

Strategies for Improving the Electronic Information Industry Security based on IOII

Kun Zhang¹ and Zhenji Zhang²

Beijing Jiaotong University, School of Economics and Management, Beijing, China

¹13113135@bjtu.edu.cn, ²zhjzhang@bjtu.edu.cn

Abstract

The rapid development of economic globalization increases the competition of global industry through the globalization of trade. Industrial security which can be defined as the ability to control domestic industries and make the industries survival and development from the external threat is given increasingly attention by academic circles. The concept of industrial security was put forward in the background that the domestic industries was influenced by the foreign capital and technology. According to policy proposed by the ministry of industry and industry technology of China, it is the focus of task to improve the deep integration of informatization and Industrialization (IOII) by improving the electronic information industry security and the coordinated development of technology, industries, security. This paper analyzes the efficiency of input and output of electronic information industry by using the data envelope analysis (DEA). DEA is a nonparametric mathematical programming method in operations research and economics which is widely used to evaluate efficiency of decision-making units (DMUs). According to the analysis results, strategies for improving the electronic information industry security based on IOII and current background of electronic information industry are proposed. As a new research perspective, it can be a good solution.

Keywords: *Electronic Information Industry, Industry Security, IOII, DEA, Strategy*

1. Introduction

With the rapid development of economic globalization, the competition of global industry through the globalization of trade increases, especially after China's accession to the WTO. Information Technologies (IT) and Information and Communication Technologies (ICT) have become the important driving force for the economic and social development in China since China's reform and opening up in the late 1970s [1]. In 2002, the Report of the 15th Central Committee of the Communist Party of China pointed out that the informatization should be taken as an important support to the industrialization. The informatization should be the impetus of the industrialization, and the industrialization should be the fuel of the informatization [2]. This national strategy reinforces the importance and critical role of integration of informatization and Industrialization (IOII) towards achieving industrialization and modernization in China. With political and financial support from the government, electronic information industry, also known as the ICT industry, has achieved a continuous and rapid development in China. Be different from the traditional manufacturing industry, electronic information industry is an industry of higher internationalization degree and more frequency in industrial cycle change.

Although the strategic adjustment of economic structure has been put into effect by Chinese Government, the industry security has become one of the core issues that restricts

the development of national economy. According to the document proposed by the ministry of industry and industry technology of China, it is important to strengthening information security guarantee by developing the information security technology and industry. Since the electronic information industry is an important pillar industry which will face a strong international competition, it has great significance to research the strategy for improving the electronic information industry security base on the theory of IOII in this context.

There is a large amount of researches about electronic information industry and IOII at home and abroad. However, there are still a slice of problems about these research results from my own perspective. In the First place, the existing studies mostly focus on the competitiveness and the development models of electronic information industry. The electronic information industry security is ignored. In the second place, there is more qualitative research rather than quantitative research. The last but not the least, there is lack of in-depth research on the information industry, and analysis on the whole mechanism. Therefore, we analyze the efficiency of input and output of electronic information industry by using the data envelope analysis (DEA) in this paper. The strategies for improving the electronic information industry security based on the analysis result are proposed combined with the theory of IOII and current background of electronic information industry.

The organization of this paper is as follows. In Section 2, which is literature review, we propose the concept of electronic information industry and analyze its characteristics. Then the concept of industry security and IOII is overviewed. In Section 3, the data envelope analysis (DEA) is selected as the evaluation method to evaluate the efficiency of input and output of electronic information industry. Then the index system is established and the relevant data is located from the Wind Database. The model solving is finished and the results analysis are proposed. In Section 4, a range of effective policy suggestions and strategies that improve the electronic information industry security based on IOII are provided. Finally, Section 5 is conclusion.

2. Literature Review

Electronic information industry is established and developed on the basis of the development and application of the electronic science and technology. It was in 1920s that the electronic information industry was firstly defined as an independent industry in China. The establishment of telecommunication industry administration was in 1950. Then the 4th mechanical industry department was set up in 1963, which indicates that electronic information industry has become an independent industrial sector. The electronic information industry in China grew rapidly after the liberalization of the economy under the national strategic policy of accelerating the informatization of its industrial development. At the beginning of the 21st century, the manufacturing output value of electronic information industry increased from RMB 755 billion in 2000 to RMB 4456 billion in 2009, which accounts for more than 8% of the total of the national manufacturing industry [3]. In 2005, China's electronic information industry made up 16.6% of the country's economic growth and its added-value output formed 7% of the GDP [4]. As the pillar industry for the development of informatization and building an information society in China, the electronic information industry is considered as the strategic, fundamental and pioneering pillar industry of the national economy [1].

The research on industry security was firstly focused on in to solve the successive economic security problems in 1970s. Michael Porter hold the view that the development and security of an industry will be under the threat from the external competitors with higher productivity. Zhao defined industry security as a state or an ability to protect the existing and potential industry rights from threat and harm [5]. Xu took the attitude that

industry security is a vital component of national economic security. He defined industry security as a state that an industry of a country stays away from the interference and threat which are from other countries and develops sustainably under the condition of open economy [6].

Integration of informatization and industrialization (IOII) is a policy guidelines proposed by the Chinese Government to promote the production upgrade and the transformation of economic development mode. The first time when IOII was proposed was in the Report of the 17th Central Committee of the Communist Party of China which was published in October, 2007. The plenum stressed that "synchronization of industrialization, informatization, urbanization, marketization and internationalization" has been the main emphasis of economic work of China at present. The plenum called for pushing forward the integration of informatization and industrialization to develop the modern industrial system [7].

IOII can be defined as a scientific innovation pattern of development which will promote the integration of informatization and industrialization. The process of IOII can be defined in a number of perspectives. Firstly, IOII should confirm the integration of strategy, which means that the strategies of informatization and the strategy of industrialization should cooperate so that their modes and development plans can cooperate. Secondly, IOII should confirm the integration of resources, which will lead to resource-saving. Thirdly, IOII is the integration of fictitious economy and real economy, which will promote the formation and development of information economy and knowledge economy. At last, IOII is the integration of information technology and industrial technology, the integration of information devices and industrial plants.

It is an intrinsic requirement for enterprise reformation and development and also a paramount way of enhancing enterprise creativity and market competitiveness. The integration should be applied into all links rather than be an independent process so that it can be effective means for the enterprises. The theory of IOII can be the backup force for the electronic information industry security.

Based on the definition of industry security, the electronic information industry security refers to the state that the survival and development of electronic information industry staying away from the threat, including survival security and development security of information industry in an open and relatively stable economic environment. According to policy proposed by the ministry of industry and industry technology of China, there are mutual effects between IOII and industry security. It is the focus of task to improve the deep IOII by improving the electronic information industry security and the coordinated development of technology, industries, security. At the same time, it is also an effective measure to enhance the electronic information industry security by taking advantage of the theory of IOII in particular context.

3. Analysis on the Efficiency of Electronic Information Industry Security

3.1. Measurement Technique for Efficiency of Electronic Information Industry Security

As a complex system, the status of electronic information industry security can be described by multiple variables. To get the quantitative relationship between the efficiency of electronic information industry security and these variables, the data envelope analysis (DEA) is used to analyze the the efficiency of input and output.

DEA, occasionally called frontier analysis, was first put forward by Charnes, Cooper and Rhodes in 1978. Since then, the methodology has become an increasingly popular management tool. It is a performance measurement technique which can not only be used

for evaluating the relative efficiency of decision-making units in organizations, but also be used for benchmarking in operations management, where a set of measures is selected to benchmark the performance of manufacturing and service operations [8]. The framework of DEA has been adapted from multi-input, multi-output production functions and applied in many industries. Compared with other measurement techniques, there are a host of advantages of DEA. Some of its advantages can be summarized as follows. 1. There is no need to explicitly specify a mathematical form for the production function. 2. Multiple inputs and outputs can be involved.

3.2. Evaluation System for Efficiency of Electronic Information Industry Security

According to the study of Berg, the main advantage to DEA is the ability to accommodate a multiplicity of inputs and outputs [8]. But it is one of the key task to select the inputs and outputs because the results of emulation are sensitive to the selection of inputs and outputs. Consequently, the following two principles should be considered when the inputs and outputs are selected. Firstly, the inputs and outputs which are selected should meet the requirements of the evaluation and reflect the electronic information industry security objectively. Secondly, if a strong linear relationship exists in two measures, they should not be selected as inputs and outputs at the same time.

The efficiency of industry security is affected by a variety of index signs, such as the economic efficiency, policies and regulation, industry export dependence, the domestic market share, the world market share, rare of foreign market control, and so on. And according to their different function ways, these factors can be divided into four first index signs, namely industry development potential, industry external dependency, industry international competitiveness and information coefficient. Seventeen second index signs are included in this index system, as shown in Figure 1.

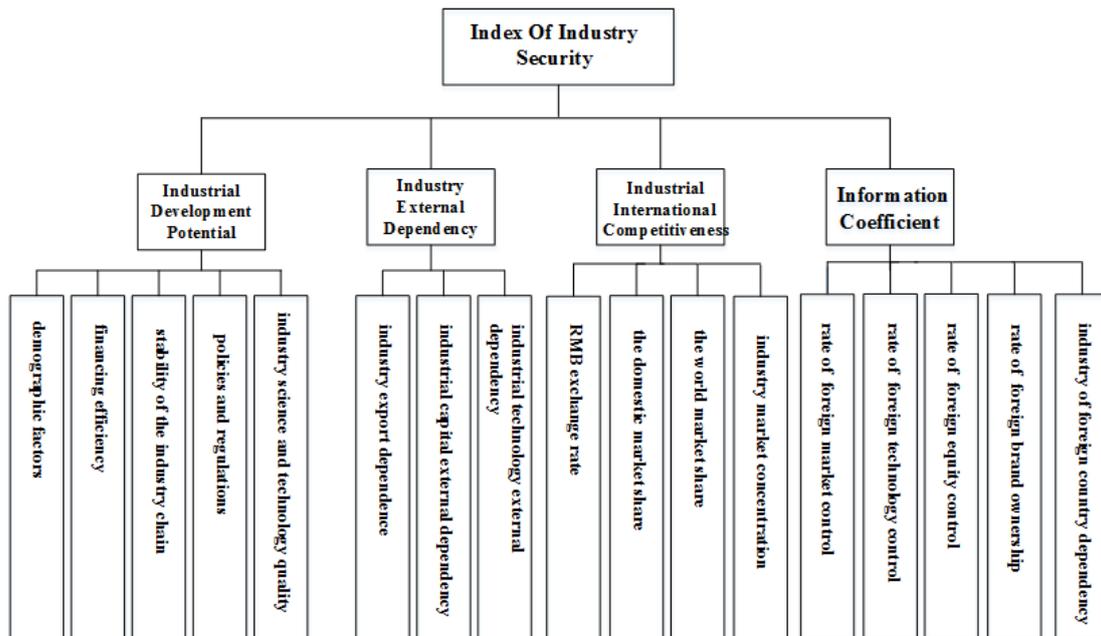


Figure 1. The Index of Industry Security

To measure the development level and key features of IOII, the ministry of industry and industry technology of China published the index system and evaluation system in 2010, as shown in Figure 2. In this index system, three first index signs and nine second index signs are included. As is shown in the following table, the first index signs are the

foundation of IOII, the application of IOII and the performance of IOII.

According to the principles above combined with the purpose of evaluation, we select the inputs and outputs of electronic information industry security referred to the factors of industry security and IOII.

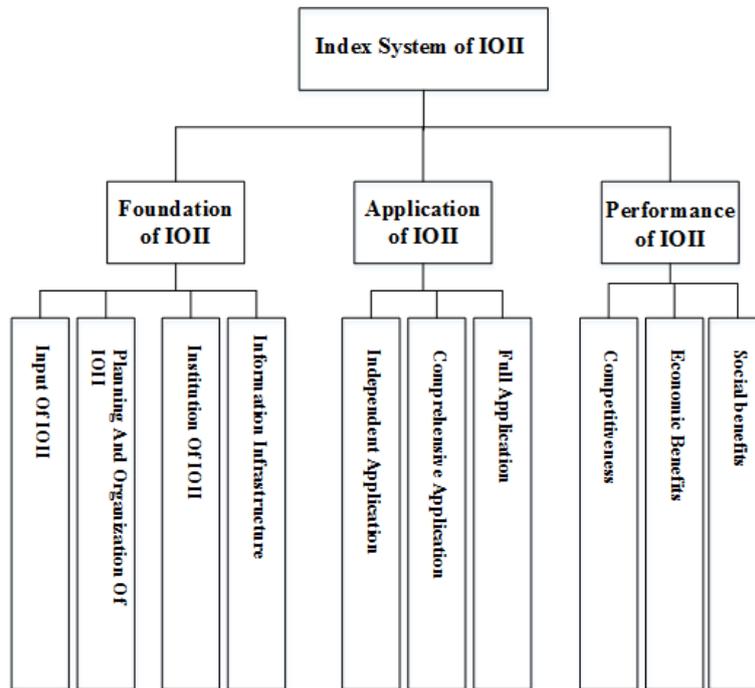


Figure 2. The Index of IOII

We have four input measures (rate of foreign equity control, industry export dependency, industry import dependency, the proportion of the tariffs to the fiscal revenue) and two output measures (external trade index and industry development speed), as shown in Table 1.

Table 1. The Index of Electronic Information Industry Security

INDICATORS	DESCRIPTIONS OF THE INDICATORS
Input Measures	
Rate of Foreign Equity Control	the registered capital of enterprises with foreign investment by the end of the year/total registered capital of enterprises with foreign investment
Industry Export Dependency	the total export value of an industry/the gross domestic product of an industry
Industry Import Dependency	the total import value on all technical project of an industry/the gross domestic product of an industry
Proportion of the Tariffs to the Fiscal Revenue	the sums of tariffs/the country's fiscal revenue
Output Measures	

External Trade Index	(total export value- total import value)/ (total export value+ total import value)
Industry Development Speed	the profit annual growth rate of the electric information industry above a certain

3.3. Results and Analysis

The data (2007-2012) of aforementioned input and output are collected from the Wind Database, which is a provider of financial data, information and services in China, as shown in Table 2.

Table 2. Input and Output Data of Indicators

	2007	2008	2009	2010	2011	2012
Input Measures						
Rate of Foreign Equity Control	0.450	0.263	0.133	0.100	0.107	0.081
Industry Export Dependency	0.169	0.144	0.112	0.123	0.112	0.108
Industry Import Dependency	0.097	0.082	0.064	0.072	0.064	0.059
Proportion of the Tariffs to the Fiscal Revenue	2.79	2.89	2.17	2.41	2.46	2.37
Output Measures						
External Trade Index	0.269	0.275	0.273	0.259	0.271	0.290
Industry Development Speed	0.158	0.182	0.385	0.389	0.22	0.131

The years to be evaluated are set as the decision making units (DMUs) in this paper. These years are 2007, 2008, 2009, 2010, 2011 and 2012. The efficiency rating for any DUM_{j_0} given can be computed by using the CRR ratio model, which is mathematically expressed as:

$$\min \theta - \in \left[\sum_{r=1}^2 S_r^+ + \sum_{i=1}^4 S_r^- \right] ST = \begin{cases} \sum_{j=1}^6 \lambda_j x_{ij} + S_i^- = \theta x_{i_0} \\ \sum_{j=1}^6 \lambda_j x_{rj} - S_r^- = y_{r_0} \\ s^{i-} \geq 0, s^{i+} \geq 0 \\ \lambda_j \geq 0; j = 1, 2, \dots, 6 \end{cases}$$

The input and output equations of DUM 2007- 2012 can be got based on DEA.

Then we can get the rate of electronic information industry security by using the software DEAP. As shown in Table 3, based on the analysis process of DEA, we get the evaluation results of the rate of electronic information industry security.

According to the results shown in Table 3, technical efficiency, pure technical efficiency and scale efficiency reach their maximum in 2009, 2010 and 2012. But the main efficiency indicators (technical efficiency, pure technical efficiency and scale

efficiency) are less than 1 and returns to scale are diminishing in 2007, 2008 and 2011. It means that the input redundancy and the output insufficient must exist and it leads to a low efficiency.

Table 3. Efficiency Evaluation

	Technical Efficiency	Pure Technical Efficiency	Scale Efficiency	Returns to Scale
2007	0.766	0.936	0.819	Diminishing
2008	0.763	0.961	0.793	Diminishing
2009	1.000	1.000	1.000	Invariant
2010	1.000	1.000	1.000	Invariant
2011	0.936	0.956	0.978	Diminishing
2012	1.000	1.000	1.000	Invariant

Based on Table 3, further analysis on input and output are discussed in Table 4.

Table 4. Input Redundancy and Output Deficiency

DMU	Effch ₁	Sort	Input Redundancy				Output Deficiency	
			P	V	C	L	Q	M
2007	0.766	5	0.060	0.037	0.450	0.361	0.018	0.011
2008	0.763	6	0.035	0.022	0.566	0.170	0.011	0.007
2009	1.000	1	0	0	0	0	0	0
2010	1.000	1	0	0	0	0	0	0
2011	0.936	4	0.002	0.003	0.168	0.006	0.012	0.010
2012	1.000	1	0	0	0	0	0	0

Firstly, we analyze the validity. According to the sort of effch₁, we get the operation efficiency. The evaluation indexes of operation efficiency are 1 in 2009, 2010 and 2012. The results show that there are three DUMs with DEA efficiency value of 1 and the left DUMs are DEA invalid.

Secondly, we analyze the input redundancy and output deficiency. Input redundancy and output deficiency provide a direction for the DUMs to improve and adjust. According to the operation efficiency, the pure technical efficiency is less than 1 and the scale efficiency is in a state of decline which means that there are huge input redundancy and output deficiency in 2007, 2008 and 2011. Although it is an ideal solution in particular situation based on Table 4, it can improve the efficiency by adjusting and reconstructing the management style to achieve the goal proposed in Table 4.

At last, we analyze the influence of index on operation efficiency. Input redundancy and output deficiency is one of the important influencing factors that affect the technical efficiency. In 2007, 2008 and 2011, the input is relative large in the rate of foreign equity control, industry export dependency, industry import dependency and the proportion of the tariffs to the fiscal revenue, while the output is relative small in external trade index

and industry development speed. This situation is particularly serious in 2007 and 2008, which leads to a low operational efficiency. Accordingly, it is a good solution to increase input of operation based on practical needs and realistic condition.

Based on the analysis above, we can know that it is input redundancy and output deficiency that has a negative influence on the evaluation of operation efficiency. Then we will analyze further the influence of scale efficiency and pure technical on input redundancy and output deficiency.

Table 5. Original Values and Expectancy Values of Input - 2007

Original Values	Expectancy Values	Scale Redundancy	Technology Redundancy
0.169	0.109	0	0.060
0.097	0.060	0	0.037
2.790	2.340	0	0.450
0.450	0.089	0	0.361

Based on Table 6, it is the scale that leads to the low output of external trade index and industry development speed. Consequently, concrete measures of strengthening technical management and assets management should be taken to improve.

Table 6. Original Values and Expectancy Values of Output - 2007

Original Values	Expectancy Values	Scale Deficiency	Technology Deficiency
0.269	0.287	0.018	0
0.158	0.169	0.011	0

The same measures can be taken to improve the situation in 2008 and 2011.

Table 7. Original Values and Expectancy Values of Input - 2008

Original Values	Expectancy Values	Scale Redundancy	Technology Redundancy
0.144	0.109	0	0.035
0.082	0.060	0	0.022
2.890	2.324	0	0.566
0.263	0.093	0	0.170

Table 8. Original Values and Expectancy Values of Output - 2008

Original Values	Expectancy Values	Scale Deficiency	Technology Deficiency
0.275	0.286	0.011	0
0.182	0.189	0.007	0

Table 9. Original Values and Expectancy Values of Input - 2011

Original Values	Expectancy Values	Scale Redundancy	Technology Redundancy
0.112	0.110	0	0.002
0.064	0.061	0	0.003
2.460	2.292	0	0.168
0.107	0.101	0	0.006

Table 10. Original Values and Expectancy Values of Output – 2011

Original Values	Expectancy Values	Scale Deficiency	Technology Deficiency
0.271	0.271	0.271	0.271
0.283	0.283	0.283	0.283

4. Policy Suggestions and Strategies

To improve the electronic information industry security based on IOII, a range of effective policy suggestions and strategies are provided as follow.

1. Create a favorable industrial developing environment

The function and the role of government in enhancing the security of electronic information industry is to publish policies and supply public services for the industry. The policies should prevent the industry from the external threat and the public technical services need to be based on certain infrastructures so that the electronic information industry can maintain coordinated, sustained and stable development. It is a good opportunity to take advantage of IOII which is an effective mean for enterprises to update technology apply the previously separate technologies in new products with IT application.

2. Improve the controlling power on electronic information industry

The controlling power of government can be seen as macro guidance and microeconomic principles. According to the research of Porter, the main role of government is to build macrocosmic microeconomic principles, which include the policy to improve competition, the tax system to encourage investment, the legal system to the benefit of consumers, the process to promote innovation and the regulatory rules to evaluate managers' performance. The controlling power means the electronic information industry can be protected and guided by the government. The main purpose of industry protection is to keep the autonomy and dependence of economic in the circumstance that the international economy is linked closely. Consequently, the industry protection or guidance should be clearly aimed. The Key enterprises in electronic information industry should be mainly monitored and followed to ensure the industry security.

3. Enhance the competitiveness of electronic information industry

As an industry with the characteristics of intensive capital, dependent on technology, high cost of management and high fixed costs, the competitiveness electronic information industry must be constrained by a high standard. The enterprises in electronic information

industry should depend on strategic investment and join in the multinational strategic alliance to enhance the international competitiveness. In technological innovation, the technological innovation ability of core technologies should be focused on. Organizations and policy makers concerned with the adoption of IT innovations should employ competitive revolutionary and evolutionary mechanisms in their technology innovation policies and strategies so as to outcompete their rivals.

The skills and quality level of practitioners are also should be attached great importance. Increasing the proportion of hi-tech products and products with a high added value and a high suitability can improve the industry development speed. When emphasizing principle innovation and technological innovation, concept innovation should be paid attention to enhance the sustainable innovation ability. The awarding of research achievements and the protection of intellectual property rights can guarantee the practical interests of industry and encourage the researchers to innovate actively in the same time. Exploring diversified international market and increasing the market share can promote cross-border operations and cooperation, and improve international competitiveness.

5. Conclusion

As a technology-intensive and capital-intensive industry, the characteristics of electronic information industry can be summarized high fixed costs, low variable costs and highly dependent on standard. IOII is a policy to promote the development of High-tech industry in strategies, technology, economy and resources. So it is indispensable and crucial to enhance the security of electronic information industry based on the theory of IOII. In this paper, we use DEA to analyze the efficiency of input and output of electronic information industry. Then policy suggestions and strategies for improving the electronic information industry security based on IOII are proposed. We hope it will be meaningful to the further research on the industry security electronic information industry.

Acknowledgments

This work was supported by a grant from the Program of Beijing Social Science Foundation Project (No. 15JGB101).

References

- [1] <http://www.lawinfochina.com/display.aspx?lib=law&id=7420&CGid=>.
- [2] Report of the 15th Central Committee of the Communist Party of China (1997).
- [3] <http://www.stats.gov.cn/english/statisticaldata/yearlydata/>.
- [4] <http://www.fujitsu.com/jp/group/fri/en/column/economic-topics/200608/2006-08-18-1.html>.
- [5] Z. Shihong, "The Research on National Industrial Security Theory Model", Central University of Finance and Economics, Beijing, China, (1998).
- [6] X. Ming, "Analysis on Industry Security Problem in China", Fudan university, Shanghai, China, (2005).
- [7] Report of the 17th Central Committee of the Communist Party of China, (2007).
- [8] W. D. Cook, K. Tone and J. Zhu, "Data envelopment analysis: Prior to choosing a model", OMEGA, vol. 44, (2014), pp. 1-4.