries of C&IS trade—India and Ireland. Since the competitiveness of C&IS trade of the US and Canada was declining, the three countries China, Japan and South Korea shortened the gap with them and even surpassed them. Compared to other Asian countries, the international competitiveness of C&IS trade of the Philippines grew rapidly: although its international market share rate was lower than that of China, the Philippines had already left China, Japan and South Korea far behind in terms of other indices for assessment of trade competitiveness. The international competitiveness of C&IS trade of Malaysia also improved relatively fast, beat that of Japan and South Korea, and, based on international competitiveness measured by the RCA index, had already surpassed that of China.

III. Analysis of Factors Influencing the Competitiveness of C&IS Trade of South Korea, China and Japan

1. Research Background and Model Assumption

At present, the research of the factors influencing service trade competitiveness is mainly to build an econometric model based on Michael Porter's "diamond model" theory so as to conduct empirical comparison of the factors that influence service trade competitiveness of the whole country and some specific department (Hejun and Guolan (2013), Zhanghui (2013) etc.) [7][8]. Michael Porter's "diamond model" theory not only emphasizes the industries and products of a country that participate in international competitions but also pay more attention to fostering the overall competitive advantage of the country; and the key of fostering the national competitive advantage lies in four basic

elements and two auxiliary elements. The four basic components are the essential factors of production, the demand conditions, the performance of related and supporting industries and the firm strategy, structure and rivalry. Two supporting elements are the chance and the government. After the comparative analysis of the competitiveness of C&IS trade of South Korea, China and Japan, the paper builds an econometric model based on Michael Porter's "diamond model" theory to analyze the main factors that influence the competitiveness of C&IS trade of the three countries.

Since trade export is the most fundamental factor that influences the international competitiveness of a country, the paper uses the export of C&IS trade (EXP) as the dependent variable to measure its international competitiveness level. According to the "diamond model" theory, combining the industrial characteristics of C&IS and taking the availability and effectiveness of data into account, the paper chooses the following variables as explanatory variables:

(1) Essential factors of production. The "diamond model" theory divides essential factors of production into primary essential factors of production and advanced essential factors of production which include natural resources, human resources, capital resources and communication infrastructure, and believes that the advanced essential factors of production are more important in forging the competitive advantage. The paper selects the urbanization level (URB) and Internet penetration (NET) to reflect the influence of essential factors of production on the international competitiveness of C&IS trade. The urbanization level and Internet infrastructure play an important basic role in the development of C&IS trade of a country. The empirical research of 28 OECD countries and their partner countries by Lennon (2008) points out that a country's internet, education level and communication technology play a more important role in service trade than in goods trade [9].

(2) Demand conditions. The "diamond model" theory attaches much importance to the role of domestic market demands in promoting and improving the national competitive advantage. The domestic market demands are the driving force of industrial development and a basis for enterprises to foster the international competitive advantage. As the C&IS industry develops and users mature, the value chain of the industry has transformed from the business-oriented type focusing on production into the consumption-oriented type focusing on products. The demand capability and preference of consumers are the driving force to promote the continuous industrial development. The paper selects the per capita GDP (GDPP) to measure the domestic consumers' demands for C&IS.

(3) Related and supporting industries. The "diamond model" theory values the role of the industrial cluster and believes that a superior industry can't exist alone but must prosper with related strong domestic industries. The electronic information industry and the communication industry are two industries which have a relatively large connection with C&IS. The sound and rapid development of the industries can provide a good industrial foundation and relevant hardware support for C&IS trade. At the same time, the increasing IT application in manufacture and service industries can also, to some extent, stimulate and encourage the development of C&IS trade. Considering the availability and comparability of data of electronic information and communication industries of the three countries, the paper only selects values of merchandise exports (EXPM) to measure the influence of the manufacture industry as a related and supporting industry on the competitiveness of C&IS trade.

(4) Government. While emphasizing the function of government, the "diamond model" theory believes that the government should not directly participate in market competitions but provide a good environment for the development of the industry and

enterprises by making policies. The paper selects the openness (OPE) of C&IS trade as the policy factor influencing C&IS trade. The research conducted by Sichei, Harmse and Kanfer (2005) has pointed out that the market openness is the main reason why South Africa lags behind the US in terms of the industry and service trade [10].

The chance events are outside of control and it is also not easy to conduct a quantitative analysis of the firm strategy, structure and rivalry which may be influenced by many factors. Therefore, the paper doesn't analyze these two factors.

2. Model Building and Data Explanation

Determine the above-mentioned five factors as explanatory variable according to "diamond theory": urbanization level (the proportion of urban population in total population-URB), internet penetration (indicate every hundred internet user-NET), per capital gross domestic product (GDPP), values of merchandise exports (EXPM) and opening degree of C&IS trade (the proportion of imports and exports values of C&IS and GDP-OPE). Date about C&IS trade and merchandise trade is from UNCTAD Database. Date about urbanization level, Internet penetration, per capital GDP are from World Bank. Date about opening degree is calculated according to relevant data of index. The data is from 2000 and 2013. Some data about 2013 is lost, so this paper uses panel data of three countries from 2000 to 2012 to establish panel data model for analyzing. Based on panel data, this paper adopts fixed effect variable-coefficient model considering national differences and referring to previous experiences (Li Xiaofeng, 2013)[11]. Estimation model of three countries is:

$$EXP_{it} = \alpha + \alpha_{it} + \beta_{1i}NET_{it} + \beta_{2i}URB_{it} + \beta_{3i}GDPP_{it} + \beta_{4i}EXPM_{it} + \beta_{5i}OPE_{it} + u_{it}, (i=1, 2, 3 \text{ represent China, Japan and South Korea, } t=2000, 2001 \dots 2012).$$

3. Empirical Test

(1) Unit root test. Before stabling regression model, test the stationarity of all panels' series to avoid spurious regression and guarantee validity of estimated result. This paper adopts the unit root test with methods of LLC (Levin-Lin-Chu) and Fisher-ADF. The result shows that test value of original series fails to pass the test, which indicates that original series is not stable. All variable passes the test after the first difference, which indicates that time series is integrated series of first-order stationary (as shown in Table 2)

Table 2. Unit Root Test of Panel Data

Test method	Level value-first difference	
	LLC test	ADF-Fisher test
EXP	4.15955(1) --2.65106 (0.0040)	2.7978 (0.8338) - 18.38 (0.005)
NET	0.98 (0.83) - -2.34 (0.01)	0.99 (0.99) - 34.16 (0.0000)
URB	1.57 (0.94) - -3.15 (0.001)	0.21 (0.999) - 29.07 (0.0001)
GDPP	5.31 (1) - -2.12 (0.017)	0.22 (0.9998) - 15.45 (0.02)
EXPM	3.44 (0.9997) - -4.69(0.0000)	0.33 (0.9994) - 28.01(0.0001)
OPE	1.54 (0.94) - -5.79(0.0000)	0.88(0.9899)- 33.31(0.0000)

(2) Co-integration test. This paper conducts the co-integration test for variable through Kao test to further test whether there is long-term and stable equilibrium relationship among all variable. ADF statistics rejects null hypothesis of "not existing co-integration" in significance level of 3%, which indicates there is equilibrium relationship among panel data of all variable and we can conduct regression analysis for it.

(3) Regression analysis and result .This paper adopts GLS estimation method Cross-section SUR weighting and EVIEWS7.2 software to estimate fixed effect variable-coefficient model. See Table3 for detailed result. Except that parameter estimation of NET variable of Japan and Korea, URB variable of Japan and EXMP variable of China in significance

level of 10% is not significant, other variable passes the statistical test in significance level of 10%.

We can say that Internet penetration is in negative correlation with international competitiveness (export values) of C&IS from β_{1i} . For example, if Internet penetration in China increases 1%, export values of C&IS decreases 0.3%, however the influence is a little. The reason may be that C&IS enterprises in China hasn't made full use of more and more Internet resources and some emerging C&IS business hasn't been developed or popularized well (Han Fei, 2009)[12]. Although Internet penetration is increasing, application of Internet by national economy departments hasn't been developed; we can say that urbanization level of both China and Korea is in negative correlation with competitiveness of C&IS trade from β_{2i} . The result shows if urbanization level increases 1%, export values of C&IS trade of both China and Korea respectively decreases 0.01% and 0.2%. The reason may be that domestic demand for C&IS is increasing with the increasing proportion of urban population. Some service is transferred into domestic market, which reduces service export to some extent, but has a little influence on both countries; we can say that per capital GDP of China, Japan and Korea is in positive correlation with competitiveness of C&IS trade from β_{3i} . The result shows if per capital GDP increases 1%, export values of C&IS trade of China, Japan and Korea increases 1.9%, 1.4% and 1.1%, which indicates improved level of domestic market demand can substantially adds export values of C&IS trade of three countries, contributing to improving international competitiveness; we can say that increasing export values of merchandise is in negative correlation with export values of C&IS trade of Japan, but in positive correlation with that of Korea from β_{4i} . The result shows if export values of merchandise increases 1%, export values of C&IS trade of Japan decreases 0.6%, and export values of C&IS trade of Korea increases 1.2%; we can say

that improved opening degree of C&IS trade of three countries in positive correlation with export values from $\beta 5i$. The result shows if opening degree of C&IS trade improves 1%, export values of C&IS trade of China, Japan and Korea increases 0.19%, 0.2% and 0.8%, which indicates that higher opening degree can improve international competitiveness of C&IS trade of three countries. However, opening degree of the market of C&IS trade of three countries is lower, less than 0.5%, which restricts the improvement of international competitiveness to some extent.

Table 3. Estimated Result of Influential Factor
On C&IS trade of the Three Countries

Country	α_i	$\beta 1i$	$\beta 2i$	$\beta 3i$	$\beta 4i$	$\beta 5i$
China	1,508.962	-119.54	-328.83	4.51	-0.001*	12,278.13
Japan	-5,197.648	0.21*	-17.31*	0.04	-0.001	8,908.23
South Korea	3,670.686	-6.20*	-122.68	0.02	0.001	4,728.76

Note: *means failing to pass statistical test in significance level of 10%, and null hypothesis is accepted.

In conclusion, per capita GDP and market opening degree can greatly affect international competitiveness promotion of three-country C&IS trade, especially per capita GDP. The influence of three-country per capita GDP on the competitiveness of C&IS trade, among which, China is the strongest, Japan is the secondary and Korea is the weakest. However, the influence of market opening degree of Korea on the competitiveness of C&IS trade is slightly higher than Japan and China. The influence of Internet penetration and urbanization level on the competitiveness of three-country C&IS trade is negatively correlated or statistically insignificant. The influence of goods exports on three-country C&IS trade is different. The influence on China is statistically insignificant. The influence on Korea is positive while that on Japan is negative. This is mainly determined by whether three-country manufacture industry and C&IS trade, especially electronic information and communication industry, can develop cooperatively

while it can also be affected by the informationization degree of manufacture industry and service industry.

IV. Conclusion and Policy Implications

1. For the international competitiveness of three-country C&IS trade, the competitiveness of China is the strongest, Japan secondary and Korea the weakest among the three countries most of the time according to the above analysis. However, the competitiveness of Korea can be promoted the most quickly and it has exceeded Japan according to TC and NXRCA indices. Though the international competitiveness of C&IS trade of China and Korea are increasing constantly, yet they have quite a large gap with India and Ireland and are started to catch by Philippines and Malaysia, two Asian countries, of which the competitiveness is promoted quickly. Thus, in the era of information economic, the three countries shall attach great importance to the driving influence of C&IS trade on promoting a country's trade development and accelerate to improve the competitiveness of C&IS trade.

2. The factors which affect the competitiveness of three-country C&IS trade shall be focused, especially the leading role of domestic market demand and market opening degree on C&IS trade export and international competitiveness. In view of the lower market opening degree and different international competitiveness, the three countries shall not only quickly promote their own market liberalization degree of C&IS but also further improve the market opening degree among three countries with the attitude of mutual complementarity and win-win progress in the further FTA negotiations. Meanwhile, based on the foundation of internet and other communication infrastructure improvements, the three countries should still further focus on extending the application field of C&IS and excavating service depth in order to really perform the supporting

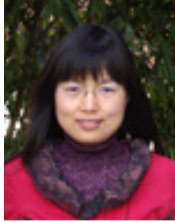
influence of network and communication infrastructure improvements (the basic element) on the development of C&IS trade. On the other hand, the three countries should try to realize the beneficial interaction and development of C&IS trade and electronic information, communication and other relevant and auxiliary industries, to further improve the informationization degree of manufacture and service industries, and to realize the positive influence of industrial agglomeration on the competitiveness promotion of C&IS trade.

This research is just a preliminary exploration and there are still some aspects worth discussing and improving:(1) Due to the statistic defect, C&IS trade data in our analysis is only about the cross-border delivery mode without the commercial presence mode, which may affect the comprehension of our research results:(2)There are many factors influencing three-country C&IS trade competitiveness, therefore, methods of selecting explanation variable and econometric model as well as the rationality of explaining the model results may also influence the research conclusions:(3) As for the future research, it is very important and interesting to analyze the differences of the influence factors between the three countries and the top-10 countries of the world and the mechanisms of influence factors on the competitiveness of C&IS trade.

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