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Research and Development Expenditure, Cash Conversion Cycle and Corporate Performance

An Empirical Study of Chinese Listed Companies

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***Abstract*—With the development of science and technology, the globalization has contributed to the vigorous development of China's economy. Business managers begin to recognize the importance of research and development expenditure and working capital management on the enterprise core competitiveness. Combining the background of listed companies in our country, and selecting 45 companies listed in the Shanghai stock exchange form 2012 to 2014 as the research sample, the paper discusses the correlation of research and development expenditure, cash conversion cycle and corporate performance. We find that research and development expenditure has a significant positive correlation with the enterprise performance; cash conversion cycle has a not significant negative correlation with the enterprise performance; research and development expenditure has a significant negative correlation with cash conversion cycle; the research and development expenditure spending of confirmed as intangible assets has a significant negative correlation with cash conversion cycle; the research and development expenditure spending of recorded into the profits and losses has a not significant negative correlation with cash conversion cycle; development spending has a significant negative correlation with cash conversion cycle.**

Keywords—research and development expenditure; cash conversion cycle; corporate performance

I. INTRODUCTION

Since the 1990s, with the increasing competition among enterprises, the uncertainty and risk of the enterprise's future operation have also been improved accordingly. At present, many enterprises' products have been found similar in the industry, which can't meet the needs of the customers completely, and the operating capital is tight. Therefore, a serious problem faced by Chinese enterprises is how to continuously improve their competitive advantage in a ruthless market and achieve market leading and growing. On the one hand, based on the saturation of many industries, enterprises can improve production technology through research and innovation, reduce production costs, develop new products, open up new business areas, seize market opportunities and gain greater profits. On the other hand, in the process of global economic integration in today's market, instead of the traditional "big and complete" enterprise system, the whole business process has been required by many enterprises to work together, where a business process will provide the necessary data for the next, form chains, and finally make the enterprise become an orderly supply chain (Supply Chain). Enterprises can improve the management efficiency of operation capital in the supply chain, reduce production and business processes for the amount of corporate capital, thereby reducing costs and improving the growth capacity of enterprises. Scholars at home and abroad have launched research on research and development investment, cash conversion cycle and business performance, theoretically opening up ways to enhance competitiveness of enterprises.

Hu, A.G and Jefferson (2003) find that there is a significant correlation between research and development investment and business performance through studying the relationship between research and development investment and business performance [1]. Liu Desheng and Zhang Yuming (2010) analyzed the relationship between return on net assets and research and development investment in three years of 2006-2008 years' listed companies, and found that increasing the performance of enterprises needs to control research and development expenditure in a reasonable range [2]. Zhao Xu and Hu Yunsheng (2002) empirically believed that the liquidity management of listed companies had a negative correlation with corporate performance and value [3]. Gill and Biger (2010) selected the 2005-2007 panel data of 88 U.S. companies as the sample, explored the relation of cash conversion cycle and profitability (operating margin).The results showed that when adjusted to a proper level, the cash conversion cycle can create profits for the enterprise [4].

Under the severe market competition and the constantly changing new demand of consumers, research and development innovation and operation management of enterprises are no longer just on the level of growth and growth of enterprises, they have risen to the height of their life and death. Based on this, the paper standing on the foundation of previous studies, explores the relationship of research and development expenditure, business performance, and the cash conversion cycle to lay a theoretical foundation for improving the enterprise performance and management efficiency. As a result, research and development activities and management

activities in the enterprise can be more coordination, and jointly promote the development of the enterprise. In addition, the enterprise can stand in the stormy competition of globalization.

II. THEORETICAL ANALYSIS AND HYPOTHESIS

The steady and healthy development of enterprise performance needs its core competitiveness as a pillar. Core competitiveness emphasizes uniqueness, scarcity, and isn't easy to be duplicated simply. It can bring economic value to enterprises, and reduce threats and opportunities for enterprises. An important way to form core competitiveness is the construction of intangible assets, while research and development activities are important sources for the formation of intangible assets.

On the one hand, research and development input can bring innovative improvements to the machine and equipment. It can improve the production efficiency and reduce the corresponding production cost at the technological level, thereby improving the profitability of enterprises. The success of research and development investment not only can bring new production concept for the enterprise, but also improve the original backward production equipment, or bring new technology and process for the enterprise, so that enterprises can not only form the speed of production process faster, more simple process, also enables enterprises to accelerate the speed and reduce the waste of raw materials, in terms of time and materials for the production of enterprises to reduce costs, increase profits, and improve enterprise performance[6].

On the other hand, research and development investment can meet people's increasingly diversified needs, expand product market share and enhance their voice in their own fields, which is conducive to the growth of product sales and the growth ability of enterprises. Through research and development, enterprises can form products or services that are different from other competitors in the market, so as to form their own product differentiation and gain competitive advantages [7].The resulting differentiation can, to a certain extent, guide consumers' preferences for demand and consumption, reduce market demand elasticity of product and service, and help to get excess profits.

Based on the above analysis, the paper puts forward hypothesis 1: there is a positive correlation between research and development expenditure and enterprise performance.

With the continuous innovation of the management system of Chinese listed companies, the continuous development and perfection of financial system, and the continuous changes of external environment of listed companies, higher requirements for internal management of listed companies are put forward. The survival of the fittest greatly in the market competition in the listed companies by the level of financial management, production management and enterprise are all related to the capital operation. So the level of financial management depends on enterprise management level for funds. The management efficiency of the enterprise operating funds can be measured by the cash conversion cycle.

First of all, the shorter cash conversion period means that the capital management of enterprises is running well in production and operation activities. Enterprises have enough funds to effectively prevent enterprises from getting into a dilemma of shortage of funds and risk of debt repayment. The cash conversion cycle can be guaranteed with good liquidity sufficient enterprise funds. In a word, enterprises possessing appropriate realizable assets can not only maintain the normal operation of production enterprises to maintain good solvency, but also enhance the enterprise financing ability. Moreover, when the enterprise funds are tight or need to appropriately increase the amount of funds, it is able to obtain the need funds from outside.

Secondly, reasonable cash conversion cycle means that operation capital management of enterprises is good. Good operation capital management makes enterprises improve working capital turnover rate, reduce the holding cost and opportunity cost of funds, which results that the overall cost of enterprises is reduced to a minimum, and improve the profitability of enterprises.

Therefore, the following assumptions are put forward hypothesis 2: there is a negative correlation between the cycle of cash conversion and the performance of the enterprise.

In recent years, with the globalization of the economy and society and the gradual aging of the population structure, the demand of customers is diversified, resulting in the acceleration of product renewal. Therefore, research and development investment plays an important role in the development of enterprises.

Schumpeter (1912) suggests that "innovation" and its mechanism can promote the growth of enterprises. The region needs to continue to increase research and development investment. Through the improvement and innovation of science and technology, enterprises can improve existing products and technology, or create higher value but lower cost products, replacing backward products, realize the difference in the product design, variety, service, function and quality, open a new market cycle in the fierce market in the competition, and form the core competitiveness of enterprises. Thus, enterprises will speed up the transformation of funds, and reduce the cash conversion cycle.

Research and development investment can improve the production efficiency of the enterprise. Through research and development investment, enterprises can acquire advanced technology and production process, the improvement of time-consuming, out-dated and complex manufacturing process, or create a new manufacturing process, form advanced, simple and convenient process, and promote the formation of scale economy of enterprises, so as to improve the production efficiency and management efficiency, reduce the residence time of enterprise capital stock, promote capital in the circulation conversion cycle and shorten the capital.

Through market research, enterprises will predict the future prospects of the market. Accordingly, enterprises need to carry out research and innovation activities, grasp the priority of a product production process, and put into the market, seize market share, cultivate customer loyalty and trust for the

enterprise, occupy the leading position in the on the market, reduce the credit policy, make the enterprise accounts receivable turnover rate increase, accordingly, and reduce the turnover days.

To sum up, the enterprise's research and development investment can accelerate the capital turnover of the enterprise. On the basis of this analysis, this paper makes the following assumptions:

Hypothesis 3: there is a negative correlation between research and development expenditure and cash conversion cycle.

Hypothesis 4: there is a negative correlation between the research and development expenditure spending of confirmed as intangible assets and cash conversion cycle.

Hypothesis 5: there is a negative correlation between the research and development expenditure spending of recorded into the profits and losses and cash conversion cycle.

Hypothesis 6: there is a negative correlation between development spending and cash conversion cycle.

III. STUDY DESIGN

A. The Selection and Source of Simple

The paper selects 2012-2014 Shanghai Stock Exchange listed companies as the research object, excluding: (1) ST and *ST listed companies; (2) data without the development expenditure balance in 2012-2014; (3) data in the notes to the financial statements without disclosing this period according to the provisions of accounting standards recognized as intangible assets and research and development expenditures included in the current the profit and loss of spending on research and development. On this basis, 45 listed companies are selected as samples. The raw data used in this paper come from the financial statements and related annotations in the annual reports disclosed by listed companies in the Shanghai Stock Exchange (http:// www .sse .com .cn). At the same time, Excel and Spss17.0 statistical software are applied to further process the data.

B. Variable Definition

1) The explained variable: Return on Total Assets (ROA) is used as an index to measure the performance of enterprises. This is because the index is more comprehensive, which covers production, sales efficiency, profitability and leverage efficiency. It reflects the profitability of the total assets of the enterprise, and appraise the operation efficiency of the enterprise.

2) Explanatory variable: Research and development expenditure (R & D) is composed of three parts, which are identified as the research and development expenditure spending of confirmed as intangible assets(R & D_1), the research and development expenditure spending of recorded into the profits and losses(R & D_2), and development expenditure(R & D_3). In order to enhance the comparability between the data, the intensity of R & D is used as an explanatory variable.

Cash conversion cycle (CCC) is equal to average turnover days of inventory adds average turnover days of accounts receivable minus average turnover days of accounts payable.

3) Control variable: Combined with Lang and Stulz (1994), Griffith (1999), Short and Keasey (1999), Wu Shinong (1999), selection of enterprise scale (SIZE), the capital structure of enterprise(DAR), corporate operating capacity (CAT), cash flow asset liability ratio (OCCD) and enterprise growth ability (OGR) as control variables.

C. Model Construction

The equations are an exception to the prescribed specifications of this template. You will need to determine whether or not your equation should be typed using either the Times New Roman or the Symbol font (please no other font). To create multileveled equations, it may be necessary to treat the equation as a graphic and insert it into the text after your paper is styled.

Number equations consecutively. Equation numbers, within parentheses, are to position flush right, as in (1), using a right tab stop. To make your equations more compact, you may use the solidus (/), the exp function, or appropriate exponents. Italicize Roman symbols for quantities and variables, but not Greek symbols. Use a long dash rather than a hyphen for a minus sign. Punctuate equations with commas or periods when they are part of a sentence, as in

$$ROA=\beta_0+\beta_1 R\&D+\beta_2 SIZE+\beta_3 DAR+\beta_4 OGR+\varepsilon \quad (1)$$

$$ROA=\beta_0+\beta_1 CCC+\beta_2 SIZE+\beta_3 DAR+\beta_4 OGR+\varepsilon \quad (2)$$

$$CCC=\beta_0+\beta_1 R\&D+\beta_2 CAT+\beta_3 OCCD+\beta_4 LNA+\beta_5 ROA+\varepsilon \quad (3)$$

Specific variables defined as “Table I”.

IV. EMPIRICAL ANALYSIS

A. Correlation Analysis

As shown in “Table II”, the correlation coefficient between R & D and ROA is 0.229 (0.008<0.01), indicating a positive correlation between research and development expenditure and total assets return rate. The correlation coefficient of CCC and R & D is -0.224 (0.010<0.05), which shows that there is a negative correlation between cash conversion cycle and research and development expenditure. The correlation coefficient between cash conversion cycle and total assets return is -0.056 (0.526>0.1), meaning that there is no significant correlation between cash conversion cycle and total assets return rate.

B. Regression Analysis

As shown in “Table III”, the coefficient of R & D is 0.265 (0.008<0.01), cash conversion cycle coefficient is -0.002

(0.526>0.1), meaning that research and development expenditure and total assets return rate has positive correlation, but between the cash conversion cycle and total assets the rate of return does not have significant correlation. It is the same as the result of correlation analysis.

As shown in the results of "Table IV", CCC can be explained by R&D in 24.3%. The coefficient of R & D is -6.340 (0.01), indicating that the negative correlation between research and development expenditure and cash conversion cycle is significant, that is to say, the more investment in research and development expenditure, the shorter the cash conversion cycle.

TABLE I. SPECIFIC VARIABLE DEFINITION

Variable Definition	Variable	Symbol	Explanation
Explained variable	Return on total assets	ROA	It is equal to profit total plus finance expenses, divided by average total assets; The average total assets equals to the initial total assets plus the final total assets divided by two.
Explanatory variable	Research and development expenditure	R & D	It is equal to research and development expenditure divided by operating revenue.
	Research and development spending of confirmed as intangible assets	R & D_1	It is equal to research and development spending of confirmed as intangible assets divided by operating revenue.
	Research and development spending of recorded into the profits and losses	R & D_2	It is equal to research and development spending of recorded into the profits and losses divided by operating revenue.
	Development expenditure	R & D_3	It is equal to development expenditure divided by operating revenue.
	Cash conversion cycle	CCC	It is equal to average turnover days of inventory plus average turnover days of accounts receivable minus average turnover days of accounts payable.
Control variables	Corporate scale	SIZE	It is equal to the total assets of natural Numbers.
	The capital structure of enterprise	DAR	It is equal to debt divided by total assets.
	Corporate operating capacity	CAT	It is equal to the operating income divided by average current assets.
	Cash flow asset liability ratio	OCCD	It is equal to the net operating cash flow divided by current liabilities.
	Corporate growth ability	OGR	It is equal to the current operating revenue minus the previous operating revenue divided by the previous operating revenue.

TABLE II. THE CORRELLATION RESULT OF EQUATION (1)

Correlation Analysis	R&D	ROA	CCC
R&D	1		
ROA	0.229*** (0.008)	1	
CCC	-0.224** (0.010)	-0.056 (0.526)	1
Control variables: CCC、SIZE、DAR、CAT、OCCD、OGR			

TABLE III. THE CORRELLATION RESULT OF EQUATION (1) AND EQUATION (2)

Regression Analysis	Coefficient	T	Significance	Coefficient	T	Significance
Constant	-17.476**	-2.445	0.016	-19.426***	-2.620	0.010
R&D	0.265***	2.678	0.008			
CCC				-0.002	-0.637	0.526
SIZE	1.129***	3.345	0.001	1.180***	3.382	0.001
DAR	-0.038	-1.551	0.123	-0.040	-1.589	0.114
OGR	0.079***	4.548	0.000	0.083***	4.678	0.000
Explained variable: ROA						

TABLE IV. THE CORRELLATION RESULT OF EQUATION (3)

Regression Analysis	Coefficient	T	Significance
Constant	240.474	1.437	0.153
R&D	-6.340***	-2.607	0.010
CAT	-83.235***	-5.592	0.000
OCCD	-16.352	-0.262	0.794
LNA	0.394	0.051	0.959
ROA	-1.601	-0.730	0.466
R^2	0.243		
Explained variable: CCC			

Next, the R&D expenditures will be further refined into the research and development expenditure of confirmed as intangible assets (R & D1), the research and development expenditure of recorded into the profits and losses (R&D2), and development spending(R&D3). Then they make a regression analysis with the cash conversion cycle.

As "Table V" shown, column (1) is recognized as the regression analysis of the research and development expenditure of confirmed as intangible assets and cash conversion cycle, the coefficient of R&D1 is -15.808 (0.006<0.01), that identified with a significant negative correlation between the strength of the research and development expenditure of confirmed as intangible assets and cash conversion cycle. Column (2) is the regression analysis of the research and development expenditure of recorded into the profits and losses and cash conversion cycle. The coefficient of R&D2 is -0.642 (0.859>0.1). It shows that there is no significant correlation between the research and development expenditure of recorded into the profits and losses and cash conversion cycle. Column (3) is the regression analysis of development expenditure and the cash conversion cycle, coefficient of R&D3 is -6.765 (0.045<0.05), indicating there is a negative correlation between the development expenditure and cash conversion cycle is significant. That is to say, the more investment in development spending, corporate cash conversion cycle is short.

TABLE V. THE FURTHER REGRESSION RESULT OF EQUATION (3)

egression Analysis	**Column (1)**			**Column (2)**			**Column (3)**		
	Coefficient	***T***	***Significance***	***Coefficient***	***T***	***Significance***	***Coefficient***	***T***	***Significance***
Constant	219.633	1.320	0.189	218.577	1.275	0.205	246.536	1.456	0.148
R&D1	-15.808***	-2.805	0.006						
R&D2				-0.642	-0.178	0.859			
R&D3							-6.765**	-2.027	0.045
CAT	-83.768***	-5.654	0.000	-74.396***	-4.968	0.000	-78.163***	-5.300	0.000
OCCD	-7.554	-0.121	0.904	-19.162	-0.298	0.767	-26.983	-0.428	0.669
LNA	0.605	0.079	0.937	-0.394	-0.050	0.960	-0.781	-0.100	0.920
ROA	-1.058	-0.491	0.624	-0.653	-0.291	0.772	-0.699	-0.321	0.749
R^2	0.249			0.204			0.228		
Explained variable: CCC									

V. CONCLUSION

Based on the 2012-2014 years' listed companies in Shanghai Stock Exchange in China, this paper explores the correlation between research and development expenditure, cash conversion cycle and business performance of listed companies. Firstly, it is found that research and development expenditure has a significant positive correlation with corporate financial performance, indicating that research and development expenditure will reduce profits in the short term, but the economic value brought by its success will generate more benefits. Secondly, there is a negative correlation between the cash conversion cycle and the corporate financial performance, but it is not significant. In a word, enterprises should strengthen the management of cash, reduce unnecessary cash shelving, speed up the turnover of cash, and promote the profitability and growth ability of listed companies. Thirdly, there is a significant negative correlation between research and development expenditure and cash conversion cycle. According to the form of annual report, the research and development expenditure can be divided into three parts: the research and development expenditure of confirmed as intangible assets, the research and development expenditure of recorded into the profits and losses and development expenditure. The empirical results show that, a significant negative correlation with the cash conversion cycle for the research and development expenditure of confirmed as intangible assets; negatively related the research and development expenditure of recorded into the profits and losses and cash conversion cycle, but not significant; a significant negative correlation between development expenditure and cash conversion cycle.

A. Suggestions

From the perspective of the research process and the conclusion, in annual report, the listed company's data is not checked, disclosure is not standardized, and research and development investment is relatively low. Therefore, the following suggestions are made:

Enterprises should improve their awareness of independent innovation, and increase investment in research and development in order to promote the circulation of liquidity of enterprises. Enterprises should pay more attention to the investment of research and development and evaluate the enterprise performance from a long-term point of view, instead of focusing on current profits. Enterprises should be fully aware of the importance of research and development expenditures, increase awareness of research and development investment, increase research and development investment and improve their own independent innovation capability.

Enterprises should strengthen the management of operation capital, speed up the circulation of operation capital flow and shorten the cash conversion cycle, so as to achieve the effect of improving business performance. The enterprise should be reasonable allocated to other current assets and non-current assets investment projects to meet the needs of enterprises for cash and make profits. And with specific development and change constantly, enterprises will change the optimal cash holdings to adapt to the size of the company. As a result, the enterprise operation capital management can achieve the best condition to obtain the maximum benefit.

The relevant government agencies should further strengthen the accuracy and standardization of the disclosure of enterprise annual reports. The relevant regulatory authorities should

improve the attention of enterprises to research and development investment, and gradually standardize the quality of the disclosure of the annual reports of listed companies.

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