

Research Expenditure and Enterprise Development: An Empirical Analysis Based on the Data of A-Share Listed Companies

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ABSTRACT

This paper studies the impact of scientific research expenditures on corporate profits. Based on the data of A-share listed companies in the Guotaian database (CSMAR), an empirical analysis is carried out using multiple linear regression models. The results show that in the short term, there is a negative correlation between scientific research expenditures and corporate profits. Increasing scientific research expenditures will reduce corporate profits; but in the long run, there is a positive correlation between scientific research expenditures and corporate profits. Increasing scientific research expenditures will significantly increase corporate profits. This positive impact is particularly evident in large-scale enterprises above designated size.

Keywords: *Research expenditure; Corporate profit; Multiple linear regression model*

1. INTRODUCTION

Under the influence of the COVID-19, the world economy as a whole is showing a downward trend. The goal of China's economic development has also changed from pursuing rapid growth to pursuing high-level growth quality. In this process, companies, especially listed companies, have played an important role. Companies are a component of the market economy. Corporate profits will affect the trend of economic development. The adjustment of the company's expenditure structure, especially the investment in R&D, will affect economic development. the quality of. In the context of the overall transformation of my country's economy, it is of great practical significance to study the structure of corporate expenditures, especially the relationship between R&D expenditures and corporate profits. Different from traditional research methods, this paper uses multiple linear regression analysis model research tools to analyze the impact of scientific research expenditures on corporate profits from the perspective of micro empirical research, and analyzes its short-term and long-term roles respectively, and concludes The results are different from traditional research.

2. LITERATURE REVIEW

The relationship between corporate cost and corporate profit has always been a hot issue that has received widespread attention. Scholars such as Li Zhaoyao have conducted related research from the perspective of the general situation of the enterprise: Li Zhaoyao and others (2020) in their paper "Research on Enterprise Scientific Research Investment Based on the Perspective of Dialectics of Nature In "Impact on Corporate Profit Rates", the relationship between R&D investment and corporate profit growth is studied. The author uses the data of 75 listed companies in Zhongguancun on R&D investment and corporate revenue and profits in the past 6 years, and analyzes based on the perspective of dialectics of nature. The results show that the R&D intensity of an enterprise has a very obvious positive effect on the profit rate of the enterprise. Within the controllable range, the increase in R&D intensity will bring about a greater increase in the profit rate.[2] Zhao Baoguo and Que Renchao (2016) studied the relationship between advertising investment and corporate performance and the optimal intensity range of advertising investment in their paper "Research on the Nonlinear Relationship between Traditional Corporate Advertising Investment and Corporate Performance". The author conducts threshold regression analysis based

on the micro-level data of China's industrial enterprise database from 2005 to 2007. The results found that the impact of advertising investment on corporate performance has phase characteristics, and there is an optimal investment interval. At the same time, the impact of advertising investment on an enterprise also depends on the characteristics of the enterprise.[5] To analyze the impact of scientific research expenditure on enterprises of different sizes, Sun Weifeng (2015) studied the relationship between scientific research expenditure and advertising expenditure and corporate systemic risk in his paper "empirical research on R&D and advertising expenditure and enterprise systemic risk". Based on the data of listed manufacturing companies in Shanghai and Shenzhen stock markets and the CSMAR database of Guotaian from 2009 to 2011, the author uses a multiple linear regression model for analysis. The results found that the significant positive correlation between scientific research expenditure and corporate systemic risk only appeared in large companies, while the significant negative correlation between advertising expenditure and corporate systemic risk only existed in small companies.[6]

Sun Weifeng (2013) studied the impact of advertising expenditure and scientific research expenditure on corporate performance in his paper "Advertising Expenditure, Scientific Research Expenditure and Enterprise Performance". Based on the data of manufacturing companies in Shanghai and Shenzhen in 2009, the author uses a multiple linear regression model to analyze. The results found that advertising expenditures and scientific research expenditures have a positive impact on corporate performance. The analysis of empirical data shows that the effects of scientific research expenditures are more significant than advertising expenditures.[8] Sun Weifeng (2013) studied the impact of scientific research expenditure on company growth in his paper "Empirical Research on the Impact of Scientific Research Expenditure on Company Growth". Based on the data of China's listed manufacturing companies from 2009 to 2011, the author used OLS, fixed effects and random effects regression analysis methods for analysis. The results show that scientific research expenditure is positively correlated with company growth, and is also affected by company size and R&D intensity.[7] Yu Liming and Chi Shengwei (2012) studied the impact of advertising expenditure and R&D investment on corporate growth in their paper "The Impact of Advertising Expenditure and R&D Investment on Enterprise Growth." Based on analysis of existing conclusions of research and development, the author found that because intangible assets have a positive effect on the development of enterprises, both advertising expenditure and R&D investment have a positive effect on the growth of enterprise sales, profit growth and market value growth.[9]

In addition, considering that different types of

enterprises differ greatly in their production and operation characteristics, scholars such as Zhang Xinxin also conduct specific analysis on different types of companies. Zhang Xinxin and Shen Chenglin (2021) studied how to coordinate advertising strategy and R&D strategy in their paper "Advertising Investment, R&D Investment and Innovative Drug Performance of Pharmaceutical Companies" Relationship to improve the market performance of innovative drugs. The author analyzes by constructing the R&D-price competition game model of duopoly pharmaceutical companies. The results show that if and only if there is a "crowding in" effect between advertising investment and R&D investment, the implementation of advertising strategy may bring a competitive advantage to the enterprise.[1] Ye Songqin (2018) and others analyzed the relationship between ZTE's scientific research investment and its financial performance around 2013 in their paper "Technical Threshold Effect, Scientific Research Investment and Corporate Performance". Based on the data of ZTE Corporation from 2013 to 2015, the author uses case analysis method for analysis. The results show that R&D investment should be focused on the time structure in order to better improve corporate performance.[3] Liu Yongcheng (2017) studied the impact of scientific research input and other factors on the profit of Kailuan Group in his paper "Analysis of the Impact of Scientific Research Input on the Profits of Coal Enterprises". Based on the data of Kailuan Group, the author analyzes the above-mentioned problems using related theories and calculation methods of microeconomics and econometrics. The results show that the increase in scientific research investment has a significant impact on the profit growth of Kailuan Group.[4] Li Xiujuan and Zhong Suyan (2008) studied the proportion of advertising expenditure and scientific research expenditure in sales revenue in the process of differentiation between well-known US pharmaceutical companies and Chinese pharmaceutical companies in their paper "Comparison of Advertising Expenditure and Scientific Research Expenditure of Chinese and American Pharmaceutical Companies". Based on the data on advertising expenditures and scientific research expenditures of the top 8 compulsory drug manufacturers in the United States in 2003 and the data on advertising expenditures and scientific research expenditures of Chinese pharmaceutical companies from 1997 to 2003, the author analyzed the analysis using Chinese and foreign comparisons and case analysis methods. The results show that the differentiation of Chinese pharmaceutical companies focuses on advertising, while world-renowned companies focus on R&D.[10]

3. METHODOLOGY AND DATA

This paper uses a multiple linear regression model to analyze the relationship between enterprise scientific research investment and profit. Multiple linear regression

models are often used to analyze multivariate disturbance problems, that is, the explained variable in a problem is affected by changes in multiple explanatory variables. The problem of corporate profit is a typical problem of this type. Corporate profit is affected by many factors such as scientific research expenditures. Under such conditions, a multiple linear regression model is established through econometric methods to accurately define scientific research expenditures among the many influencing factors. The influencing factors become particularly important. The specific model form is shown in equation (1).

$$y_i = \beta_0 + \beta_1 x_i + \beta_2 z_i + u_i \dots \dots \dots (1)$$

In equation (1), the dependent variable y_i is the corporate profit, the independent variable x_i is the scientific research expenditure, and the coefficient β_1 represents the impact of scientific research expenditure on the corporate profit. In order to accurately understand the impact of corporate scientific research expenditure on the profit, this paper adds a series of control variables z_i , including sales expenses, management expenses, financial expenses, total operating income, etc. In the estimation process of the model, this paper uses the least square method in the mathematical optimization technique to find the best function match of the parameters by minimizing the square sum of the error. The least square method can be used to easily obtain the parameters to be estimated, and minimize the sum of squares of the errors between the obtained parameters and the actual parameters. The specific process is shown in equation(2). B^* is any linear unbiased estimator of B .

$$E[(B^* - B)(B^* - B)'] \geq E[(\hat{B} - B)(\hat{B} - B)'] \dots \dots \dots (2)$$

According to the Gauss-Markov theorem, given the assumption of classical linear regression, the least squares estimator is a linear unbiased estimator with the smallest variance. Therefore, when the classical assumption holds, there is no need to look for other unbiased estimators, and none of them will be better than ordinary least squares estimators. That is to say, if there is a good linear unbiased estimator, the variance of this estimator is at most as small as the variance of the ordinary least squares estimator, and will not be less than the variance of the ordinary least squares estimator.

The data used in this paper comes from the enterprise data of 1,304 Chinese A-share listed companies from the Guotaian Data Service Center. The CSMAR economic and financial research database is based on the needs of academic research, and draws on the professional standards of the University of Chicago CRSP, Standard & Poor's Compustat, New York Stock Exchange TAQ, I/B/E/S, Thomson and other internationally renowned databases, combined with China's actual conditions. Economic and financial database developed by national conditions. After 21 years of continuous accumulation

and improvement, the CSMAR database has covered 18 series of factor research, character characteristics, green economy, stocks, and companies, including more than 160 databases, more than 4,000 tables, and more than 50,000 fields. The coverage of the data is relatively wide, and the information and content contained can meet the requirements of the analysis of this paper.

4. RESULTS

This paper uses the commonly used measurement analysis software Stata to realize the model establishment and data processing. The output results of the multiple linear regression model are shown in Table 1.

Table 1. Multiple linear regression model results

VARIABLES	(1) profit	(2) profit	(3) profit
Current R&D expenditure	-0.551*** (0.0113)	-0.768*** (0.0362)	-0.163*** (0.00739)
Cumulative R&D expenditure	0.514*** (0.0254)	0.863*** (0.0773)	-0.000982 (0.0195)
Sales expense	0.0388*** (0.00582)	0.0596*** (0.0154)	0.00991 (0.0121)
Total operating income	0.523*** (0.00599)	0.493*** (0.0161)	0.798*** (0.00820)
Total operating costs	-0.500*** (0.00609)	-0.470*** (0.0164)	-0.820*** (0.00863)
Management costs	0.224*** (0.00959)	0.201*** (0.0252)	0.426*** (0.0230)
Financial expenses	-0.997*** (0.0217)	-1.097*** (0.0595)	0.746*** (0.0353)
Constant	1.417e+09*** (2.389e+08)	2.969e+08 (6.979e+08)	2.218e+09** (2.007e+08)
Observations	35,734	4,550	31,184

R-squared	0.651	0.659	0.283
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Standard errors in parentheses

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

The dependent variable of the regression is the monthly net profit of the listed company. The independent variables of regression include two parts: the first part is the main influencing variable scientific research investment, which is divided into the current expenditure of enterprise research and development and the accumulated expenditure of enterprise research and development; the second part is other control variables, including enterprise sales expenses, management expenses, financial expenses and representatives. The total operating income and total operating cost of the business scale.

Column (1) of the table reports the regression results of all companies in the sample. From the perspective of regression coefficients, current R&D expenditures, cumulative R&D expenditures, sales expenses, management expenses, financial expenses, total operating income, and total operating expenses all have a significant impact on net profit. Among them, the current R&D expenditure and the R&D cumulative expenditure have different impacts on the net profit. The R&D current expenditure has a significant negative impact on the current net profit, with a coefficient of -0.551, while the R&D cumulative expenditure has a significant positive impact on the current profit, with a coefficient of 0.514. Sales expenses showed a positive impact on net profit, with a coefficient of 0.0388, which is less than the cumulative R&D expenditure. Among the control variables, total operating income has a positive effect on net profit, with a coefficient of 0.523, and total operating costs have a negative relationship with corporate net profit, with a coefficient of -0.500; management expenses and net profit have a positive correlation with a coefficient of 0.224. Financial expenses have a significant negative impact on net profit, with a coefficient of -0.997. The value of R-square is 0.651, indicating that the selected variable can better describe the changes in the company's net profit.

Column (2) of the table reports the regression results of enterprises above designated size (the annual income of the enterprises is greater than the average income of the sample enterprises). From the perspective of regression coefficients, current R&D expenditures, cumulative R&D expenditures, sales expenses, management expenses, financial expenses, total operating income, and total operating expenses all have a significant impact on net profit. Among them, the current R&D expenditure and the R&D cumulative expenditure have different impacts on the net profit. The R&D current expenditure has a significant negative impact on the current profit with a coefficient of -0.768, while the R&D cumulative expenditure has a significant positive impact on the current profit with a coefficient of 0.863. Sales

expenses show a positive impact on the company's annual net profit, with a coefficient of 0.0596, but the impact is less than that of scientific research expenditures. Among the control variables, total operating income has a positive effect on net profit, with a coefficient of 0.0493, and total operating costs have a negative relationship with corporate net profit with a coefficient of -0.470; management fees and net profit have a positive correlation with a coefficient of 0.201. Financial expenses have a significant negative impact on net profit, with a coefficient of -1.097.

Column (3) of the table reports the regression results of the enterprises below the scale (the annual income of the enterprises is less than the average income of the sample enterprises). From the perspective of regression coefficients, current R&D expenditures, management expenses, financial expenses, total operating income, and total operating expenses all have a significant impact on net profit. Among the two types of scientific research expenditures, current R&D expenditures have a negative impact on current profits with a coefficient of -0.163, while cumulative R&D expenditures have no significant impact on current profits. Sales expenses have no significant impact on the company's net profit. Among the control variables, total operating income has a significant positive impact on net profit, with a coefficient of 0.798, and total operating costs have a negative relationship with corporate net profit, with a coefficient of -0.820; there is a positive correlation between management expenses and net profit, with a coefficient of 0.426. Financial expenses have a significant positive impact on net profit, with a coefficient of 0.746.

The results of the multiple linear regression model show: Firstly, the accumulation of scientific research expenditure has a significant positive impact on corporate profits. Since scientific research expenditures are often a long process from input to benefits, scientific research expenditures will reduce the net profit of enterprises in the short term. However, in terms of long-term effects, scientific research expenditures provide core market competitiveness for corporate products, and are positive for corporate long-term profit growth. Secondly, sales expenses, management fees, and financial expenses have an important impact on corporate profits. This shows that for corporate operations, expanding advertising, strengthening internal management, and rationalizing financial expenses can effectively increase corporate profits. Finally, the impact of corporate scientific research expenditures and various expenditures on corporate profits will be affected by the scale of the company. For large enterprises above the designated size, there is indeed a positive correlation between scientific research expenditures and corporate profits, while for small and medium-sized enterprises below the designated size, the corporate management and financial expenses have a greater impact on corporate profits.

5. CONCLUSIONS

From the perspective of enterprise cost allocation, this paper studies the factors that affect enterprise profits. Mainly focus on the impact of scientific research expenditures and other expenses on corporate profits. Based on the results of empirical research, this paper believes that: First, large enterprises should pay attention to the investment and accumulation of scientific research expenditures. Scientific research expenditures can effectively improve the level of long-term corporate profits and are the basis for the future development of enterprises. Secondly, large enterprises should also balance sales expenses and management expenses. In the short term, the investment in scientific research will have a negative impact on corporate profits, and a reasonable increase in advertising and other sales expenses can effectively increase the company's current profits, help the company maintain a stable cash flow, and provide a guarantee for the sustainable development of the company. Finally, for small and medium-sized enterprises, the investment in scientific research expenditures should be treated with caution, and financial strategies should be used rationally to increase corporate profits. In short, at different stages of its development, an enterprise should adjust its cost strategy according to its strategic objectives, and take into account the long-term development strategy of the enterprise while pursuing profit maximization.

At the same time, it should be noted that the data in this paper comes from the enterprise data of the Guotaian Data Service Center. The analysis performed is a relatively static analysis and cannot be a good measure of the long-term trend of enterprise development. Since the impact of enterprise R&D expenditures on profits is a dynamic issue, based on the subsequent acquisition of more abundant data, this paper plans to establish a dynamic model for more accurate estimation.

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