The Influence of Technological Innovation on the Profitability of Enterprises

Li Shasha[1]

[1]Beijing Jiaotong University, Department of Economics and Management, Beijing, China

Abstract—This paper studies whether the investment intensity of R&D expenses of listed companies can improve the profitability of enterprises. The data indicators of listed companies from 2015 to 2017 are obtained by using CSMAR database. R&D investment is divided into two indicators: relative number index and absolute number index, and regression analysis is carried out by establishing the econometric analysis model of profitability and absolute number index and relative number index of R&D investment. It is found that the intensity of R&D investment has a positive effect on the profitability of enterprises. Therefore, enterprises can improve their profitability through technological innovation and increasing R&D investment.

1 INTRODUCITIN

With the continuous advancement of China's modernization process, the role of scientific and technological innovation has become increasingly significant. In recent years, the focus of China's economic development has gradually shifted from the speed of development to the quality of development. High-quality development not only focuses on the present, but also needs long-term development momentum support, which requires constant injection of fresh vitality. Technological innovation is one of the driving forces of economic growth and enterprise upgrading, and it coincides with the innovation demand in the stage of high-quality development. Therefore, the state has promoted the status of scientific and technological innovation more significantly, and its strong support for technological innovation is reflected in various policies for innovation in various regions and enterprises in recent years. The most outstanding performance of applying scientific and technological innovation to various enterprises is the input of R&D expenses and R&D personnel.

The research on the impact of technological innovation on enterprise performance started earlier in foreign countries, and many scholars took the R&D investment of enterprises as an explanatory variable in the research process. Weygand(1955) analyzed the relationship between R&D investment and enterprise performance based on the data of about 400 enterprises, and the results showed that there was a positive correlation between them[1]. Ren and Eisingerich(2015) also found that the increase of R&D investment will have a positive impact on the performance of SMEs affected by the internationalization trend[2].

In China, the research on the impact of technological innovation on enterprise performance started relatively late. In the early stage, enterprises did not disclose the R&D investment and expenditure of enterprises, so there was no basic data to support the research. Therefore, with the update and perfection of accounting standards in 2007, enterprises began to disclose these data information in the statements, and domestic scholars began to analyze from these micro data. Wang Yuchun and Guo Yuanyan (2008) take the R&D information of A-share listed companies in manufacturing and information technology industries as sample data, and the results show that R&D investment has a positive effect on the profitability and growth ability of enterprises, and this effect is lagging behind and cumulative[3]. Zhang Jijian(2009) takes the high-tech enterprises that fully disclosed R&D expenditure information from 2003 to 2007 as the research sample, and takes the operating income as the measure index of enterprise performance[4]. The empirical results also verify the positive correlation between R&D investment and enterprise performance.

On the whole, the R&D investment of enterprises can positively promote the performance of enterprises. However, only R&D investment is measured as a variable, which lacks relativity. In this paper, R&D investment intensity, which is a relative index, and R&D expenditure, which is an absolute index, are taken as explanatory variables respectively. Using two different models to analyze whether the enterprise's performance and profitability will be improved by enhancing scientific and technological innovation.

2 RESEARCH HYPOTHESIS

Technological innovation will bring technological progress to enterprises. When enterprises develop new

liss0304@163.com

products and improve technology, they will first occupy the market in a short time and expand market share, thus improving the performance of enterprises. The improvement of production efficiency will also make enterprises have a larger price elasticity range, and expand the market profit share of enterprises. For intangible assets, we can also obtain benefits by transferring the ownership of assets. Driven by interests and the influence of market competitiveness, if enterprises want to maintain or even improve their own profitability, they need to continuously invest in research and improvement, so as to improve production efficiency, reduce production costs, or develop products that better meet customer needs. Tang Qingquan, Xu Xin and others (2009) studied the relationship between R&D investment and corporate profitability based on the data of listed companies from 2002 to 2005, and concluded that there is a positive correlation between them, but it is necessary to ensure that R&D investment is uninterrupted. Du Yong and Yan Bo (2014) took 43 high-tech listed companies as research objects, and also verified the positive correlation between R&D investment and profitability. In addition, due to the lag effect of R&D investment, it may affect the profitability in the lag period. Wang Yuchun and Guo Yuanyan (2008) took listed companies in information and manufacturing industry in China as the research objects, and made an empirical analysis of the cumulative R&D investment and enterprise performance. The results show that the R&D investment of listed companies in information and manufacturing industry is cumulative, and sustained R&D investment will bring lasting economic benefits to enterprises. When Chen Xu (2011) studied the relationship between R&D investment and the market value of high-tech enterprises, he found that R&D investment can not only improve the market value of the current period, but also have a lag and cumulative impact on the market value. By combing the above-mentioned literatures, we can see that the R&D investment intensity does not necessarily have a positive impact on the profitability of the current period, but there will be accumulation and lag, which will have an impact on the profitability of subsequent periods. Based on this, this paper puts forward the following assumptions:

HI: The greater the R&D investment intensity, the greater the current profitability of the enterprise

H2: The greater the R&D investment intensity, the smaller the current profitability of the enterprise

3 RESEARCH DESIGN

3.1 Variable Settings

3.1.1 *Interpreted variable*

In this paper, the analysis of profitability is mainly from the company's financial indicators. Return on total assets (ROA) and operating gross profit margin (GM) are selected as interpreted variables. Because the direct impact on the profitability of enterprises is profit, the higher the operating gross profit margin, the higher the profit after deducting various expenses, and the stronger the

profitability of enterprises. Whether the purpose of R&D activities is to optimize production and reduce costs, or to develop new products and expand sales, it will increase operating gross profit margin and enhance profitability, and the stronger the profitability, the more funds will be available for R&D.

3.1.2 *Explanatory variable*

The reason why scientific and technological innovation can influence the performance of enterprises is that R&D investment can influence the performance of enterprises through the interaction of various production factors in organizations. The most important factor is the investment of R&D expenses. However, for different companies, there will be different scale and R&D expenditure, which is lack of comparability. According to previous studies, R&D expenditure input (RD) and R&D expenditure input intensity (RDI) are defined as the ratio of total R&D expenditure input to operating income.

3.1.3 *Control variable*

As the performance of an enterprise will be affected not only by R&D investment, but also by such factors as company size , capital intensity, asset-liability ratio, etc. Time is taken as a dummy variable, and it will be taken as 1 in that year instead of 0 in other year. In the empirical analysis, these factors should be controlled so as not to interfere with the results.

3.2 Data source

The data analyzed in this paper comes from CSMAR, which is mainly the data of listed companies from 2015 to 2017, and is screened according to the following criteria; Removing missing value samples; 2 Remove samples with asset-liability ratio greater than 1 or less than or equal to 0; Delete the samples of the year before listing and the previous year; Delete the samples of financial enterprises such as banks and insurance , and finally used for regression analysis.

3.3 Model setting

Because this paper uses two indexes, one relative index and the other absolute index, this paper uses two models to carry out regression analysis on relative index and absolute index.

3.3.1 *multiple linear regression model*

$$Y_{ij} = \alpha + \beta_1 RDI_{ij} + \beta_2 SIZE_{ij} + \beta_3 CI_{ij} + \beta_4 LEV_{ij} + \sum Year + \varepsilon_{ij}$$

(1)

In which: i=1,2,….n;   j=1,2,3,4.

α is the intercept term of the regression equation, β is the regression coefficient of each variable, and ε is the

residual term. The enterprise performance of the i-th superior company in the j-th year is measured by ROA. In which RDJ is the investment intensity of R&D expenses, SIZE is the scale of enterprises, CI is the capital intensity, LEV is the Asset-liability ratio, and Year is the year.

3.3.2 Modified Cobb-Douglas Production Function Model

In order to construct the linear regression equation, the logarithm of both sides of the total model equation is obtained:

$$Y = LnY = LnA + aLnK + bLnL + cLnS + \varepsilon \ (2)$$

Y represents R&D output, with operating income minus operating cost as the measurement index. K, L and S represent R&D input, using R&D input cost, R&D input personnel and total assets as the measurement indexes, and a, b and c respectively represent the elasticity of the three.

4 EMPIRICAL RESULTS

4.1 Statistical Descriptions of Related Variables are Shown in Table 1.

TABLE 1. RELATED VARIABLES

Variable	Mean	Std .Dev.	Min	Max
ROA	0.04	0.12	-3.91	7.45
RD(billion)	0.172	0.67	0	0.186
RDI	0.05	0.06	0	1.52
RPI	0.17	1.33	0	110.66
SIZE	22.10	1.27	18.96	28.51
CI	2.66	6.30	0.09	289.89
LEV	0.40	0.20	0.02	2.58
Asset(billion)	13.7	67.3	0.172	0.24
Profit(billion)	1.62	0.997	-10.6	432

TABLE 2. MULTIPLE REGRESSION RESULTS

	(1)	(2)
	ROA	GM
RDI	-0.1557***	0.7509***
	(-6.02)	(22.21)
SIZE	0.0098***	0.0055***
	(7.76)	(3.34)
CI	-0.0005**	0.0006**
	(-2.31)	(2.21)
LEV	-0.1951***	-0.3582***
	(-24.63)	(-34.81)
Year_2016	0.0087**	0.1230***
	(2.55)	(2.75)
Year_2017	0.0064*	0.0203***
	(1.93)	(4.69)
_cons	-0.0938***	0.2756***
	(-3.52)	(7.91)
N	7553	7553
R^2	0.0801	0.2561
F	110.7086	433.20
p	0.0000	0.0000

The correlation coefficients of the interpreted variable GM and the interpreted variable RDI are 0.7509, respectively, which are relatively large and significantly positively correlated at the significance level of 1%. They have passed the correlation test and the goodness of fit exceeds 20%, indicating that the model has certain explanatory ability. It preliminarily shows that the R&D expenditure investment intensity RDI can have a positive impact on the current operating gross profit margin GM. The correlation coefficient between interpreted variable ROA and interpreted variable RDI is -0.1557, which is negatively correlated at the significance level of 1%, indicating that R&D expenditure is negatively correlated with the current return on total assets of enterprises. The reason for this result is that although the investment in R&D expenses can improve the profitability of enterprises, the excessive investment in R&D expenses will lead to a negative correlation between the net income and the investment intensity of R&D expenses. Based on the above analysis, the investment intensity of R&D expenses can have a positive impact on the profitability of enterprises, which verifies hypothesis H1.

TABLE 3. DOUGLAS REGRESSION RESULTS

	(1)
	LNProfit
LNRD	0.1523***
	(16.59)
LNRP	0.0635***
	(6.08)
LNAssets	0.7396***
	(99.88)
_cons	0.7396
	(3.83)
N	7.5e+03
R^2	0.7444
F	7090.99
p	0.0000

It can be seen from the table that the goodness of fit is 0.7444, indicating that R&D investment has a good explanation for the current performance of the enterprise, and the regression coefficients of R&D expense investment and R&D personnel investment are positive, and both of them have passed the significance test, indicating that the R&D expense investment RD and R&D

personnel investment RP are positively correlated with the current operating Profit Profit. From the above analysis, this test supports the previous viewpoint, thus assisting in verifying hypothesis H1.

5 Conclusion

By collecting the indicators of listed companies from 2015 to 2017, and combing the relevant literature, this paper puts forward the hypothesis. By using multiple regression model and modified Douglas production function model, this paper makes an empirical analysis to explore the relationship between R&D investment intensity of listed companies and corporate profitability. According to the empirical results, we can draw the following conclusions: the greater the investment intensity of R&D expenses, the better the current profitability indicators, but if the R&D investment intensity is too high, it will also have negative effects on the performance of the growing enterprises.

6 Enlightenment

6.1 Optimize the technological innovation environment

For enterprises, increasing R&D expenditure is only a basic condition for technological innovation. If enterprises want to improve the efficiency of scientific and technological innovation. First of all, they should improve the quality of scientific and technical personnel. The improvement of technical personnel quality depends on the cultivation of enterprises, so enterprises should increase the investment of training funds for employees and cultivate high-quality technical innovation talents. Secondly, formulate relevant regulations to encourage employees to learn continuously, optimize the environment of scientific and technological innovation of enterprises, and inject fresh vitality into scientific and technological innovation of enterprises.

6.2 Reasonably plan R&D investment

With the trend of scientific and technological innovation, many enterprises began to increase investment in R&D in order to improve their performance and bring long-term development to enterprises. However, the greater the investment in R&D is not the better. Enterprises should formulate their future development strategies according to their own economic conditions and future development trends. Therefore, the investment in research and development can be reasonably planned. In addition, R&D activities are risky and time-sensitive. If R&D has been surpassed by other enterprises before it has achieved results, the upfront costs may all be sunk costs. Therefore, R&D investment should match with the overall development of the enterprise, and should be carried out rationally and in a planned way.[6]

6.3 Establish a scientific management system.

Enterprise is the main body of technological innovation, and it is also the main front for the transformation of commercial value of technological innovation achievements. For enterprises, the first thing to consider in innovation is the fund management of innovation activities. Because the cost of R&D activities is an incalculable amount, enterprises should establish a scientific management mechanism when investing in R&D, so that enterprises can reasonably control unnecessary costs and reduce waste of resources. Secondly, for the management of R&D personnel, enterprises can improve the subjective initiative and efficiency of R&D personnel from the perspective of incentive, so that the scientific and technological innovation of enterprises can be carried out in a more orderly manner.

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