Contents List available at VOLKSON PRESS Economics & Management Innovations(EMI)

DOI : <http://doi.org/10.26480/icemi.01.2017.139.141>

R&D spending value effect research of China's listed manufacturing companies

Wanhao Zhang^{1,*}, Xiding Chen¹¹ Wenzhou Business College, Wenzhou, Zhejiang, China

* wanhaozhang@foxmail.com

This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ARTICLE DETAILS

ABSTRACT

Article History:

Received 02 october 2017

Accepted 06 october 2017

Available online 11 october 2017

Keywords:

Manufacturing industry, R&D expenditure, Market value..

Through studying the impact of R&D expenditure on the market value of firms according to the data of manufacturing-listed companies in Shanghai and Shenzhen A stock market from 2001 to 2014, we find that the R&D expenditure of manufacturing-listed companies shows a positive correlation with the market value. Meanwhile, R&D expenditure can generate better value effect in smaller firms. The value effect from R&D expenditure in private enterprises is greater than that in state-owned enterprises.

1. Introduction

The relationship between R&D expenditure and company value has been a hot topic of academic researches in many countries. R&D expenditure is equal to company's intangible asset investment for future growth. Although there are uncertainties in R&D expenditure and no immediate rewards, enterprises have to increase investment to create new products to distinguish them from competitors and gain future competitive advantages and monetization opportunities. Lots of literature confirms that the R&D expenditure of manufacturing-listed companies shows a positive correlation with the market value. Therefore, whether R&D expenditure can increase the company value still remains an empirical proposition worthy of study.

This paper, taking example for the manufacturing-listed companies in China, studies the value effect of R&D expenditure. China is a manufacturing power, so the optimization and upgrading of manufacturing industry is the key to accelerating the transformation of economic development pattern and driving the economic development into a more efficient direction. And R&D expenditure is the key to the optimization and upgrading of manufacturing industry. Hence, as for manufacturing-listed companies, the research about the value effect of R&D expenditure has both theoretical significance and practical significance.

The content structure of this article is as follows: the second part is the literature review and research hypothesis; the third part is the research design; the fourth part is the empirical result; the final part is the conclusion.

2. Literature review and research hypothesis

2.1 The R&D expenditure and market value of manufacturing-listed companies

Lots of literatures confirmed that the R&D expenditure showed a positive correlation with the market value of listed companies [1]. However, some empirical evidence didn't support the positive correlation between them. Erickson and Jacobson (1992) found that R&D expenditure did not contribute to the company's market value just like other expenditures [2]. Some scholars studied the relationship between the investment in scientific research and enterprise performance, and the results showed that the above relationship in information industry and manufacturing industry was not obvious. Through the empirical analysis based on the data of the listed companies in manufacturing industry and information

technology industry from 2005 to 2008, some scholars found that the R&D expenditure showed a negative correlation with the performance of listed companies at that time [3,4]. With the above arguments, we propose the first hypothesis (expressed in the form of null hypothesis):

Hypothesis 1: the R&D expenditure of the manufacturing companies in China is irrelevant to their market value.

2.2 The size effect of manufacturing-listed companies

Connolly and Hirschey's (2005) study confirmed the value effect of R&D expenditure was closely related to the company's size, and their empirical result showed that the value effect from R&D expenditure in large enterprises was greater than that in smaller enterprises [3]. Jefferson et al. (2006) used the panel data of Chinese manufacturing enterprises to empirically analyze the determinants of R&D input intensity, R&D output function and the impact of R&D on corporate performance, and the study found that R&D expenditure mainly focused on large capital-intensive enterprises [4]. Some studies showed that the role of R&D expenditure could be influenced by the firm size, but only the R&D expenditure of small enterprises had significantly positive correlation with enterprise value. On the basis of above arguments, we propose the second hypothesis:

Hypothesis 2: the value effect of R&D expenditure in Chinese manufacturing-listed companies is irrelevant to the company size.

2.3 The ownership effect of R&D expenditure in manufacturing-listed companies

Most economists have long since believed that state-owned companies operate less efficiently than private ones. State-owned enterprises' pursuing specific social and political goals rather than maximizing profits causes above phenomenon. Boycko et al. (1996) believed that political pressure forced state-owned companies to hire more employees [5]. Krueger (1990) believed that state-owned enterprises employed politically connected people rather than those who were best for the job [6]. While Vickers and Yarrow (1991) argued that state-owned companies didn't operate less efficiently than private ones, because there were also serious principal-agent problem in private enterprises, especially in large ones. Empirical studies also did not give consistent evidence, and a large number of studies have shown that private companies operated less efficiently than state-owned ones, while much evidence showed that result was not true [7,8]. Based on these arguments, we propose the third hypothesis:

Hypothesis 3: the value effect of R&D expenditure in Chinese

manufacturing-listed companies is no different in state-owned and non-state-owned enterprises.

3. Research design

3.1 Regression model

In order to examine above hypotheses, we adopt following regression equation:

$$MV_{it} = \alpha_0 + \alpha_1 RD_{it} + \alpha_2 AD_{it} + \alpha_3 E_{it} + \alpha_4 D_{it} + \alpha_5 EF_{it} + \alpha_6 BV_{it} + \varepsilon_{it} \quad (1)$$

i represents the company, t represents the year, the dependent variable MV represents market value, RD represents R&D expenditure, AD represents advertising expenditure, E represents total profits, D represents dividend, EF represents equity financing, BV represents book value, and ε_{it} represents error term.

Equation (1) is the extended form of Ohlson (1995) theoretical model. His research suggests that a company's market value can be shown as a linear equation including the surplus, book value and shareholders' net cash flow (the dividend subtracts the equity financing). We add (AD), the advertising expenditure variable, on the right of Ohlson model, because lots of literature confirmed that AD expenditure would affect a company's market value [9,10]. We add (RD), the R&D expenditure variable, on the right of the model, and R&D expenditure is a key variable in this paper. If

R&D expenditure has value effect, the regression coefficient α_1 will be not significant zero. In order to reduce the heteroscedasticity, each continuous variable in equation (1) is deflated by the book value [10].

3.2 Data, samples and descriptive statistics

In this paper, the data is from two aspects: the data of R&D and advertising expenditure is from the corporate annual reports in the websites of Shanghai Stock Exchange and Shenzhen Stock Exchange. Other data, including financial data and market data, is derived from CSMAR of Shenzhen GTA Education Tech Ltd. We delete the following firm-year observations: the observations whose book values are negative, the observations missing R&D expenditure variable and the observations missing other variables.

The samples in this paper are the listed companies in Shanghai and Shenzhen A stock market from 2001 to 2014. In addition to the companies' market capitalization, other variables are derived from the companies' financial statements of the year. The current accounting system in China asks listed companies to publish the financial statements of the previous financial year before April 30 every year. In order to make financial data and market data match each other, every firm-year observation of the company value is taken as the market value in late April of next year. Through the above filter, we obtain 3756 observations from 2001 to 2014. Table 1 shows the definitions and descriptive statistics of each variable. To reduce the effect of singular values on empirical results, all continuous variables are processed by winsorization at 1% and 99%. As we can see, in a medium company, the ratio of market value to book value is 2.93; the ratio of R&D expenditure to book value is 1.46%; the ratio of advertising expenditure to book value is 0.07%. This shows that Chinese manufacturing enterprises prefer R&D expenditure rather than advertising expenditure.

Table 1. Descriptive statistics

Variable	Definition	Obs	Mean	Median	Std. Dev.
MV	The market value in late April next year	3756	3.8129	2.9320	3.1456
RD	R&D expenditure	3756	2.01%	1.46%	1.85%
AD	Advertising expenditure	3756	0.70%	0.07%	1.52%
E	Gross profit	3756	9.10%	8.90%	15.49%
D	Dividend	3756	2.22%	1.34%	2.91%
EF	Equity financing	3756	11.33%	0.00%	23.02%

Table 2 lists the correlation coefficient matrix of each variable, and it can be seen that both R&D expenditure and advertising expenditure are positively correlated with market value.

Table 2. Correlation coefficients of each variable

	MV	RD	AD	E	D	EF
MV	1					
RD	0.1430** *	1				
AD	0.1488** *	0.0375	1			
E	0.0554** *	0.0287	0.0501** *	1		
D	0.0693** *	0.0582** *	0.1062** *	0.2814** *	1	
EF	0.0597** *	0.1232** *	0.0838** *	0.0222	0.1335** *	1

4. Empirical result

Table 3 gives a regression result about the impact of R&D expenditure on the market value of listed companies. Among all the regression analyses, in order to deal with potential heteroscedasticity and sequence related issues, all the standard deviations of regression coefficients are processed by Cluster on the enterprise level.

4.1 The impact of R&D expenditure on the market value of listed companies

Through the regression analysis of the overall sample based on least square method, it can be found that after controlling AD expenditure, surplus, dividend, equity financing, annual fixed effect and industrial fixed effect, R&D expenditure is not conspicuous zero at 1% level and the regression coefficient is 42.78. This indicates that R&D expenditure will significantly promote the market value of manufacturing-listed companies. Because we control the company surplus while regressing, the coefficient of R&D expenditure can be regarded as a long-term impact on the company value, so we can see R&D expenditure as intangible assets investment in the future cash flow of the company.

The empirical results of table 3 rejects hypothesis 1, which show that the R&D expenditure is positively correlated with the market value of manufacturing-listed companies. Moreover, the regression results confirm several scholars' research on American listed companies [1].

4.2 The impact of R&D expenditure on the market value of listed companies: the size effect

In this paper, the samples are divided into small enterprises, medium-sized enterprises and large enterprises according to the market value of listed companies. As we can see, although the R&D expenditure of large enterprises shows a significantly positive correlation with the market value, it is just conspicuous in about 10% level. Additionally, small enterprises and medium-sized enterprises are not conspicuous zero at 1% level. As for the coefficient size, that in large enterprises (16.91) is also far below that in medium-sized enterprises (52.43) and small enterprises (45.73).

Above all, the empirical results in Table 3 show that the value effect of R&D expenditure in Chinese manufacturing-listed companies is related to the company size. And the performance of small enterprises and medium-sized enterprises is better than large ones. The Research by Griliches (1990) showed that small firms' R&D efficiency (measured by patents per unit of R&D) was higher than that of large firms [11].

The Research by Connolly and Hirschey (2005) also confirmed the value effect of R&D expenditure is closely related to the company size, but their empirical results showed that the value effect of R&D expenditure effect in large firms is greater than that in small firms. Some recent researches also showed that the value effect of R&D expenditure only existed in small firms. Their research samples only contained the listed companies in Shanghai and Shenzhen A stock market in 2009, while our samples covered all non-financial listed companies in Shanghai and Shenzhen A stock market from 2001 to 2009. So we believe that the empirical results in this paper are more credible.

Table 3. The impact of R&D expenditure on market value of listed companies

		RD	AD ^{***}	E	D	EF	Intercept	Obs	R ²
State-owned enterprises	Large	-2.48 (-0.24)	26.06* (1.83)	-1.02 (-0.38)	-2.18 (-0.49)	-1.07* (-1.88)	6.14*** (9.98)	612	0.29
	Medium-sized	24.33 (1.52)	64.24** (2.26)	-3.20* (-1.77)	-2.40 (-0.41)	-1.54** (-2.36)	5.41*** (6.06)	491	0.37
	Small	17.98 (1.16)	1.78 (0.16)	-3.06* (-1.75)	-1.92 (-0.34)	-1.01 (-1.61)	5.33*** (5.93)	355	0.35
	State-owned	24.09*** (3.27)	24.97** (2.41)	-1.63** (-1.98)	3.22 (0.81)	-0.88*** (-2.87)	5.02*** (11.40)	1458	0.26
	Large	41.64** (2.42)	17.33 (1.03)	6.19** (2.36)	-1.63 (-0.38)	-1.12** (-2.03)	4.22 (1.35)	634	0.48
	Medium-sized	52.58*** (4.79)	17.65 (0.75)	5.433** (2.42)	-6.51 (-1.55)	-2.31*** (-6.88)	9.06** (2.40)	773	0.59
Private enterprises	Small	51.78*** (4.11)	145.6*** (4.53)	3.364** (2.06)	-8.23* (-1.96)	-1.45*** (-5.16)	13.6*** (32.18)	891	0.51
	Private	49.96*** (5.62)	46.00*** (2.75)	5.88*** (5.08)	-2.70 (-1.04)	-1.47*** (-7.78)	8.54*** (3.01)	2298	0.45
	Large	16.91* (1.70)	18.27* (1.85)	2.290 (1.12)	-2.58 (-0.80)	-1.46*** (-3.95)	6.33*** (12.57)	1246	0.36
The whole samples	Medium-sized	52.43*** (4.45)	48.87** (2.16)	-0.28 (-0.17)	-2.69 (-0.72)	-1.91*** (-6.12)	4.86*** (4.46)	1264	0.42
	Small	45.73*** (4.07)	75.94*** (2.83)	0.23 (0.18)	-6.58 (-1.55)	-1.54*** (-5.45)	7.74*** (5.04)	1246	0.40
	The whole samples	42.78*** (6.52)	37.16*** (3.92)	1.33* (1.76)	-0.16 (-0.07)	-1.40*** (-9.05)	5.64*** (8.70)	3756	0.33

Note: *** indicates that it's conspicuous at 1% level; ** indicates that it's conspicuous at 5% level; * indicates that it's conspicuous at 10% level.

4.3 The impact of R&D expenditure on the market value of listed companies: the ownership effect

Then we know the influence of ownership on the value effect of R&D expenditure, and the corresponding regression results are also given in table 3. As we can see, the R&D expenditures of state-owned enterprises and private enterprises show a positive correlation with the market value, but the size coefficient of state-owned enterprises (24.09) is smaller than that of private enterprises (49.96). In conclusion, the ownership of private enterprises is connected with the value effect of R&D expenditure. In addition, the value effect of the R&D expenditure in private enterprise is greater than that in state-owned enterprises.

Our empirical results confirm that private enterprises are more efficient than state-owned enterprises. The reasons of low efficiency in state-owned enterprises include: (1) Chinese state-owned companies have particular social and political objectives, for example, they tend to hire more employees to ensure the employment. Obviously, this will lower the operational efficiency (including R&D efficiency). (2) The nominal owners of state-owned enterprises are the whole people without active ability. Actually state-owned enterprises are controlled by officials appointed by the government. Nevertheless, personal income maximization of the management consisting of government officials (for example, the more enterprises invest, the greater the income of officials' control power becomes) is in conflict with enterprise profit maximization, which causes the dissimulation of enterprises' behavior. (3) In order to maintain the dominant position of public ownership, the Chinese government takes strict admittance regulations in many industries, such as oil, telecommunications, railway, etc. to prevent private companies from these industries. Consequently, the state-owned enterprises in these industries can gain higher monopoly profit without new R&D products and new services, which will obviously hinder the efficiency of R&D in state-owned enterprises.

4.4 Robustness test

In allusion to the above results, we did lots of robustness test. First, we take sales income instead of book value as a deflator indicator, and the results are no different from the results in this paper. Second, R&D expenditure may be zero, so it is not in the annual report. We set up a larger sample for robustness test, which requests that other variables should not be missed, except for R&D expenditure variables (it is set to zero). The results are no different from the results in this paper. Third, we narrowed the sample to balance panel data, and the results are no different from the results in this paper. Fourth, we take stock yield as the dependent variable, and the results are similar to the results in this paper. Finally, as

for all the continuous variables, we take the logarithm and make a regression, and the results are similar to the results in this paper. Based on these tests, we believe the empirical results in this paper are robust.

5. Conclusion

Through studying the impact of R&D expenditure on the market value of firms according to the data of manufacturing-listed companies in Shanghai and Shenzhen A stock market from 2001 to 2014, we find that the R&D expenditure of manufacturing-listed companies shows a positive correlation with the market value. And R&D expenditure can generate greater value effect in smaller firms. Finally, this paper finds that the value effect of R&D expenditure in private enterprises is greater than that in state-owned enterprises.

Since R&D expenditure has value relevance, this means that it can be the reference for market participants to estimates the market value of listed companies in China, such as the selection of investment targets, etc. Moreover, R&D expenditure can also provide policy makers with decision basis, such as the disclosed policies about R&D expenditure and the reform of state-owned enterprises.

Acknowledgements

This paper is a staged achievement of the theme of Zhejiang social sciences (Grant No. 14NDJC086YB), humanities and social sciences research foundation project of the Ministry of Education (Grant No. 13YJC790011) and Zhejiang natural science foundation project (Grant No. LQ13G030012).

References

- [1] Bae S C, Park B J, Wang X. Multinationality, R&D intensity, and firm performance: evidence from US manufacturing firms. *Multinational Business Review*, 2008, 16(1): 53-78.
- [2] Erickson G, Jacobson R. Gaining comparative advantage through discretionary expenditures: The returns to R&D and advertising. *Management Science*, 1992, 38(9): 1264-1279.
- [3] Connolly R A, Hirschey M. Firm size and the effect of R&D on Tobin's q. *R&D Management*, 2005, 35(2): 217-223.
- [4] Jefferson G H, Huamao B, Xiaojing G, et al. R&D performance in Chinese industry. *Economics of Innovation and New Technology*, 2006, 15(4-5): 345-366.
- [5] Boycko M, Shleifer A, Vishny R W. A theory of privatisation. *The Economic Journal*, 1996: 309-319.
- [6] Krueger A O. Government Failures in Development. *The Journal of Economic Perspectives*, 1990, 4(3): 9-23.
- [7] Vickers J, Yarrow G. Economic perspectives on privatization. *The Journal of Economic Perspectives*, 1991, 5(2): 111-132.
- [8] Kole S R, Mulherin J H. The Government as a Shareholder: A Case from the United States 1. *The Journal of Law and Economics*, 1997, 40(1): 1-22.
- [9] Ohlson J A. Earnings, book values, and dividends in equity valuation*. *Contemporary Accounting Research*, 1995, 11(2): 661-687.
- [10] Shah S Z A, Stark A W, Akbar S. The value relevance of major media advertising expenditures: Some UK evidence. *The International Journal of Accounting*, 2009, 44(2): 187-206.
- [11] Griliches Z. Patent Statistics as Economic Indicators: A Survey. *Journal of Economic Literature*, 1990, 28(4): 1661-1707.