

Analysis of the Factors Influencing the Development of Integrated Circuit Industry in China Based on Regression Analysis

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ABSTRACT

As the core of information technology industry, integrated circuit industry is a strategic, basic and leading industry to support economic and social development and ensure national security, which is also an important indicator of a country's comprehensive competitiveness. From the perspective of quantitative analysis, based on the study of the main factors affecting the development of China's integrated circuit industry, this report uses the relevant sample data of nearly 20 years to establish a econometric model, and uses Eviews software to conduct a series of quantitative analysis, so as to obtain the main factors, and then provides opinions and suggestions for the development of China's integrated circuit industry.

Keywords: *Integrated circuit industry, econometric analysis, influence factors*

1. INTRODUCTION

Integrated circuit is a new type of semiconductor device developed in the past 50 years of the 20th century. It is known as the grain of modern industry. It is the strong foundation of information industry and the cornerstone of the new generation of information industry. Under the background of the rapid development of information society in China, it is of great strategic and practical significance to promote the industrial scale and technical level of integrated circuit. Therefore, to pay attention to the research on the influencing factors of the development of IC industry, especially in China, will have important reference for the government's policy-making.

2. OVERVIEW OF INTEGRATED CIRCUITS IN CHINA

Integrated circuit is a kind of micro electronic device or component. With the rapid growth of the global semiconductor market, China's semiconductor industry is also booming. By 2018, the output of China's semiconductor industry has exceeded 170 billion. In recent years, and the proportion of global market demand has increased from 18.5% in 2003 to 60% in 2017, becoming the world's largest semiconductor market.

In sharp contrast with the vigorous market demand, the overall competitiveness of China's integrated circuit industry is not strong, the overall technical level of the industry is not high, the core product innovation ability is not strong, and the overall product is still in the middle and low end. There are still obvious shortcomings in the

industrial development. There is a big gap between the supply and demand of local integrated circuits. Integrated circuit belongs to the field of precision manufacturing, which has the characteristics of expensive equipment and high technology content. It is a typical high-tech barrier field. At present, in the field of integrated circuit manufacturing, China's strength is relatively weak, there is a large gap between China and the world's advanced level, and there is a huge space for import substitution, which requires long-term development from technology, talents, funds, policies and other aspects. Therefore, through the data to understand the main factors affecting China's integrated circuit, and more targeted to propose solutions.

3. REVIEW OF INTEGRATED CIRCUIT RESEARCH IN CHINA

In the research on the status and development of integrated circuit industry, Chen Jian [1] believes that the wave of global informatization, networking and knowledge economy has improved the development factors of China's integrated circuit industry. Ding Wenwu and others [2] analyze the opportunities and challenges brought by technology and market changes to China's integrated circuit industry. Chen Xian [3] believes that China's integrated circuit industry has made great progress thanks to the huge market pull, preferential industrial policies and support of R&D projects. Li Jianming [4] analyzed the current problems of IC manufacturing industry, and elaborated the industry development path according to the national planning.

In the study of influencing factors of China's integrated circuit industry, Zou Xuecheng et al. [5] used Malmquist

total factor productivity index to decompose the production efficiency, analyzing the internal and external factors affecting the production efficiency of China's integrated circuit industry, and found that the main influencing factors are the internal factors including technical level, scale effect and personnel quality. Based on Porter's diamond model, Xi Yongqin and Zhou Xiongyong [6] analyzed the key factors affecting the competitiveness of China's integrated circuit industry from seven perspectives: production factors, market demand, related and supporting industries, enterprise strategic structure and competition, and government policies.

To sum up, the research on the development and influencing factors of China's integrated circuit industry started very early. With IC industry becoming a strategic emerging industry and international trade friction in China, IC has become the neck technology in China. Therefore, by understanding the main factors that affect or even determine the IC industry in China, suggestions will be put forward to realize the high-speed and efficient development of IC in China.

4. THE CHOICE OF FACTORS INFLUENCING THE DEVELOPMENT OF INTEGRATED CIRCUIT INDUSTRY IN CHINA

The main factors affecting the development of China's integrated circuit industry are the growth of national economy, industry investment and export, talent supply, industry demand and technical ability, and related industries.

National economic level. Integrated circuit industry is highly related to economic development. Under the influence of economy, interest rate, oil price and fiscal stimulus measures will affect the scale and market growth rate of integrated circuit market, and industrial capital expenditure, technology development ability and product price will also affect the industry.

Industry investment. Investment promotes the industry to increase the total amount of factors, gather factors, improve the marginal productivity of capital, help enterprises to increase scale, and promote the optimization and upgrading of industrial structure. Semiconductor industry is an industry with high technical barriers and high capital threshold. It needs constant R&D investment and capital investment. Industry investment, especially fixed asset investment, is an important factor.

Integrated circuit talents. The important resource of industrial development is talents. The height of talents determines the height of development, and the scale of talents determines the scale of development. At present, the lack of integrated circuit talents is an important reason to limit the rise of China's integrated circuit.

Export and industry demand. The market demand of China's integrated circuit industry is domestic demand and foreign demand. Market demand is the key factor to promote the development of strategic emerging industries.

China's and even the world's large demand for chips is an important factor in the further development of integrated circuits in China.

Technological innovation ability. In the integrated circuit industry, people, money and technology are the three most important factors, and technology leads the development of the integrated circuit industry.

Relevant industrial factors. It refers to the development status and international competitiveness of industries related to the industry. Its huge driving force can be indirectly affected by the industry demand, not considered as a factor alone.

In addition, there are also some factors, such as industrial environment, government role and external opportunities, which have an important impact on the competitive advantage of China's integrated circuit industry and the development of the industry itself. However, most of these factors are indirect, and most of them are qualitative and difficult to measure, so they are not included as random error items.

5. EMPIRICAL STUDY, CONCLUSIONS AND SUGGESTIONS

5.1. Model Construction and Index Data Selection

Based on the above analysis, the data variables preliminarily selected in this paper include IC sales (Y), GDP (X_1), fixed investment in IC industry (X_2), number of people engaged in IC industry (X_3), export volume (X_4), domestic industry demand (X_5) and patent disclosure volume of IC industry in that year (X_6). Several explanations about the data variables: (1) The number of people engaged in integrated circuit industry is the sum of full-time equivalent and full-time number of research and test development personnel in high-tech industry of electronic component manufacturing industry in China, which may be less than the actual number of employees. (2) The demand of domestic industry is the demand of integrated circuit market estimated by China Semiconductor Association.

Next, I will analyze the influence of various factors on the scale of national debt issuance from a quantitative perspective. The sample data used in this paper are annual data. The sample period is from 2004 to 2017, with 14 groups of data. The sample data comes from China Statistical Yearbook, China Semiconductor Association, etc. Set the model as follows:

$$Y = b_6 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + U$$

Among them, U is a random error term, which describes the interference of factors other than explanatory variables on the sales of integrated circuits.

5.2. First Empirical Results

Dependent Variable: Y
 Method: Least Squares
 Date: 05/20/19 Time: 18:39
 Sample: 2004 2017
 Included observations: 14

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-717.8826	590.2173	-1.216302	0.2633
X1	-0.000118	0.005327	-0.022159	0.9829
X2	0.154444	1.092020	0.141430	0.8915
X3	-0.027483	0.009672	-2.841427	0.0250
X4	-1.271503	1.033826	-1.229900	0.2585
X5	0.687910	0.382519	1.798369	0.1152
X6	0.100508	0.042053	2.390050	0.0482

R-squared	0.987351	Mean dependent var	2162.416
Adjusted R-squared	0.976510	S.D. dependent var	1458.552
S.E. of regression	223.5457	Akaike info criterion	13.96396
Sum squared resid	349808.6	Schwarz criterion	14.28349
Log likelihood	-90.74773	Hannan-Quinn criter.	13.93438
F-statistic	91.06996	Durbin-Watson stat	2.212475
Prob(F-statistic)	0.000003		

Figure 1 First empirical results

As we can see in Figure 1, the results of the first model estimation show that the development of China's IC industry has a reverse relationship with the national economic output value, IC exports and IC practitioners, which is different from the theoretical analysis and empirical judgment, and some variables cannot pass the relevant tests, so further adjustment is needed.

5.3. Model Adjustment and Second Empirical Analysis

After multiple collinearity, correlation, significance, heteroscedasticity test and causality test, the model was modified to be logarithmic model. After the above analysis and test, it can be concluded that the fitting model basically meets the standard, and all the requirements have passed the test. Finally, the model is determined as follows:passed the test. Finally, the model is determined as follows:

$$\ln Y = -1.72 + 0.14 \ln X_2 - 0.96 \ln X_3 + 2.21 \ln X_5$$

Dependent variable: LNY
 Method: Least Squares
 Date: 05/23/19 Time: 12:17
 Sample: 2004 2017
 Included observations: 14

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.728606	1.718103	-1.006113	0.3381
LN2	0.143489	0.086231	1.664015	0.1271
LN3	-0.964779	0.334846	-2.881266	0.0164
LN5	2.206961	0.269097	8.201345	0.0000

R-squared	0.990618	Mean dependent var	7.468506
Adjusted R-squared	0.987804	S.D. dependent var	0.683588
S.E. of regression	0.075492	Akaike info criterion	-2.094617
Sum squared resid	0.056991	Schwarz criterion	-1.912030
Log likelihood	18.66232	Hannan-Quinn criter.	-2.111519
F-statistic	351.9753	Durbin-Watson stat	1.437796
Prob(F-statistic)	0.000000		

Figure 2 Second empirical results

As we can see in Figure 2, through empirical analysis, we find that the most important factors that affect the development of integrated circuit in China in recent years are market scale and the fixed investment of government and private in integrated circuit, while human capital has a negative impact.

The expansion of market demand and capital investment has always been an important driving factor for the development of China's industry, so has the integrated circuit industry. Integrated circuit is closely related to our life, so the demand is very large and continues to grow. In order to master the core technology, our government and market continue to increase investment in it, so the fixed investment and market demand of integrated circuit become an important influencing factor Element. China's IC industry has been in a trade deficit, so the impact of IC exports on China is not very big, but China has only begun to attach importance to intellectual property in recent years, so the impact of property rights on the previous IC is also very small, which can be ignored.

As for the inverse relationship between IC sales and industrial personnel, the reasons may be as follows: First is data problem, because the annual number of employees in the IC industry cannot be collected, the full-time equivalent of research and test development personnel in the high-tech industry of China's electronic component manufacturing industry is selected, which may not be replaced to some extent, so the results and theoretical predictions are different. Second, because the integrated circuit industry is a high-end industry, the impact of ordinary practitioners on it is far less than that of technicians, so in recent years, although the number of practitioners in China's integrated circuit industry has increased, the proportion of technicians is relatively small.

5.4. Conclusions and Suggestions

According to the empirical results, we can see that what affects the rapid development of integrated circuits in China is the investment in the integrated circuit industry in China, especially the investment in fixed assets, and the demand for integrated circuits in China and even in the world. Compared with the above two factors, the industrial practitioners and patents have less influence on the development of integrated circuits, which is still in the immature stage compared with China's integrated circuits. The national conditions are basically in line.

In the future, the demand for integrated circuits will still grow fast, and because of the trade friction between China and the United States, the demand for domestic integrated circuits will be greater. After the ZTE incident, there was an upsurge of integrated circuit industry in China. Local governments issued a number of supporting policies, and financial support in the integrated circuit industry is also increasing. Therefore, in the future, China's integrated circuit industry will still show high-speed development. But at present, there are still some problems in the development of China's integrated circuit industry:First, the level of industrial technology is low, and the core

technology is controlled by others. Although China's integrated circuit industry has made great progress, it still lags behind the international advanced level. The production technology level is 2-3 generations lower than that of the leading countries, and the overall level is 6-8 years behind the international level. Second, the internal structure of the industry is unreasonable and the IC design ability is weak. In the high-end packaging and testing links with relatively high technology content, only in the past two years did some foreign investment and joint ventures start. Third, there are very few independent copyright products, and the trade deficit continues to be high. China's IC industry has been in the export less than the import, and China did not pay attention to the protection of IC intellectual property rights and patent layout before. Fourth, the lack of industrial leaders seriously restricts the leapfrog development of the industry. There has been a talent gap in China's integrated circuit industry, and this gap is still expanding.

In view of the current situation and existing problems in the development of integrated circuits in China, this paper puts forward the following suggestions for the development of integrated circuits in China: First of all, we should strengthen the research and development of key technologies and products, and improve the level of industrial technology. Secondly, we should strengthen the cultivation and introduction of integrated circuit talents, and establish a sound system for the cultivation of integrated circuit talents. Then we should strengthen the development and protection of independent intellectual property products, pay attention to the development of SOC technology and IP core, form a new generation of technology and products with independent intellectual property rights, and give full protection through relevant laws.

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