The Impact of Tax Incentives on R&D Investment of Integrated Circuit Enterprises

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Abstract. This paper explores the impact of tax incentives on R&D investment by IC firms. As a technology-intensive and talent-intensive industry, the integrated circuit industry is a key industry to promote national economic development. In order to enhance the independent research and development capabilities of China's integrated circuit industry and reduce its dependence on foreign countries, the Chinese government has successively introduced a series of support policies since 2014. Based on an empirical analysis of the panel data of 116 A-share listed IC companies from 2015 to 2022, this paper finds that tax incentives significantly promote R&D investment. Especially in the economically developed eastern region, the effect of tax incentives is even more obvious. This paper proposes to further expand the scope of tax incentives, pay attention to talent training and incentives, and strengthen local government incentives to promote the development of the integrated circuit industry.

Keywords: R&D investment, tax incentives,Tax incentives

1 Introduction

The integrated circuit industry, also known as the IC industry, involves the design, production, packaging and testing of integrated circuit chips. This industry has the two characteristics of technology-intensive and talent-intensive[1], which support each other, prompting enterprises to transform from relying on labor to relying on technology, and then effectively promoting the development of domestic industrial structure in a more optimized and advanced direction. This transformation is in line with China's overall goal of pursuing high-quality economic development. This is not only the cornerstone of the contemporary information industry, but also a key leading industry in China[2]. With the key role of integrated circuits in promoting national development in recent years, the government has also attached great importance to their development. With the acceleration of digital transformation, integrated circuits have become the foundation and driving force in many fields such as information technology, communications, and consumer electronics.

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2 The Status Quo of China's Integrated Circuit Industry

It has become the consensus of the whole society to accelerate the high-quality development of China's integrated circuit industry and solve the problem of "stuck neck" that restricts the development of key core technologies for industrial development[3]. In order to enhance China's independent research and development capabilities of integrated circuits and reduce foreign dependence, China has successively issued a series of policies to support China's integrated circuit industry since 2014. For example, in 2014, the State Council issued the "National Integrated Circuit Industry Development Promotion Outline", which clearly stated that by 2020, it is necessary to basically build a technologically advanced, safe and reliable integrated circuit industry system to achieve leapfrog development[4]; In 2021, the Ministry of Finance, the State Administration of Taxation and the General Administration of Customs jointly issued the Notice on Import Tax Policies to Support the Development of the Integrated Circuit Industry and the Software Industry, proposing to implement preferential tax policies for relevant enterprises. China is issuing policies from all angles to jointly promote the progress of the integrated circuit industry.

With the introduction of a series of incentive policies, although China's integrated circuit industry started later than other countries, it has developed rapidly and achieved significant progress. According to the China Semiconductor Industry Association, the market size increased from 541.1 billion yuan in 2017 to 1,099.6 billion yuan in 2021, with an average annual compound growth rate of 19% during this period[5]. Globally, China has maintained its position as the largest consumer market for integrated circuits for many years, currently accounting for 34.4% of the global market share.

The friction of the Sino-US trade war has brought further challenges to the development of integrated circuits in China[6]. In 2023, the U.S. Department of Commerce's Bureau of Industry and Security (BIS) further clarified and strengthened restrictions on semiconductor exports to China, revising and expanding restrictions on certain advanced computing projects through two new temporary rules. These sanctions have had a significant impact on China's integrated circuit industry. Therefore, how to achieve technological breakthroughs and overcome technological difficulties has become a practical problem that China needs to solve at present[7].

3 Research Hypothesis

The innovation activities of integrated circuit enterprises are the process of upgrading existing technology or developing new technologies, creating new products and eventually transforming them into income, with considerable positive externalities, the progress of the entire industry technology level after successful research and development, each integrated circuit enterprise has obtained the benefits brought by the success of research and development free of charge, but the integrated circuit enterprises that really carry out research and development can not be compensated for this, so as to reduce innovation activities[8]. Tax incentives can correct the problem of externalities, subsidies narrow the gap between private benefits and social benefits, rela-

tively reduce the R&D costs of enterprises, increase the enthusiasm of enterprises for R&D investment, and realize the effective allocation of resources[9]. Tax incentives can also help integrated circuit enterprises share part of the risk, change the risk appetite of enterprise capital investment, and thus incentivize integrated circuit enterprises to increase the amount of their R&D investment.

Therefore, according to the nature of tax incentives, the following assumptions are made: tax incentives promote the R&D investment of integrated circuit enterprises, and based on the above analysis, the following regression model is constructed, see equation (1).

$$R\&D_{it} = \alpha + \gamma_i + \lambda_i + \beta_1 TR_{it} + \beta_2 firmage_{it} + \beta_3 ROA_{it} + \beta_4 size_{it} + \beta_5 lev_{it} + \beta_6 liquid_{it} + \beta_7 employee_{it} + \epsilon_{it} \quad (1)$$

The data in this article comes from the A-share listed integrated circuit enterprises on the Guotaian website, excluding the negative and incomplete data of total profit and net profit, in order to ensure the stability of the data and the accuracy of the empirical results, ST and *ST listed integrated circuit companies are deleted. Considering that the research requires a sufficient sample size, this paper selects the enterprise data of 116 listed IC companies from 2015 to 2022 for eight years, with a total of 929 valid panel data. Stata16 software was used for empirical analysis. In this paper, R&D investment is selected as the explanatory variable (R&D), which is the amount of R&D investment of the enterprise in the current year, and the explanatory variable is the preferential tax rate (TR), which is obtained through "25%-the effective tax rate of income tax", that is, the difference between the standard tax rate and the effective tax rate of enterprise income tax as the proxy for tax incentives, where the standard tax rate is 25%, and the effective tax rate is equal to income tax expense divided by pre-tax profit. The explanatory variable is selected as the firmage, which is the logarithm of the year of the current year - the year of establishment of the company+1, the net profit on total assets (ROA) is the net profit/average balance of total assets, the size of the company is the natural logarithm of the total assets of the year, the debt-to-asset ratio (lev) is the total liabilities at the end of the year/the total assets at the end of the year, the current ratio (liquid) is the current assets/current liabilities, and the company size (employee) is the natural logarithm of the number of employees.

4 Regression Results and Analysis

Table 1 reports the overall regression results. In Table 1, *, **, and *** represent 10%, 5%, and 1% at the level, respectively, and the values in parentheses are for each statistic. According to the regression results in column (1), the core coefficient is the core explanatory variable R&D at the 1% level, which is significantly positive, and the preferential tax policy has a significant role in promoting the R&D investment of integrated circuit enterprises, and the assumption is true. In order to further verify the reliability and robustness of the empirical results in this paper, the robustness test is

carried out by removing the explanatory variables. Here, the net asset return margin is removed, and the remaining explanatory variables are substituted into the model for regression analysis. The results are shown in column (2) of Table 1. In addition, the robustness test was performed using the method of increasing the explanatory variables, and the two explanatory variables of basic earnings per share (PEPS) and the number of R&D personnel were added for regression analysis, and the results are shown in column (3) of Table 1. In order to test whether the preferential tax policy on the R&D investment of integrated circuit enterprises is related to the role of enterprises in the eastern region or enterprises in the non-eastern region, according to the above regression, the complete sample of 116 enterprises is divided into eastern enterprises and non-eastern enterprises. The two sub-samples returned separately, of which 92 were eastern enterprises and the rest were non-eastern enterprises. The regression results are shown in columns (4) and (5) of Table 1.

Table 1. Regression Results.

	(1)	(2)	(3)	(4)	(5)
x	-0.0750*	-0.0751*	-0.0420*	-0.0736*	-0.3034
	(0.0426)	(0.0427)	(0.0219)	(0.0406)	(0.3106)
firmage	-1.6951	-1.6431	-0.0274	-2.3143*	0.1747
	(1.0582)	(1.0551)	(0.3702)	(1.2476)	(0.9613)
ROA	-0.3042		-1.3471*	-0.2922	-0.3276
	(0.3185)		(0.6981)	(0.3610)	(0.3590)
size	0.4304**	0.4219**	0.0518	0.6226***	0.0647
	(0.1698)	(0.1677)	(0.0808)	(0.2207)	(0.1468)
lev	-0.6451*	-0.5788	-0.5526***	-0.8537**	-0.2922
	(0.3782)	(0.3555)	(0.2094)	(0.4187)	(0.2777)
liquid	0.0229**	0.0232**	0.0006	0.0313**	0.0009
	(0.0102)	(0.0102)	(0.0041)	(0.0124)	(0.0091)
employee	0.3704***	0.3721***	-0.0354	0.3398**	0.1348
	(0.1393)	(0.1399)	(0.0810)	(0.1411)	(0.1551)
peps			0.2865*		
			(0.1524)		
rdperson			0.0004***		
			(0.0000)		
_cons	-7.2064	-7.2092	-0.7088	-9.4743*	-2.6273
	(4.5610)	(4.5476)	(2.3739)	(5.5189)	(4.0870)
N	928	928	928	734	194
adj. R^2	0.2347	0.2350	0.7086	0.2599	0.2458

Standard errors in parentheses

* p < 0.1, ** p < 0.05, *** p < 0.01

It can be seen that whether the explanatory variables are removed or added, there is a significant positive correlation between enterprise R&D and tax investment, and the

results of the robustness test still support the null hypothesis, that is, tax incentives promote the R&D investment of integrated circuit enterprises. In the heterogeneity test, the promotion effect of tax incentives on R&D investment in the eastern region is more significant. For enterprises in non-eastern regions, the effect of tax incentives on R&D investment is not obvious. The above results show that there is a significant positive correlation between tax incentives and the R&D investment of integrated circuit enterprises in the eastern region, and the incentive effect is more obviously reflected in the R&D investment of integrated circuit enterprises in the eastern region. The reason may be that the eastern region is more economically developed, has a higher degree of opening to the outside world, has a more complete R&D management system, has a higher willingness to R&D, and the incentive effect of tax incentives is also more significant.

5 Conclution and Proposal

5.1 Conclusion

This study analyzes how the preferential tax policies for integrated circuits from 2015 to 2022 will affect the investment of R&D expenses of enterprises. The results show that the preferential policy has a significant effect on the R&D investment of integrated circuit enterprises, and the impact on eastern enterprises is greater than that of non-eastern enterprises.

5.2 Proposal

Expand the Scope of Incentives. Currently, China's preferential tax policies mainly focus on providing value-added tax exemptions, corporate income tax exemptions, and import tax exemptions for specific technologies and projects[10]. However, to further promote the development of the industry, consideration could be given to extending the scope of tax incentives, such as the introduction or expansion of R&D tax credits. By providing greater tax credits for enterprises' investment in R&D, enterprises can be encouraged to increase investment in the development of new technologies and new products, thus accelerating technological innovation and product upgrading, and enhancing the international competitiveness of the industry. Differentiated tax preferential policies can also be provided according to different links in the integrated circuit industry chain (such as design, manufacturing, packaging and testing, etc.) and the different development stages of the enterprise (such as start-up, growth and maturity stages), which can help accurately Support the specific needs of enterprises and promote the comprehensive development of the industrial chain[11].

Focus on Talent Development and Incentives. The development of the integrated circuit industry is highly dependent on talents, especially highly skilled talents. In view of the intensive demand for high-tech talents in the semiconductor industry, it is recommended to adopt a tax system that combines personal income tax and corporate

income tax concessions. In the semiconductor industry, R&D activities essentially rely on innovative activities carried out by scientific researchers and enterprises. Especially considering the current domestic and foreign demand for semiconductor talents, certain individual tax incentives are provided to scientific researchers involved in high-tech R&D, which can Promote the development of domestic scientific research teams and inspire individual innovation[12]. In addition, we can consider providing personal income tax exemptions for scientific researchers engaged in integrated circuit research and development, providing tax incentives for talents who have returned from studying abroad, and providing employee training subsidies for enterprises. Through these measures, we can not only attract outstanding talents at home and abroad to join the integrated circuit industry, but also promote the skills improvement and career development of existing talents.

Enhance Local Incentives. Given China's vast territory and varying levels of economic development, different regions have different foundations and needs for the integrated circuit industry. Therefore, encouraging local governments to formulate and implement preferential tax policies that are consistent with local industrial development characteristics based on local actual conditions, while ensuring consistency with national policies, may more effectively promote the development of the integrated circuit industry. Local governments can design more targeted and innovative tax incentives based on local realities to attract and foster the agglomeration and development of the integrated circuit industry. For example, companies can be attracted to invest and build factories locally to promote employment and technological progress by providing preferential land use rights, tax exemptions, and financial support. And regularly evaluate the effects of tax preferential policies implemented by local governments, including multi-dimensional evaluations such as investment growth, technological progress, and job creation brought about by the policies[13]. Based on the evaluation results, adjust and optimize tax preferential policies to ensure the effectiveness and timeliness of the policies, and encourage policy innovation and the sharing of best practices.

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