The Influence of R&D and Learning on the Business Performance of Listed Companies

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Abstract. This paper takes the R&D learning and business performance of 85 listed enterprises in Liaoning, Jilin and Heilongjiang provinces in the northeast of China from 2016 to 2020 as research samples, establishes panel data, and uses fixed effect regression analysis to explore the relationship between R&D learning and business performance. It finds that the relationship between R&D learning in the current period and corporate profitability and development capacity is negative, lagging behind one period There is a significant positive correlation between the R&D investment in the second phase and the profitability and development capacity of the enterprise, that is, there is a lag effect between the R&D learning and the business performance of the enterprise.

Keywords: R&D activities;Enterprise Learning; Business performance

1 Introduction

From the macro level, innovation is an important way to improve the quality of national development; From the micro level, innovation is the key factor to help enterprises win the competitive advantage in the industry. As one of the main bodies of national scientific and technological innovation, enterprises shoulder the important responsibility of technological innovation and transforming innovation into the driving force of economic development. At the same time, as a profit oriented organization, whether the innovation activities can effectively support the improvement of the enterprise's operating performance is the key to its sustainable research and development and learning. Therefore, the relationship between R&D investment and business performance has become a hot topic in the society. In the research on the relationship between the two, the academic community generally believes that R&D learning can promote the growth of business performance. On this basis, some studies put forward that the difference of regional economic development is also caused by the gap of R&D investment in various regions to a certain extent. To sum up, R&D investment has an important impact on business performance and regional economic development. In the context of the country's supply side reform and high-quality economic development, it is of great significance to study the mechanism of the impact of R&D learning on business performance, and then propose countermeasures and suggestions to optimize R&D learning.

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2 Theoretical analysis and research hypothesis

2.1 R&D learning can effectively stimulate the growth of business performance

The resource-based view proposes that the scarce resources owned by enterprises that other enterprises do not have can help to form the benefit difference between enterprises. This hard to replace core resource that can open the gap with other enterprises is the main way to gain competitive advantage (Guo Lixin, 2019)[1]. With the economic globalization and the deepening process of scientific and technological modernization, technological innovation has become an important channel for enterprises to open up markets and gain competitive advantages. As the main way for enterprises to carry out technological innovation, R&D activities have more and more profound impact on the business performance of enterprises. In addition, based on market feedback, timely improvement and innovation of products through existing technologies can more accurately cater to consumer needs and improve sales, thus bringing benefits to enterprises (Chen Shou et al., 2015)[2].

2.2 The positive impact of R&D investment on business performance is lagging behind

From any point of view, it will take a long time from the start of R&D activities to the output results until the products are accepted by consumers. In the short term, R&D activities need to continue to invest a large amount of R&D funds and experienced R&D personnel as support, and go through a long research and development stage. It is difficult to get compensation in the short term. Whether it can bring profits to the enterprise is also uncertain, and there is even a risk of loss. Therefore, R&D expenditure is also regarded as an investment behavior. What distinguishes it from other investment behaviors is that R&D activities are more uncertain and risky (Zhang Jian et al., 2014)[3], that is, R&D expenditure is highly likely to become a sunk cost. However, in the long run, R&D activities require a large amount of investment and will last for a long time[4]. It is a future oriented activity and largely depends on long-term investment[5]. Only when the enterprise has sufficient R&D funds and strong R&D willingness can R&D activities continue until they bring considerable economic benefits to the enterprise.

2.3 Research hypothesis

To sum up, the academic community has made relatively rich achievements in the research on the relationship between R&D investment and business performance.[6]

It is generally believed that R&D investment can promote the improvement of business performance, there is a certain lag in this impact. Based on the above analysis, this paper proposes the following assumptions:

Hypothesis 1: Under the condition that other conditions remain unchanged, the current R&D learning is negatively related to the profitability of the enterprise.

Hypothesis 2: With other conditions unchanged, the R&D learning lagging behind Phase I and Phase II is positively related to the profitability of the enterprise.

Hypothesis 3: Under the condition that other conditions remain unchanged, R&D learning in the current period is negatively related to the development capacity of the enterprise.

Hypothesis 4: With other conditions unchanged, R&D learning lagging behind Phase I and Phase II is positively related to the development capacity of the enterprise.

3 Research Design

3.1 Sample selection and data source

This study selects A-share listed companies in Liaoning Province, Jilin Province and Heilongjiang Province in 2016-2020, and excludes the following companies: (1) exclude listed companies that were ST, ST * and PT in 2016-2020; (2) Exclude companies that have been listed for less than 5 years; (3) Exclude listed companies that do not disclose R&D investment information and financial data are incomplete. After screening, 85 listed companies (including 41 in Liaoning Province, 23 in Jilin Province and 21 in Heilongjiang Province) were selected as the research objects[7]. The data of the selected companies are all from the annual reports of listed companies on CNINFO, and are processed with Excel, SPSS19.0.

3.2 Variable definition

1. Dependent variables

This paper uses operating profit margin (Y_1) to reflect the profitability of enterprises. The economic benefits brought by R&D activities of enterprises are mainly reflected in their profitability. At the same time, the growth rate of gross operating income (Y_2) is used as an indicator to measure the development ability of enterprises[8].

2.Independent variables

The intensity of R&D investment is taken as an explanatory variable, and the intensity of R&D investment=R&D investment/operating income. Compared with the absolute value index of R&D investment, the ratio index of R&D investment intensity can make different enterprises comparable[9].

3.Control variables.

In addition to the impact of R&D investment, the business performance of enterprises will also be affected by factors such as age, size, capital structure, etc. Therefore, these factors will be used as control variables in the research process[10]. To sum up, the variables used in this paper and their definitions are shown in Table 1.

Table 1. Variable Definition

Variable types	Variable name
Interpreted variable (Y)	Operating profit rate (Y_1)
	Growth rate of total operating revenue (Y_2)
Independent variables	Research and development learning intensity (RDL)
Control variables.	Enterprise size (SIZE)
	Asset liability ratio (LEV)
	Age of enterprise (AGE)

3.3 Model construction

According to the research assumptions of this paper and previous research results, the following two models are designed in this paper:

1. Test the impact of R&D learning in the current period on business performance:

$$Y_{i,t} = \beta_0 + \beta_1 RDL_{i,\ t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,\ t} + \beta_4 AGE_{i,\ t} + U_{it} \quad (1)$$

2. Test the impact of R&D learning at a later stage on the current business performance:

$$Y_{i,t} = \beta_0 + \beta_1 RDL_{i,\ t-k} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,\ t} + \beta_4 AGE_{i,\ t} + U_{it} \quad (2)$$

Among them,β_1、β_2、β_3、$\beta_4$is the unknown parameter to be estimated; U_{it} is the error term; I is an enterprise; T is the time; K is taken as 1 and 2, t-1 represents lag phase I, and t-2 represents lag phase II; Y is the explained variable, including operating profit margin (Y_1) and growth rate of total operating revenue (Y_2); RD is an explanatory variable, indicating the intensity of R&D learning; SIZE, LEV and AGE are the control variables, which respectively represent the size, asset liability ratio and age of the enterprise.

4 Empirical analysis

4.1 Profit capacity

This paper conducts empirical research on the data related to R&D learning and profitability of enterprises in the three provinces, and the regression results are shown in Table 2. From the estimation results of each model in Table 2, the symbols and the significance is basically consistent, which indicates that the estimation results in this paper are effective and stable.

Table 2. Test on Correlation and Lagging Effect between R&D learning and Profitability

Y_1	Model(1) T	Model(2) T-1	Model(3) T-2
RD	-8.825***	-13.742***	-14.824***
	(1.261)	(1.795)	(2.350)
SIZE	0.311***	0.414***	0.434***
	(0.080)	(0.099)	(0.139)
LEV	-1.907***	-2.197***	-2.132***
	(0.271)	(0.362)	(0.520)
AGE	-0.046***	-0.049**	-0.039
	(0.015)	(0.022)	(0.038)
L.RDL		4.300***	
		(1.540)	
L2.RDL			2.729
			(2.677)
_cons	-2.262**	-3.429***	-3.781**
	(0.962)	(1.225)	(1.769)

It can be seen from Table 2 that in the regression analysis of R&D investment and enterprise profitability, the regression coefficient of explanatory variables under model (I) is -8.825, which indicates that the two are significantly negatively correlated at the level of 1%. The

current R&D investment hinders the growth of enterprise profitability, confirming hypothesis 1; The regression coefficients of the explanatory variables of lag phase I and lag phase II in model (2) are 2.973and 0.372 respectively, which are positively correlated at the 10% significance level, confirming the conjecture of hypothesis 2. To sum up, the R&D investment in the current period has an obvious inhibitory effect on the profitability of enterprises, while the R&D investment lagging behind Phase I and Phase II can promote the improvement of the profitability of enterprises, that is, the positive role of R&D investment has a time lag.

4.2 Developing capacity

It can be found from Table 3 that in the regression analysis of R&D investment and enterprise development capability, the regression coefficient of explanatory variables under model (1) is -9.152 , which is significantly negatively correlated at the level of 1%, indicating that R&D investment in the current period will significantly reduce the enterprise development capability, confirming the hypothesis 3; The regression coefficients of the explanatory variables of Phase I and Phase II lag in model (2) are 16.245and 0.349, respectively, passing the tests at the levels of 1% and 5%, indicating that the R&D investment of Phase I and Phase II lag can promote the improvement of enterprise development capability. Hypothesis 4 is confirmed. In the regression analysis of lag phase I. To sum up, the R&D investment in the current period has an obvious inhibitory effect on the development ability of the enterprise, while the R&D investment lagging behind Phase I and Phase II has an obvious promoting effect on the development ability of the enterprise.

Table 3. Test on Correlation and Lagging Effect between Learning and Development Capacity

Y_2	Model（1） T	Model（2） T-1	Model（2） T-2
RD	-9.152***		
	(1.816)		
SIZE	0.234**	0.525***	0.450***
	(0.115)	(0.112)	(0.112)
LEV	-0.209	0.203	0.575
	(0.391)	(0.416)	(0.426)
AGE	-0.066***	-0.155***	-0.059*
	(0.022)	(0.024)	(0.031)
L.RDL		16.245***	
		(1.763)	
L2.RDL			0.349**
			(2.153)
_cons	-1.517	-5.091***	-5.261***
	(1.384)	(1.387)	(1.432)

5 Research conclusions

The impact of R&D investment on business performance has a time lag.The regression analysis results above show that R&D activities require a large amount of funds to support them. In addition, the high risk of R&D activities has brought a heavy burden to enterprises. The current R&D investment has significantly hindered the improvement of enterprise business performance, and the role of R&D investment in promoting enterprise business

performance has gradually emerged after a period of time. Therefore, the R&D investment lagging behind Phase I and Phase II has significantly promoted the improvement of enterprise business performance.

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