

Current layout of Yangtze River Delta IC industry and the realistic choice of Ningbo IC industrial policy

Hongle Zhang

College of International Economics & Trade, Ningbo University of Finance and Economics, Ningbo, Zhejiang, China

zhanghongle@sina.com

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Abstract: In recent years, China's integrated circuit industry has developed rapidly, forming four industrial agglomeration areas represented by the Yangtze River Delta. The Yangtze River Delta region is half of China's integrated circuit industry scale, among which Shanghai's industrial scale has reached a quarter of the whole country. According to the analysis based on flying-geese model, Ningbo, as a latecomer of the integrated circuit industry, must aim at some links of the integrated circuit industry according to its own industrial advantages, so as to occupy a place in the national integrated circuit industry.

1. Development situation of the integrated circuit industry in the Yangtze River Delta

According to the data compiled by the China Institute of Commerce and Industry, from 2016 to 2020, China's integrated circuit output increased year by year. In 2020, the national integrated circuit output reached 261.26 billion pieces getting a year-on-year growth of 29.5%, and the output reached a new high. At present, there are four main industrial agglomeration areas in China, namely, the Yangtze River Delta with Shanghai as the center, the Bohai Rim with Beijing as the center, the Pan-Pearl River Delta with Shenzhen as the center, and the central and western regions represented by Wuhan and Chengdu. On the whole, the Yangtze River Delta and Pearl River Delta regions are developing comprehensively in the basic design, manufacturing, sealing and testing; the Beijing-Tianjin-Hebei region prefers the IC design industry, while the central and western regions are developing well in the sealing and testing industry.

It is need to pay attention that the current Yangtze river delta IC industry scale occupies half of the country, with the Shanghai IC industry develop the best, and Shanghai's IC industry scale reached 250 billion yuan, accounting for about a quarter of the country. Shanghai gathered more than 1000 key enterprises, attracting 40% of the national integrated circuit talent^[1].

Jiangsu province is one of the provinces with the whole integrated circuit industry chain in China. With the help of a new round of national policies and market demand, Jiangsu integrated circuit industry has achieved rapid development in recent years. In 2021, the sales revenue of the integrated circuit industry in the province was 275.809 billion yuan (excluding equipment and materials), seeing the 25.3% year-on-year growth. Among them, the design industry was 70.57 billion yuan, up 40.58% year-on-year growth; the manufacturing industry was 51.55 billion yuan, up 34.59% year-on-year growth; and the packaging and testing industry was 153.62 billion yuan, up 16.82% year-on-year growth. A number of major industrial projects with advanced technology and obvious driving role, such as Nanjing TSMC, Guobo Electronic Integrated Circuit, Huatian Sealing Test, Wuxi SK hynix second factory and M8, Huahong 12-inch process line and production expansion project, Zhonghuan leading large-size silicon wafer, and Xuzhou Xinjing large-size silicon wafer, have been signed and started construction, and the industrial development level and technical level have been further improved.^[2]

Anhui is the latecomer area of the integrated circuit industry in the Yangtze River Delta region, with Hefei as the main center. Although in the field of integrated circuit design, Hefei has developed late and accumulated less, it has adopted the development strategy introducing mature enterprises,

and has gathered a number of high-quality integrated circuit enterprises in a relatively short time. Among them, the represented enterprises are MediaTek Technology (Hefei) Co., LTD., MediaTek Innovation Hefei, etc. Although there are some differences between the semiconductor display industry and the integrated circuit industry, its industrial chain and talent structure overlap greatly, which makes Hefei gradually form a semiconductor industry chain with several leading semiconductor display and integrated circuit manufacturing enterprises as the center^[3].

Zhejiang started late in the field of integrated circuit, focusing on the development of integrated circuit design field. At present, a number of influential design companies in the field of subdivision are emerging. During the 13th Five-Year Plan period, the output scale of integrated circuit in Zhejiang province has grown from 7.40 billion in 2016 to 17.41 billion in 2020, with a compound annual growth rate (CAGR) of 23.8%, fully demonstrating the rapid growth of Zhejiang province in the scale of integrated circuit industry. While vigorously developing the industrial scale of the integrated circuit industry, Zhejiang province has also gradually formed the industrial integrated service system and the public application of service extension. However, Zhejiang's integrated circuit development has also exposed technology gap constraints, weak research and development capacity, insufficient talent support system and other problems^[4].

2. Analysis on development status and Advantages and disadvantages of Ningbo Integrated Circuit Industry

Ningbo integrated circuit industry started early which can traced back to the "Lili Electronics" 6-inch monocrystalline silicon project in 2000. After 17 years of cultivation and development, Ningbo IC industry has formed a certain scale of integrated circuit industry foundation and application market, emerging a number of leading enterprises such as SMIC Ningbo, Jiangfeng Electronics, Jin Ruihong, Kangqiang Shares, BYD semiconductor and etc.

Beilun Chip Port Town is the focus of Ningbo chip industry layout. Under the promotion of Chip Port Town, the scale of Ningbo integrated circuit industry is also constantly expanding. In addition to the Plemar semiconductor project from Germany, there are also well-known IC industry enterprises including SIC Integrated Circuit (Ningbo) Co., LTD., Anji Microelectronics, NTU Optoelectronics, Hengshuo and other enterprises.

2.1. Analysis of the advantages of Ningbo' integrated circuit industry

From the perspective of the current development situation of integrated circuit industry in Ningbo and the industrial foundation of Ningbo, its advantages in the development of integrated circuit industry are mainly as follows:

2.1.1. The good manufacturing foundation in Ningbo has formed a good support for the integrated circuit industry

Ningbo is a city with good development of China's automotive electronics industry. It is also one of the three major clusters of small home appliance manufacturing industry in China, with Cixi and Yuyao as the main gathering places.

Ningbo has more than 4,400 auto parts manufacturers, such as Joyson Electronics and Huaxiang Group, and its products involve four categories: automobile powertrain, chassis, body and accessories, and electrical instruments. Ningbo has high-end parts development blocks with Yinzhou, Ninghai, Xiangshan, Yuyao and Cixi as the core, and vehicle production bases with Hangzhou Bay New Area and Beilun as the core.

Home appliance industry is also an advantageous industry of Ningbo, accounting for about one-eighth of the city's total industrial output value. Ningbo has more than 4,500 complete machine manufacturing enterprises, 15,000 spare parts supporting enterprises, and its annual operation scale reaches 220 billion yuan per year.

In recent years, the intelligent upgrading of the small home appliance market has become the mainstream. Ningbo has issued "Ningbo Smart Home Appliance Industry Cluster Development Plan (2019-2025)", "Ningbo Three-year Action Plan for the Development of Smart Small Home Appliance

Industry (2020-2022)" and other documents to promote the development of Ningbo small home appliances to the direction of intelligence.

Ningbo' industrial advantages in automotive electronics and small home appliances creates a great demand for chips, but the technical requirements of these two industries are not very high. The 28 nm and 14 nm chips already mastered in China can fully meet the requirements of such chips.

2.1.2. Ningbo has industrial advantages in integrated circuit material manufacturing

In recent years, the introduction of integrated circuit enterprises mainly concentrated in the photoelectric materials enterprises, such as Sheng-jisheng, Lizhu Intelligent, Huarun Allsemi and Nanda photoelectric (photoresist), Anji Microelectronics (polishing liquid, cleaning liquid), Yunde Semiconductor (high purity quartz), Risheng New Materials (polishing liquid) and other key materials enterprises. Ningbo used to be one of the important photoelectric industry bases in China, whose chip target production base have a high popularity in China, which represented by Jiangfeng Electronics and Kangqiang Electronics.

2.2. Analysis of the disadvantages of Ningbo' integrated circuit industry

2.2.1. The insufficient talent reserve of Ningbo integrated circuit industry

Influenced by the regional and industrial atmosphere, Ningbo has no advantage in attracting talents as much as Shanghai and Hangzhou, resulting in a serious talent loss. In addition, universities in Ningbo lack the ability to cultivate talents in this respect. Only Ningbo University and Ningbo Nottingham University provide such major related to integrated circuits, but the student number is small[5]. At the same time, the competitiveness of Ningbo IC industry is weak compared with other regions of China, so it is difficult to attract high-end IC talents to work in Ningbo for the lack of leading chip enterprises in Ningbo.

2.2.2. The deficiencies in industrial policy guidance

In recent years, Ningbo has also released a series of plans and policies for the development of the integrated circuit industry. Viewing all these policies and plans ,we found that, although these policies are aiming at comprehensive support and encouragement for the integrated circuit industry chain, but because of not considering the integrated circuit industry in the Yangtze river delta industry layout and development, these policies just results in policy-shopping among Yangtze River Delta cities.

2.2.3. Analysis based on the " flying-geese model"

"Flying-geese model" was first proposed by Japanese economist Akisong in the 1930s, later developed and improved by Kojdo and other scholars, and used to explain the general law of industrial transfer and upgrading in the region[6]. The early " flying-geese model" was used to explain how Japan, as a latecomer country, used its changing comparative advantage to surpass other countries, and it was later used to explain the " The East Asian Miracle of the 1960s and 1980s. Therefore, the " flying-geese model" has become a description of the regional unbalanced economic development and the obvious regional gradient phenomenon, and serves for the latecomer countries or regions to formulate catch-up strategies.

Some scholars used the model to analyze the integrated circuit industry in the Yangtze River Delta, and calculated the value-added level of each production link in the value chain of the Yangtze River Delta from 2011 to 2018, and empirically tested the impact of the city level on the value-added level of the industrial value chain. Their research holds that, in order to promote the benign interaction between the spatial layout and industrial layout of urban agglomeration, all kinds of cities in the Yangtze River Delta region need to give full play to the favorable conditions of regional division of labor and cooperation, industrial linkage and complementarity, integrating more actively into the organizational system of regional industrial value chain, thus enhancing the overall competitiveness of the regional region. Cities should adhere to the concept that there is no "high and low level" in the industrial chain. No matter what production link is embedded in the regional value chain, as long as they work hard to improve the level of production technology and realize the connotative

development, they can share the "dividend" of development in the internal circulation of the regional economy.

From the above analysis, it can be seen that the national layout of the integrated circuit industry has been basically formed, and the Yangtze River Delta region has accounted half of China's integrated circuit industry. In this region, Shanghai plays a very obvious leading role while other cities such as Nanjing, Hefei, Suzhou and Hangzhou also have their own advantages. Ningbo belongs to the late-comer region in the layout of the integrated circuit industry in the Yangtze River Delta. It can only aim at one or two links in the integrated circuit industry chain according to the existing development status and the existing industrial layout of the integrated circuit industry. In line with it, the industrial policy can only focus on supporting these one or two links, so that we can occupy a place in the layout of the Yangtze River Delta IC industry.

3. The policy choice of Ningbo's integrated circuit industry

3.1. Strengthening the research and development and application of basic materials in the integrated circuit industry

Relying on the scientific research advantages of Ningbo Institute of Materials of Chinese Academy of Sciences and Oriental Institute of Technology (under construction), and combined with the existing integrated circuit key material enterprises such as Jiangfeng Electronics, Ningbo can have a certain voice and industrial advantages in the field of key materials of the integrated circuit industry. Developing and expanding this advantage is the best choice and realistic choice for Ningbo IC industry.

3.2. In terms of integrated circuit design and application, Ningbo shall aim at the advantageous industries such as small home appliances and automotive electronics, and form the supply chain advantages of application and research and development as soon as possible.

In recent years, the development and popularization of new energy vehicles and intelligent vehicles worldwide have driven the rapid rise of the automotive electronics industry, such as microcontrollers, memory chips, power semiconductors, intelligent sensors, wireless communication, relay and other integrated circuit products have become the new favorite in the market. The chip manufacturing in the home appliance industry and the field of automotive electronics does not require high technical level, and China's existing 28 nm and 14 nm lithography technology has been able to fully meet the needs. On the other hand, the demand market for the new generation of pure electric and intelligent new energy vehicles is expanding rapidly, becoming the fastest growing segment industry. In addition, the epidemic has led to the imbalance of global automotive chip production capacity, and all countries are actively introducing the supply chain, and automotive chips are expected to become the main expansion field in the future.

Therefore, Ningbo integrated circuit industry can be fully competent for such chip production.

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