

Research on the impact of R&D Expenses and Sales Investment the Enterprise Performance---Based on Empirical Analysis from the GEM Pharmaceutical Industry

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Abstract: Technological innovation and marketing capability are important means for enterprises to enhance the competitive advantage. This paper used the listed companies of the GEM Pharmaceutical Industry as samples, 2012--2014 years as the test period, to examine the relationship between R&D expenses, sales investment and the enterprise performance. We find that R&D expenses has a significant negative correlation with the current enterprise performance and the lagged one period performance, but the correlation with lagged two period performance is not significant;and sales investment has a significant positive correlation with the current enterprise performance.

Introduction

In the new normal, the economic development transform from resource-driven to innovation-driven, and there is no doubt that technological innovation and marketing capabilities are important means to enhance their own competitive advantage. The pharmaceutical is an industry integrated with many kinds of advanced technology, and is related to the national economy and high-tech industry groups. In recent years, the growth rate of pharmaceutical manufacturing industry basically remain declined, and the growth performance in 2015 located at the lowest point of the past decade's. Pharmaceutical products and medical technology innovation have not yet formed mechanisms of systematization and industrialization, and their production equipment is out-date, production technology is lagged, products updates are slow, and drugs mainly are generics. Meanwhile, because of the low barriers to enter the market, many small and medium enterprises rushed in, the phenomenon of repeat production is serious, resulting in that some enterprises even defy the law to sell products. Under this background, according to the Chinese government network, Premier Li Keqiang, chaired the State Council executive meeting in 14 February 2016, deploying the innovation and upgrade of pharmaceutical industry to give better service for people and economic development. So, if the performance of the pharmaceutical industry could be enhanced by increasing investment in technological innovation and marketing investment? This question is worth of our thinking and studying.

Through literature review, we found that scholars have not reached a consensus about the research on R&D expenses and enterprise performance. Some scholars found that, R&D expenses has a significant positive correlation with the enterprises performance. (Xie Weimin and Tang Qinquan, 2011; Zhou Jiangyan, 2012; Zhao Xicang and Wu Junxiang, 2013; Du Yong, Yan Bo and Chen Jianying, 2014); Some other scholars found that, R&D expenses and the current enterprises performance are negatively correlated (Lu Yumei and Wang Chumei, 2011; Zhu Yanhua and Xu Min, 2013); other scholars found that, R&D investment and the enterprises performance are curve related (Wang Yurong, etc., 2015; Sheng Yuhua and Lu Lu, 2016).

About the research on the relationship of sales investment and the enterprises performance, existing literature suggested that the marketing ability can positively impact enterprises performance significantly (Meng Jijia, etc., 2012; Li Xianjiang, 2013; Chen Xiaohong and Yu Tao, 2013). We can see that, although the domestic research on R&D Expenses, Sales Investment and the Enterprise Performance are abundant, the literature focusing on GEM listed company in

pharmaceutical industry is less.

In this study, learning from the predecessors' research results, combined with the background of transitional economy system, we examined the relationship between R&D expenses, sales investment and enterprises performance in pharmaceutical samples from GEM listed companies, and tried to answer the following question: (1) if R&D expenses and the current enterprises performance were significantly negatively correlated; (2) if R&D expenses exist significant lag effect on the enterprises performance; (3) if sales investment and enterprise performance were significantly correlated positively. To provides empirical evidence for the pharmaceutical industry developing the policy of R&D expenses and sales investmet.

Theoretical Analysis and Research Hypothesis

R&D Expenses and the Enterprise Performance

Technological innovation theory (Schumpeter, 1912) proposed that technological innovation begin in the research and end in the market. Enterprises increased R&D expenses in order to obtain the technological advantage in the market of fierce competition, consolidate or increase market share and profit. But there are some problems of development in the pharmaceutical industry. First of all, factors of long cycles of technology development, high cost, high risk and so on are likely to affect the current performance; secondly, compared to larger enterprises, due to the economies of scale, the GEM enterprises' R&D spending of unit allocation is higher, and the contribution of R&D activity on the operating performance is less significant. (Zhang Ziran, Luo Jing, 2015). Based on the above analysis, we make the following assumptions:

H1: Based on other conditions unchanged, R&D expenses has a significant negative correlation with the current enterprises performance.

R&D activity is a continuous process, and the earnings of the current research cannot be reflected in the current period. He Wei's study (2003) showed that the output elasticity of China's industrial enterprises' technology development costs in the same year, lag 1 year, lag 2 years were 0.358, 0.361 and 0.439, corresponding to the t test value respectively 2.339, 2.009, 3.271. That is to say, the role of R&D in the early stage will not be immediately apparent, it is necessary to have a certain period of time to really play a role. Liu Haiyang and Ma Jing (2012) found that the lag length of R&D investment is two, and the degree of influence is gradually weakened through the analysis of data linking industrial enterprises for three years. But Zhu Yanhua and Xu Min (2013) found that the lag length of R&D investment is two, and the effect is the most obvious in the lag 2 years. Zheng Xiaodan, Huang Yi and Zhuang Yan (2015) found that R&D investment was not related with the current performance through empirical analysis, but there are hysteresis effects, and the effect is the most obvious in the lag three years but is not obvious in the lag 1, 2 or 4 years significantly.

Once the successful development of new drugs in pharmaceutical companies, it can be the first to snatch the market and improve the market share. Because of the long development cycle of new drugs, there will be no substitute for products in the short term, the enterprise will be able to obtain excess profits. Therefore, the contribution of R&D expenses to the enterprise performance may be obvious when the research is successful and the new drug come to market. Based on the above analysis, we make the following assumptions:

H2: Based on other conditions unchanged, the effect of R&D expenses on the enterprise performance has lagged effect.

Sales Investment and Enterprise Performance

Based on the resource-based theory, Muhammad Usman Ahmed found that, marketing capabilities can improve the enterprise performance. According to statistics, although pharmaceutical industry is the high technology industry, and the overall trend is rising, the speed of growth was slower and slower. Most of the company expect profit through improving sales performance or the way of the mergers and acquisitions, and there are few pharmaceutical enterprises improve the performance by its transformation and innovation of scientific research.

With the three wholesale pattern be broken, the new effective pharmaceutical distribution system has not been fully established, illegal drugs trade repeatedly. Although some large pharmaceutical companies set an example to implement mergers and acquisitions to improve market situation of the pharmaceutical industry, duplicate and inefficient production work for many years lead to an oversupply of most of the drugs. In this context, the management hope to increase sales investment in order to keep sales market stable. There is no economical scale, because most of the GEM pharmaceutical enterprises are small and medium-sized. In order to achieve short-term visible high operating profit, management tend to promote to improve corporate profits, to obtain better enterprise performance. Chen Xiaohong and Yu Tao (2013) choose 340 listed companies of Small board as samples, the empirical analysis found that the stronger the marketing ability is, the better the market performance is. Based on the above analysis, we make the following assumptions:

H3:Based on other conditions unchanged,sales investment has a significant positive correlation with the current enterprise performance.

Research Design

Sample Selection and Data Sources

According to the new industry classification standard of Shenyin & Wanguo, bio-pharmaceutical industries includes Chemical pharmaceutical, medicine, biological products, pharmaceutical business, medical devices and medical services. This paper selected GEM listed companies before 2012 which had the disclosure of R&D expenses for three consecutive years during 2012-2014.And we perform the following screening program for sample firms:(1)excluding firms with incomplete research data, to ensure the integrity of date during the study period ;(2)excluding ST and PT, because of the serious financial problems and other special circumstances, to ensure the relative accuracy of the research. Based on the above principals of screening, we finally get 32 sample companies, 96 valid observations. Main data used in the paper is from the Choice financial terminals, and part of the data is from the annual reports in Ju Chao Website. We get the final data by hand and the data processing is mainly done by SPSS17.0.

The Selection and Measurement of Variables

Explanatory Variables

R&D Expenses and Sales Investment are explanatory variables. We used R&D investment intensity and Sales Cost investment to measure them respectively. R&D investment intensity (RDM)is the ratio of R&D expenditure and operating income, and the date of R&D expenditure is abstained from “R&D spending” project in the annual report notes; Sales Cost investment (SEM) is the ratio of the cost of sales and operating income, which all can be abstained from the annual report.

Explained Variables

The Enterprise Performance is explained variable, and the methods of measurement are variable in academia: OPE(Liang Xin Levin et al., 2006),enterprise profit(Liao Zhongju, 2013) ,Return On Sales(Sun Weifeng and Huang Zuhui,2013),Tobin's Q,ROE, etc. Given the return on assets (ROE) can reflect the operation of enterprises and financial situation to a certain extent, learning from the practice of the most scholars, we choose it as an alternative to measure the Enterprise Performance.

Control Variables

Table 1 Variable definitions and measurement.

| Category ^o | Variables ^o | Symbol ^o | Calculating Formula ^o |
|------------------------------------|---------------------------------------|------------------------------|---|
| Explained Variables ^o | Enterprise performance ^o | ROE ^o | Net profit/Net assets ^o |
| Explanatory Variables ^o | R&D Expenses ^o | RD _M ^o | R & D spend/Total operating income ^o |
| | Sales Investment ^o | SE _M ^o | Selling expenses/Total operating income ^o |
| Control Variables ^o | the size of total assets ^o | SIZE ^o | Average value of assets ^o |
| | current ratio ^o | CR ^o | Current assets/Current liabilities ^o |
| | total asset turnover ^o | TAT ^o | operating income/the size of total assets ^o |
| | Ownership Concentration ^o | S ₁₀ ^o | The total proportion of the top ten shareholders ^o |

In addition to R&D Expenses and Sales Investment, factors affecting the performance of bio-pharmaceutical companies include a number of other factors, such as Current Ratio in the Solvency indicators. To fully reflect the impact of R&D Expenses and Sales Investment to Enterprise Performance of Pharmaceutical companies, we selected the size of total assets, current ratio, total asset turnover and Ownership Concentration as control variables. The names of all the variables, symbols and methods of measurement are shown in Table 1:

Research Model

The research model of this paper is designed as follows

$$ROE_{it} = \alpha_{it} + \beta_1 RDM_{it} + \beta_2 SEM_{it} + \beta_3 S10 + \beta_4 CR + \beta_5 TAT + \beta_6 SIZE + \varepsilon_{it} \quad (1)$$

$$ROE_{it} = \alpha_{it} + \beta_1 RDM_{it-j} + \beta_2 SEM_{it} + \beta_3 S10 + \beta_4 CR + \beta_5 TAT + \beta_6 SIZE + \varepsilon_{it} \quad (2)$$

$$i=1, 2, 3 \dots I, \quad t=0, 1, 2, \quad j=1, 2.$$

“i” represents the i-th sample enterprises, t represents the t-th year, ROE_{it} represents the Enterprise performance of the i-th sample enterprise in the t-th year, RDM_{it}, SEM_{it} represent R&D Expenses and Sales Investment of the i-th sample enterprises in the t-th year respectively. Model (1) is used to test the impact of R&D expenses and Sales Investment to the current Enterprise Performance. Model (2) is used to test the impact of R&D expenses to the performance of lag one or two phases.

Empirical Results and Analysis

Descriptive Statistics

Table 2 Descriptive statistics.

| | year ^o | mean (%) ^o | median (%) ^o | Max ^o (%) ^o | Min ^o (%) ^o | Standard deviation ^o |
|--|-------------------|--------------------------|----------------------------|--------------------------------------|--------------------------------------|------------------------------------|
| R&D Expenses intensity ^o (RD _M) ^o | 2012 ^o | 6.2930 ^o | 5.1955 ^o | 22.1093 ^o | 0.1885 ^o | 4.1480234 ^o |
| | 2013 ^o | 6.9449 ^o | 5.5285 ^o | 25.6236 ^o | 0.2067 ^o | 4.9224801 ^o |
| | 2014 ^o | 7.4379 ^o | 4.8451 ^o | 31.4795 ^o | 0.3988 ^o | 6.7055971 ^o |
| Sales Investment ^o Intensity ^o (SE _M) ^o | 2012 ^o | 23.1235 ^o | 20.4340 ^o | 55.7010 ^o | 1.8492 ^o | 15.1549451 ^o |
| | 2013 ^o | 23.1619 ^o | 19.4206 ^o | 72.9591 ^o | 1.7739 ^o | 17.1147478 ^o |
| | 2014 ^o | 22.6462 ^o | 19.8880 ^o | 69.3738 ^o | 1.5871 ^o | 16.4198300 ^o |

Table 2 displays the descriptive statistical analysis of the sample companies. The results show that: the mean of R&D Expenses intensity of the sample companies increased yearly, from 6.2930% in 2012 to 7.4379% in 2014, and the growth rate reached 18.19%; The mean of the Sales

Investment intensity of the sample companies fluctuates slightly, and the overall appears downward trend ,from 23.1235% in 2012 to 22.6462% in 2014, a decrease of 2.06%.

To make 6%, 7% as a dividing line of R&D investment intensity (RDM) to a further analysis, we find that when the RDM is less than or equal to 6%,there are 21 sample companies in 2012, 19 sample companies in 2013 and 19 sample companies in 2014,showing a decreasing characteristic in number; when the RDM ranges from 6% to 7%, there are 2 sample companies in 2012, 2 sample companies in 2013 and 1 sample company in 2014, showing a little change in number; when the RDM is greater than or equal to 7%, there are 9 sample companies in 2012, 11 sample companies in 2013 and 12 sample companies in 2014, showing a yearly increase in number. Visibly, GEM Pharmaceutical Industry increased the R&D Expenses year by year, and emphasized on the effect of R&D investment on the performance and innovation performance gradually.

However, according to widespread international recognition, only the percentage of R&D Expenses intensity accounted for revenues be more than 5%,can the corporate has its competitive advantage. According to statistical data of the sample companies, both 18 enterprises have an annual 5% of the standard in 2012 and in 2013,while there were only 15 in 2014.That is to say, nearly half of the sample has not yet to gain a competitive advantage, indicating that the samples still has great room for growth in R&D investment. The statistics in Table 2 also shows that: in general, the R&D Investment is much lower than sales, indicating the management tends to achieve short-term visibility benefits through promotion.

Correlation Analysis

Table 3 Correlation analysis.

| variables ^o | ROE ^o | RD _M ^o | SE _M ^o | S10 ^o | CR ^o | TAT ^o | SIZE ^o |
|------------------------------|-----------------------|------------------------------|------------------------------|--------------------|-----------------------|-----------------------|-------------------|
| ROE ^o | 1 ^o | ^o | ^o | ^o | ^o | ^o | ^o |
| RD _M ^o | -0.324** ^o | 1 ^o | ^o | ^o | ^o | ^o | ^o |
| SE _M ^o | 0.258* ^o | -0.006 ^o | 1 ^o | ^o | ^o | ^o | ^o |
| S10 ^o | -0.143 ^o | -0.081 ^o | -0.243* ^o | 1 ^o | ^o | ^o | ^o |
| CR ^o | -0.026 ^o | 0.187 ^o | 0.015 ^o | 0.134 ^o | 1 ^o | ^o | ^o |
| TAT ^o | 0.336** ^o | -0.267** ^o | 0.049 ^o | 0.124 ^o | -0.300** ^o | 1 ^o | ^o |
| SIZE ^o | 0.080 ^o | -0.075 ^o | -0.049 ^o | 0.047 ^o | -0.158 ^o | -0.267** ^o | 1 ^o |

NOTE: * and ** represent the 1% and 5% level was significantly associated.

Table 3 reports the Pearson correlation analysis results of the variables. The results show that: R&D Expenses (RDM) and the Enterprise Performance (ROE) have a significant negative correlation at the 1% level, and hypothesis 1 gets a preliminary verification; sales investment (SEM) and the Enterprise Performance (ROE) have a significant positive correlation at the 5% level, and hypothesis 3 gets a preliminary verification.

Multiple Regression Analysis

Table 4 VIF of independent variables on the dependent.

| variables ^o | RD _M ^o | SE _M ^o | S10 ^o | CR ^o | TAT ^o | SIZE ^o |
|------------------------|------------------------------|------------------------------|--------------------|--------------------|--------------------|--------------------|
| VIF ^o | 1.115 ^o | 1.077 ^o | 1.151 ^o | 1.250 ^o | 1.383 ^o | 1.195 ^o |

Taking the possible presence of multicollinearity between the variables in the model into account , this study calculated variance inflation factor VIF of variables and the results are shown in Table 4 below. The VIF explanatory variables are fluctuated around 1, less than 10, indicating that there is no multicollinearity.

The Regression of R&D Expenses, Sales Investment and the Enterprise Performance.

Table 5 regression analysis .

| variables | ROE | variables | ROE |
|-----------------------|-----------|-----------------------------------|-----------|
| C | 9.019** | TAT | 8.906*** |
| | (2.553) | | (3.893) |
| RD_M | -0.254*** | SIZE | -5.888*** |
| | (-2.720) | | (2.281) |
| SE_M | 0.065** | Adjusted- R² | 0.263 |
| | (2.139) | F | 6.648*** |
| S10 | -0.098** | Sample- size· N | 96 |
| | (-2.145) | | |
| CR | 0.205** | | |
| | (2.043) | | |

NOTE: The values in parentheses are t value, *, ** and *** represent the 10%, 5% and 1% significance level.

Table 5 shows the results of regression analysis of R&D expenses, sales investment and the current enterprise performance. The results shows that R&D expenses (RDM) and the current enterprise performance (ROE) are significantly negatively correlated at 1% level (regression coefficient is -0.254), and hypothesis 1 gets a verification. Sales investment (SEM) and the current enterprise performance (ROE) are significantly positively correlated at the 5% level (regression coefficient is 0.065), and hypothesis 3 gets a verification. Control variable TAT, CR and the current enterprise performance(ROE) are significantly positively correlated at 1% and 5% level respectively, indicating that the higher the total business turnover and the higher the current ratio , the better the enterprise performance.Both the Control variables S10 and SIZE with enterprise performance(ROE) showed a significant negative correlation at the 5% level, indicating that the company should reasonably control the firm size and ownership concentration, the blind expansion of business scale and concentration of ownership have a negative impact on business performance .

Table 6 the results of R&D investment and the enterprise performance lag regression .

| variables | ROE (j=1) | ROE (j=2) |
|----------------------------------|-----------|-----------|
| C | 10.756** | 6.323 |
| | (2.352) | (0.705) |
| RD_M | -0.355** | -0.240 |
| | (-2.478) | (-0.867) |
| SE_M | 0.046** | 0.047** |
| | (2.506) | (1.945) |
| S10 | -0.125** | -0.045 |
| | (-2.195) | (-0.443) |
| CR | 0.235 | 0.290 |
| | (1.468) | (0.911) |
| TAT | 9.356*** | 4.232 |
| | (3.347) | (0.913) |
| SIZE | -5.377** | -3.675 |
| | (2.124) | (1.891) |
| Adjusted R² | 0.297 | 0.132 |
| F | 5.446*** | 1.784 |
| Sample size· N | 64 | 32 |

NOTE: The values in parentheses are t value, *, ** and *** represent the 10%, 5% and 1% significance level.

Table 6 shows the lag effect analysis of R&D expenses to the enterprise performance. The results shows: R&D expenses has a significant negative correlation at the 5% level with the lagged one period enterprise performance, a negative correlation with the lagged two period performance but not significantly. So hypothesis 2 was partially verified. The reason may be that the R&D expenses of sample companies did not form the core competitiveness and create enough profit to cover large amount of early R&D expenses.

Conclusions and Implications

Conclusions

This paper used GEM listed companies before 2012 as the research sample, and 2012-2014 as the test period, to examine the impact of R&D expenses, sales investment on the enterprise performance. Empirical analysis: (1) R&D expenses has a significant negative correlation with the current enterprises performance and the lagged one period performance, but the correlation with lagged two period performance is not significant; (2) Sales investment has a significant positive correlation with the current enterprises performance.

Implications

(1) Increasing the R&D investment, improving the scientific and technological content and added value of products. R&D may be negatively correlated with the enterprises performance in short time, but it is the source and the inner power of business growth, and R&D investment should focus on the long-term interests of enterprises. Only did the companies continue to increase R&D investment, can they obtain long-term technical advantage in the fierce market competition to achieve the sustainable development.

(2) Establishing and improving the pricing and marketing strategies, to extend the product life cycle. Only drugs be reasonably priced, may sales be immediate, otherwise it may lead to sales disruption due to inflated prices. Therefore, enterprises should pay attention to choose the pricing and marketing strategies in order to extend the product life cycle, to obtain greater profits.

References:

- [1] Zhao Xicang, Wu Xiangjun, the Comparative Study of the relationship between R&D Investment and Enterprise Performance from Small Board Listed Companies [J], Technology Management Research, 2013 (12): 104-108.
- [2] Du Yong, Yan Bo, Chen Jianying, the Impact of R&D Investment in High-tech Business Performance [J], Technology Progress and Policy, 2014, 31 (2): 87-92.
- [3] Zhu Yanhua, Xu Min, Empirical Study of R&D Investment' Influence to Performance in Small Board Listed Companies [J], Science and Technology Management Research, 2013 (13): 164-167.
- [4] Wang Yurong, Gao Fei, Zhang Haobo, Empirical study of the relationship between R&D Investment and Innovation Performance in High-tech Equipment Manufacturing Industry [J], Statistics and Decision, 2015 (10): 135-137.
- [5] Sheng Yuhua, Lu lu, Inverted N-shaped relationship between R&D Investment and Enterprises Performance [J], Nanjing Social Sciences, 2016 (1): 32-38.
- [6] Li Xianjiang, the Relationship between Dynamic Marketing Capabilities, Customer Value Innovation and Enterprise Performance under Background of Green Entrepreneurial Orientation [J] Soft Science, 2013, 27 (9): 60-72.
- [7] Chen Xiaohong, Yu Tao, the Influence of Marketing Ability to Technology, Innovation and Enterprises Performance---An Empirical Study of China Small and Medium Listed Companies [J], Scientific Research, 2013, 31 (4): 585-595.
- [8] Zheng Xiaodan, Huang Yi, Zhuang Yan, Research on the Influence of R&D Investment to

Companies Performance-----Based on the Communications and Related Equipment Manufacturing Listed Companies [J], Science Technology and Industry, 2015,15 (5): 38-43 .

[9]Muhammad U A, Mehmet M K, Mark Pagell. Impact of Operational and Marketing Capabilities on Firm Performance: Evidence from Economic Growth and Downturns[J], International Journal of Production Economics, 2014,154(1): 59-71.

[10] Liao Zhongjun, the Relationship of R&D Investment, technological innovation capability and Enterprises Economic Performance [J], Technical and Economic, 2013,32 (1): 19-23.

[11] Sun Weifeng, Huang Zuhui , Ad Expenses, R&D Investment and Enterprises Performance [J], Research Management, 2013,34 (2): 44-51.

[12] Zhang Ziran, Luo Jing, the Correlation between R&D investment , Sales and Enterprises Performance in Pharmaceutical [J], Contemporary Economic, 2015,09: 116-119.