Research on the Influence of Capital Structure on R&D Investment based on Big Data of Listed Companies

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Abstract: Based on the big data of China's computer, communication and other electronic equipment manufacturing listed companies from 2017 to 2020. This paper empirically analyzes the impact of capital structure on R&D investment.

1 INTRODUCTION

The R&D level of an enterprise reflects its competitiveness. A slight change in the allocation of property right ratio, ownership structure and debt structure that reflects the capital structure will affect the amount of R&D investment of enterprises. Therefore, this paper selects computer, communication and other electronic equipment manufacturing industries to conduct in-depth research, and empirically analyzes the impact of capital structure on R&D investment intensity and scale, hoping that the conclusion will have theoretical reference for this industry and even other industries (Duan 2020).

2 BUILDUP OF MODEL

This paper constructs two multiple regression models to verify the impact of capital structure on R&D investment intensity and scale (Liu 2018).

2.1 R&D Intensity

$$RDI=\beta_0+\beta_1 DER+\beta_2 OCD+\beta_3 CDR+\beta_4 SIZE+\beta_5 RI+\beta_6 GRO+\beta_7 AGE+\varepsilon$$

2.2 R&D Investment Scale

$$RD=\beta_0+\beta_1 DER+\beta_2 OCD+\beta_3 CDR+\beta_4 SIZE+\beta_5 RI+\beta_6 GRO+\beta_7 AGE+\varepsilon$$

Where β_0 is a constant and ε represents random error

Table 1: Variable Description and Measurement Description.

Variable type	variable symbol	meaning	variable value method and description
The explained variable	RDI	R&D intensity	R&D expenditure /end-of-period total assets
	RD	R&D investment scale	R&D costs take natural logarithm
Explanatory variable	DER	equity ratio	Total liabilities/ total shareholders ' equity
	OCD	Ownership Concentration	Square sum of top ten shareholders
	CDR	current liabilities ratio	current liabilities / total liabilities
Control variable	SIZE	enterprise scale	Ln (year-end total assets)
	RI	profitability	net profit / total assets
	GRO	Enterprise Growth	Main Business Income Growth Rate
	AGE	Listing Time	Natural logarithm of listing time

3 EMPIRICAL RESEARCH

This paper selects 39 types of computer, communication and other electronic equipment manufacturing enterprises in the industry category code under A-share manufacturing (C) in Shenzhen and Shanghai Stock Exchanges from 2017 to 2020 as the research sample selection range.

3.1 Descriptive Statistics

3.1.1 Descriptive Statistics of the Explained Variables

First of all, the average value of the relative index (RDI) of R&D investment intensity of enterprises in each year in Table 2 is between 1% and 2%. It can be seen that the R&D investment level of China's computer, communication and other electronic equipment manufacturing industry is low. Overall, RDI (mean) has an increasing trend year by year, but the increase is small; the scale of corporate R&D investment (the natural logarithm of R&D expenditure) gradually increased from 16.34 in 2017 to 16.62 in 2020, which also showed a slight upward trend. Therefore, based on the above, the conclusion is that the scale of R&D shows an upward trend in terms of both R&D investment intensity and R&D investment scale, which benefits from China's emphasis on R&D and innovation in recent years. To develop into an innovative country, we should start with increasing R&D investment (Lv 2010).

Table 2: Descriptive statistics of the R&D input intensity (RDI) and scale (RD).

year	sample capacity	ndex	inimum	maximum	mean	standard deviation
2017	25	DI	0.000040	0.046580	0.011266	0.012174
		RD	11.8204	21.1061	16.3445	2.2133
2018	42	RDI	0.000072	0.082393	0.014952	0.018850
		RD	12.4070	19.6921	16.4025	1.7525
2019	59	RDI	0.000062	0.128730	0.016478	0.022528
		RD	11.8578	21.6181	16.5763	2.0924
2020	60	RDI	0.000065	0.167144	0.016174	0.024453
		RD	11.8578	21.7990	16.6209	1.9149
ample overall	186	RDI	0.000040	0.167144	0.015335	0.021230
		RD	11.8204	21.7990	16.5203	1.9672

3.1.2 Descriptive Statistics on Explanatory and Control Variables

The above table is the result of descriptive statistics on explanatory and control variables from 2017 to 2020. There is still a big gap between the minimum value of 0.0248 and the maximum value of 6.1816 in the property right ratio (DER), that is, there are great differences in the use of debt financing and equity financing among enterprises. It is generally believed that the financial structure with the average value of the property right ratio close to 1 is stable. From the average value of 0.7649, the ratio is less than 1, that is, in general, equity financing is more selected than debt financing. Ownership concentration (OCD) minimum is 0.0137, the maximum is 0.4699, the average is 0.1440, the difference is not big. The maximum value of current liabilities ratio (CDR) is 1, indicating that all liabilities of the company are current liabilities. From the perspective of the average value of 0.8500, the sample companies focus more on short-term current liabilities in debt financing. From the perspective of financing sources, short-term financing is easier, the company's repayment period is short, the risk is small from the perspective of creditors, banks or other financial institutions are more inclined to short-term lending to enterprises. The minimum value, minimum value and mean value of enterprise scale (SIZE) have little difference, indicating that the selected company scale is basically balanced. The minimum value of profitability (RI) is negative, but the absolute value of the minimum and maximum is almost the same. The minimum value of enterprise growth (GRO) is negative, but it is almost the same as the absolute value of the maximum value, and the situation is good. Listing time (AGE) minimum, maximum, mean change little, the situation is good.

Table 3: Descriptive statistics of explanatory variables and control variables of sample companies.

index	minimum	maximum	mean	standard deviation
DER	0.0248	6.1816	0.7649	0.8250
OCD	0.0137	0.4699	0.1440	0.0877
CDR	0.1432	1.0000	0.8500	0.1675
SIZE	19.5411	25.4003	21.5779	1.1969
RI	-0.4042	0.1917	0.0306	0.0604
GRO	-0.5690	2.1575	0.1955	0.3546
AGE	1.3863	3.0910	2.2535	0.4965
N	186	186	186	186

3.2 Correlation Analysis

Table 4: Correlation between explanatory and explained variables (Model 1).

		RDI	DER	OCD	CDR
RDI	Pearson correlation	1			
	Significance (bilateral)				
DER	Pearson correlation	0.090	1		
	Significance (bilateral)	0.220			
OCD	Pearson correlation	0.249**	-0.128	1	
	Significance (bilateral)	0.001	0.083		
CDR	Pearson correlation	-0.240**	-0.049	-0.024	1
	Significance (bilateral)	0.001	0.507	0.749	

**. Significant correlation was significant at 0.01 level (bilateral).

Table 5: Correlation of explanatory and explained variables (Model 2).

		RD	DER	OCD	CDR
RD	Pearson correlation	1			
	Significance (bilateral)				
DER	Pearson correlation	0.455**	1		
	Significance (bilateral)	0.000			
OCD	Pearson correlation	0.057	-0.128	1	
	Significance (bilateral)	0.443	0.083		
CDR	Pearson correlation	-0.211**	-0.049	-0.024	1
	Significance (bilateral)	0.004	0.507	0.749	

**. Significant correlation was significant at 0.01 level (bilateral).

Table 4 shows the ownership ratio (DER) and R&D intensity (RDI) were positively correlated, but the significant (bilateral) value was 0.220, and the correlation was not significant. Ownership concentration (OCD) is positively correlated with R&D investment intensity (RDI), and current debt ratio (CDR) is negatively correlated with R&D investment intensity (RDI), and both are at 1% level.

Table 5 shows the correlation between the three independent variables representing the capital structure and the dependent variable R&D investment scale (RD) in Model 2. For the correlation between independent variables and dependent variables, first of all, the Pearson correlation coefficient between the ratio of property rights (DER) and the scale of R&D investment (RD) is 0.455, that is, the two are

positively correlated and are significantly indigenous at the 1% level. Ownership concentration (OCD) is positively correlated with R&D investment scale (RD), but the coefficient of significant (bilateral) is 0.443, so the correlation is not significant. The Pearson correlation coefficient between current debt ratio (CDR) and R&D investment scale (RD) is-0.211, that is, the two are negatively correlated at the 1% level.

3.3 Regression Analysis

Table 6: Results of model I and II regression analysis.

variable	Model 1 （RDI）				Model 2 （RD）			
	Standard coefficient （B）	T value	sig.	VIF	Standard coefficient （B）	T value	sig.	VIF
Constant		2.790	0.006***			-0.453	0.651	
DER	0.273	2.909	0.004***	1.925	0.184	2.337	0.021**	1.925
OCD	0.246	3.465	0.001***	1.100	0.102	1.716	0.088*	1.100
CDR	-0.308	-4.262	0.000***	1.144	-0.129	-2.117	0.036**	1.144
SIZE	-0.146	-1.501	0.135	2.056	0.571	7.009	0.000***	2.056
RI	-0.029	-0.383	0.702	1.266	-0.117	-1.832	0.069*	1.266
GRO	-0.168	-2.222	0.028**	1.245	-0.076	-1.199	0.232	1.245
AGE	-0.118	-1.414	0.159	1.533	-0.179	-2.545	0.012**	1.533
Adj-R2	0.155				0.403			
F-Value	5.847				18.832			
(Sig.)	(0.000)				(0.000)			

Note : *. , * *. , * * *. respectively, indicating that the regression coefficients are significant at 10%, 5%, 1% levels.

Table 6 shows that the F values of Model 1 and Model 2 are 5.847 and 18.832, respectively, and the sig values are 0.000, indicating that both the regression models have significant statistical significance.

First of all, the data results of the first analysis model show that the three independent variables of property rights ratio (DER), ownership concentration (OCD), current liabilities ratio (CDR) have passed the test of the regression coefficient, which are at the level of 1%, indicating that under the control of other variables, the above three independent variables have a significant impact on the dependent variable. The strongest explanatory power is the current debt ratio (CDR), and the coefficient is -0.308. Observing the regression coefficient, the first two are positive, the latter is negative, which is consistent with the correlation analysis results of the previous model one, that is, the ownership ratio (DER), ownership concentration (OCD) and R&D investment intensity are positively correlated; current debt ratio (CDR) is negatively correlated with R&D investment intensity. Then look at the variance expansion factor (VIF) in the table, VIF values are between 0 and 10, so the independent variables in model 1 do not have serious collinearity problem.

The data results of the second analysis model show that the three independent variables have passed the significance test, and the property right ratio (DER), ownership concentration ratio (OCD), current liabilities ratio (CDR) and R&D investment scale (RD) are significantly indigenous at the levels of 5%, 10% and 5%, respectively. It also shows that the above three independent variables have significant indigenous effects on the dependent variables when other variables are controlled. Looking at the standardization coefficient, the independent variable with the strongest explanatory power of R&D investment scale (RD) is the property right ratio (DER), the coefficient is 0.184. By observing the regression coefficient, the first two are positive, and the latter is negative, which is consistent with the correlation analysis results of Model 2, namely, the property right ratio (DER) and ownership concentration (OCD) are positively correlated with the scale of R&D investment. The current debt ratio (CDR) is negatively correlated with the scale of R&D investment. The variance expansion factor VIF in the table is between 0 and 10, so there is no serious collinearity problem in model 2 (Lv 2018).

4 CONCLUSIONS AND POLICY RECOMMENDATIONS

Through the above research, the following conclusions can be drawn: the proportion of property rights and ownership concentration are positively correlated with the intensity and scale of R&D investment, and the current debt ratio is negatively correlated with the intensity and scale of R&D investment (Zhang 2019).

First, enterprises should choose more debt financing in the choice of financing methods, so that the management control rights of existing shareholders will not be diluted. The existing large shareholders will stand in the company' s long-term development and pay more attention to R&D investment. Second, in terms of ownership structure, it is necessary to appropriately enhance the ownership concentration of enterprises. The higher the ownership concentration is, the larger shareholders controlled by enterprises will have more discourse power, and they are also the real owners of enterprises (small shareholders generally make short-term investments). For their own interests and the good development of enterprises, they will operate and manage more seriously. Third, in terms of debt structure, if the enterprise needs debt for R&D investment, it is difficult for the author to recommend long-term borrowing. Because of the lag of R&D investment, the potential economic return funds can not be recovered in the short term. The current debt will make the enterprise have a lot of repayment pressure, which is likely to cause the rupture of capital flow and bring risks to the normal operation.

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