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The Impact of Government Subsidies on the R & D Investment and Business Performance of GEM Enterprises in China

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Abstract Based on the data of China's GEM companies from 2015 to 2017, this paper uses linear regression analysis model to verify the relationship among government subsidies, R&D investment and business performance. The results show that government subsidies have no significant impact on business performance, but when the intensity of government subsidies increases, the R & D investment of GEM enterprises also increases significantly. On this basis, we also concluded that the existence of R & D investment makes the government subsidies to be positively correlated with the business performance. Therefore, there is a mediating effect of R & D investment between government subsidies and business performance.

Keywords: *government subsidies, R & D investment, business performance, mediating effect*

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1. Introduction

As the second stock exchange market, GEM plays an important role in the development of enterprise economic innovation and the whole capital market. The government, as the leading regulator, provides financial support to GEM enterprises to support their rapid development. But will government subsidies stimulate R & D investment and affect business performance as expected? With the help of linear regression analysis model, the paper selects the relevant data of 485 GEM enterprises from 2015 to 2017 to conduct an empirical research on the relationship among government subsidies, R & D investment and business performance.

2. Literature Review

2.1. The Impact of Government Subsidies on R & D Investment

Hong Liu, Mei Feng Xiao and Qing Quan Tang (2012) [1] believed that government subsidies have different degrees of stimulation for different types of listed companies.

Xiao Hong Zhang and Yu Duo LU (2014) [2] considered that government subsidies can not only provide capital for enterprises' R & D innovation, but also compensate for the profit risks faced by enterprises due to R & D innovation. Since government subsidies can effectively alleviate the externality problems caused by R & D investment, government subsidies have an incentive effect on enterprises' R & D investment.

Peng Yuan Shen and Hai Feng Zou (2018) [3] focused on Chinese manufacturing listed companies, and use the endogenous transformation regression model to analyze the data from 2009 to 2013. The results show that R & D subsidies have a positive impact on R & D investment.

Lach (2003) [5] believed that government subsidies will positively stimulate small manufacturing enterprises. Therefore, for small manufacturing enterprises, government subsidies have a positive correlation with R & D investment significantly.

In summary, most experts and scholars believe that government subsidies have a positive impact on R & D investment of enterprises.

2.2. The Impact of R & D Investment on Business Performance

N·Leonard (1971) [6] analyzed the relevant data of the U.S. manufacturing industry, and found that R & D investment has no significant impact on business performance in the current year, however it will continue to produce a positive effect over the next decade.

Mei Qi (2013) [7] made an empirical analysis on the relevant data of listed companies on the SME board from 2007 to 2010, and the results showed that R & D investment is significantly negatively correlated with the current business performance. On this basis, Mei Qi further analyzed the previous R & D investment and the

current business performance, and found that there was a significant positive correlation between them. It is probably due to the time required for R & D investment to turn into productivity, which makes the impact of R & D investment lag behind.

Jian Zhang and Ling Hong Zhang (2014) [8] selected the data of China's listed companies from 2009 to 2011 as research samples, and analyzed that the R & D investment and business performance were significantly negatively correlated in the current year and following two years.

Through the data analysis of a large number of enterprises, Lev and Sougiannis (1996) [9] also believed that R & D investment has a significant lag effect on business performance.

To sum up, although in the long run, with the increase of R & D efforts, the business performance of enterprises is not optimistic in the current period of R & D investment.

2.3. The Impact of Government Subsidies on Business Performance

Jordi McKenzie, W.David Walls (2013) [10] found that government subsidies have no significant impact on the success performance of film box office.

Through empirical analysis, Wan Ting Zhuang, Fang Feng Li and An Lan Li (2018) [11] showed that 11.78% of the effect of government subsidies on business performance is realized through R & D investment, which shows that enterprise R & D investment plays a partial mediating role in the relationship between government subsidies and business performance, that is, government subsidies will affect and enterprise performance by R & D investment.

Overall, many studies at home and abroad show that government subsidies have no significant impact on business performance. However, due to the existence of R & D investment, government subsidies have a significant positive impact on business performance, indicating that R & D investment has a mediating effect between them.

3. Research Hypothesis and Sample Selection

3.1. Research Hypothesis

Hypothesis 1: Government subsidies are significantly positively correlated with R & D investment.

Hypothesis 2: There is a significant negative correlation between R & D investment and business performance in the short term.

Hypothesis 3: Because of the R & D investment, government subsidies and business performance are positively correlated. That means R & D investment has a mediating effect between them.

3.2. Sample Selection and Data Sources

The data of GEM enterprises from 2015 to 2017 as samples were selected to analysis the relationship among government subsidies, R & D investment and business performance. In these samples, the companies whose research variables are unknown or missing are removed, and new companies established after 2015 are selected. A total of 485 companies' 3-year data is obtained from Guo Taian database.

3.3. Variable Design and Model Building

3.3.1. Variable Selection and Definition

Table 1. Main Variables

Main Variables	Symbolic Representation	Variable Definition or Algorithm
Government Subsidies Intensity	SUB	SUB=Government subsidies/operating revenue
R & D Investment Intensity	RD	R & D investment/ operating revenue
Business Performance	ROA	ROA=(Total Profits+ Financing Expenses)/ Average total assets

Table 2. Control Variables

Control Variables	Symbolic Representation	Variable Definition or Algorithm
Enterprise Size	SIZE	SIZE=Logarithm of total assets
Proportion of Male Executives	SEX	Male:1 female:0 SEX=Average (1,0,…)
Development Level of Enterprises	DEV	DEV=increase of owner's equity in the current year/owner's equity at the beginning of the year

3.3.2. Model Building

Table 3. Model Building

	Linear Regression Model	
Model 1	Impact of Government Subsidies on R & D Investment	RD=β0 + β1SUB + β2SIZE + β3SEX + β4DEV + λ
Model 2	Impact of R & D Investment on Business Performance	ROA=β0 + β1RD + β2SIZE + β3SEX + β4DEV + λ
Model 3	Impact of Government Subsidies on Business Performance	ROA=β0 + β_1SUB + β2RD + β3SIZE + β4SEX + β5DEV + λ
β0 is the constant term, β1 , β2,β3 are coefficients. Λ is the random error *term*.		

4. Empirical Analyses

4.1. Descriptive Statistics

From Table 4, the maximum and minimum of SUB are 1.3897 and 0.0002, which shows the big difference. The average ratio of SUB is 4.34%, which shows that the intensity of the government subsidies for GEM enterprises is not big enough. The standard deviation is 0.0621, indicating that there is little difference among GEM enterprises in obtaining government subsidies. The mean of RD is 0.0703, which reflects that the proportion of R & D investment to operating revenue of GEM enterprises in China is 7.03%. The standard deviation of RD is 0.0600, which indicates that the R & D investment intensity of the whole industry has little fluctuation, and the R & D investment intensity of GEM enterprises is still relatively weak. The mean of SEX is 0.7909, which indicates that the proportion of male executives is close to 80%, and the maximum is 1, which indicates that all the executives are male in some enterprises. The maximum of DEV is 7.1706 and the minimum is - 1.0636, which reflects the uneven development ability of GEM enterprises.

4.2. Correlation Test

According to the Table 5, it is not difficult to find that when the intensity of government subsidies increases, the R & D investment of enterprises increases, which coincides with hypothesis 1.On the other hand, the correlation coefficient between SUB and ROA is -0.023 indicating the weak correlation between them. There is a significant negative correlation between RD and ROA. That means the increase of R & D investment will make the business performance worse which is consistent with hypothesis 2. Based on the correlation coefficients of SUB and RD, SUB and ROA, and RD and ROA, it can be preliminarily concluded that the government subsidies will affect the business performance of enterprises through R & D investment, that is, there is a mediating effect between them.

Table 4. Descriptive Statistics

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std.Deviation
SUB	1455	0.0002	1.3897	0.0434	0.0621
RD	1455	0.0006	0.7275	0.0703	0.0600
ROA	1455	-0.6618	0.4169	0.0651	0.0654
SIZE	1455	19.5550	24.6159	21.4742	0.8286
SEX	1455	0.3571	1.0000	0.7909	0.1072
DEV	1455	-1.0636	7.1706	0.3846	0.7142
Valid N (list status)	1455				

Table 5. Correlation Analysis

Results of Correlation Analysis							
		SUB	RD	ROA	SIZE	SEX	DEV
SUB	Pearson Correlation	1	0.528**	-0.023	-0.082**	0.021	-0.035
	Significance		0.000	0.380	0.002	0.430	0.182
	N	1455	1455	1455	1455	1455	1455
RD	Pearson Correlation	0.528**	1	-0.139**	-0.154**	-0.015	-0.069**
	Significance	0.000		0.000	0.000	0.578	0.008
	N	1455	1455	1455	1455	1455	1455
ROA	Pearson Correlation	-0.023	-0.139**	1	0.028	-0.022	0.210**
	Significance	0.380	0.000		0.289	0.400	0.000
	N	1455	1455	1455	1455	1455	1455
SIZE	Pearson Correlation	-0.082**	-.154**	0.028	1	0.042	0.157**
	Significance	0.002	0.000	0.289		0.106	0.000
	N	1455	1455	1455	1455	1455	1455
SEX	Pearson Correlation	0.021	-0.015	-0.022	0.042	1	0.018
	Significance	0.430	0.578	0.400	0.106		0.486
	N	1455	1455	1455	1455	1455	1455
DEV	Pearson Correlation	-0.035	-0.069**	0.210**	0.157**	0.018	1
	Significance	0.182	0.008	0.000	0.000	0.486	
	N	1455	1455	1455	1455	1455	1455

****. Significantly correlated at the level of 0.01**

4.3. Linear Regression Analysis

4.3.1. Analysis of the Impact of Government Subsidies on R & D investment of Enterprises

The adjusted R^2 in model 1 is 0.291, showing the better goodness of fit of the model, which can better reflect the relationship between government subsidies and R & D investment. The F-measure is 150.035, and the corresponding P-value is 0, less than 0.05. It shows that the regression effect of the whole model is significant, that is, government subsidies have a significant impact on the R & D investment of GEM enterprises. The β-value of SUB is 0.501, which further indicates that government subsidies are significantly positively correlated with R & D investment, which is consistent with hypothesis 1. Through further analysis of control variables, it can be found that the t-value of enterprise size is -4.648, and P-value of t test is 0.00, less than 0.05, indicating that the larger the size of GEM enterprises, the smaller the R & D investment of enterprises. The P-value of SEX is much greater than 0.05, which shows that the effect of SEX on R & D investment is not significant. The t-value of DEV is -1.530, and P-value is 0.126, greater than 0.05, indicating that the relationship between the development ability of enterprises and R & D investment is not significant; on the other hand, the VIF of collinearity statistics are all less than 10, indicating that there is no serious multicollinearity problem in the model.

Table 6. Regression Analysis of Model 1

Model summary				
Model	R	R-squared	Adjusted R-squared	SEE
1	0.541a	0.293	0.291	0.050501253273122

a. Predictive variable: (constant), SUB, SEX, DEV, SIZE

Table 7. ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	1.531	4	0.383	150.035	0.000
Residual	3.698	1450	0.003		
Total	5.229	1454			

a. Dependent Variable: RD
b. Predictive Variable: (constant), SUB, SEX, DEV, SIZE

Table 8. Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std.Error	Trial Version			Tolerance	VIF
(constant)	0.222	0.036		6.195	0.000		
SIZE	-0.008	0.002	-0.105	-4.684	0.000	0.968	1.033
SEX	-0.011	0.012	-0.020	-.916	0.360	0.997	1.003
DEV	-0.003	0.002	-0.034	-1.530	0.126	0.975	1.026
SUB	0.501	0.021	0.519	23.394	0.000	0.992	1.008

4.3.2. Analysis of the Impact of R & D Investment on Business Performance

Table 9. Regression Analysis of Model 2

Model summary				
Model	R	R-squared	Adjusted R-squared	SEE
2	0.246a	0.061	0.058	.063467104

a. Predictive Variable: (constant), RD, SEX, DEV, SIZE。

Table 10. ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	0.377	4	0.094	23.425	.000b
Residual	5.841	1450	0.004		
Total	6.218	1454			

a. Dependent Variable: ROA
b. Predictive variable: (constant), SUB, SEX, DEV, SIZE

Table 11. Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	standard error	Trial Version			Tolerance	VIF
(constant)	0.120	0.046		2.619	0.009		
SIZE	-0.002	0.002	-0.023	-0.881	0.378	0.953	1.049
SEX	-0.016	0.016	-0.027	-1.049	0.294	0.998	1.002
DEV	0.019	0.002	0.205	7.936	0.000	0.973	1.028
RD	-0.140	0.028	-0.129	-4.985	0.000	0.974	1.026

The F-measure is 23.425, and the corresponding P-value is 0, less than 0.05. It shows that the R & D investment of GEM enterprises has a significant impact on business performance. The β-value of RD is -0.140, which further indicates that R & D investment is significantly negatively correlated with business performance, which is consistent with hypothesis 2. The t-value of enterprise size is -0.881, and the P-value of t test is 0.378, greater than 0.05, indicating that the negative correlation between the size of GEM and business performance is not significant. The t-value of SEX is -1.049, and the P-value is greater than 0.05, which shows that the negative correlation between SEX and business performance is not significant. However, the t-value of DEV is 7.936, the corresponding P-value is 0, less than 0.05, which shows that there is a significant positive correlation between DEV and business performance, that is, the stronger the development ability of GEM enterprises, the better the business performance; on the other hand, the VIF of collinearity statistics are all less than 10, indicating that there is no serious multicollinearity problem in the model.

Considering that the impact of R & D investment on business performance is more or less lagging, and most of the GEM enterprises are small and medium-sized enterprises, we also analyze the impact of R & D investment of GEM enterprises in 2015 on business performance in the following two years.

Table 12. Research on the Lag of the Impact of R & D Investment on Business Performance in 2015 (1)

Model summary				
Model	R	R-squared	Adjusted R-squared	SEE
2	0.195a	0.038	0.030	0.055952011
a. Predictive Variable: (constant), RD, SEX, DEV, SIZE				

Table 13. ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	0.059	4	0.015	4.740	0.001
Residual	1.503	480	0.003		
Total	1.562	484			
a. Dependent Variable: ROA					
b. Predictive Variable: (constant), RD, SEX, DEV, SIZE					

Table 14. Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Standard Error	Trial Version			Tolerance	VIF
(constant)	0.066	0.075		0.884	0.377		
SIZE	0.001	0.003	0.014	0.300	0.764	0.965	1.037
SEX	-0.023	0.024	-0.042	-0.947	0.344	0.997	1.003
DEV	0.009	0.003	0.114	2.518	0.012	0.973	1.028
RD	-0.116	0.039	-0.136	-2.985	0.003	0.971	1.030

The P-value of F test is 0.001, which shows that the effect of the model is significant. The β-value is -0.116, t-value is -2.985, and p-value is 0.003, which is obviously less than 0,05. Therefore, it can be found that there is a significant negative correlation between R & D investment of GEM enterprises in 2015 and business performance of the next year.

Table 15. Research on the Lag of the Impact of R & D Investment on Business Performance in 2015 (1)

Model summary				
Model	R	R-squared	Adjusted R-squared	SEE
1	0.173a	0.030	0.022	0.070996685
a. Predictive Variable: (constant), RD, SEX, DEV, SIZE				

Table 16. ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	0.075	4	0.019	3.719	0.005b
Residual	2.419	480	0.005		
Total	2.494	484			

a. Dependent Variable: ROA
b. Predictive Variable: (constant), RD, SEX, DEV, SIZE

Table 17. Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Standard Error	Trial Version			Tolerance	VIF
(constant)	0.312	0.095		3.301	0.001		
SIZE	-0.012	0.004	-0.123	-2.680	0.008	0.965	1.037
SEX	-0.005	0.030	-0.007	-0.154	0.878	0.997	1.003
DEV	0.009	0.004	0.093	2.048	0.041	0.973	1.028
RD	-0.110	0.049	-0.102	-2.236	0.026	0.971	1.030

The t-value is -2.236, and p-value is 0.026, less than 0,05. It shows that there is still a significant negative correlation between R & D investment in 2015 and business performance in 2017. Based on the above analysis, we can know that the R & D investment and business performance are significantly negatively correlated in the current year and the following two years, that is to say, although the intensity of R & D investment increases, the impact on business performance will not work in the short term.

4.3.2. Analysis of Mediating Effect of R & D Investment

Table 18. Regression Analysis of Model 3

Model	R	R-squared	Adjusted R-squared	SEE
3	0.254a	0.064	0.061	.063368266

a. Predictive Variable: (constant), SUB, SEX, DEV, SIZE, RD

Table 19. ANOVA

Model	R	R-squared	Adjusted R-squared	SEE	Model
Regression	0.400	5	0.080	19.904	0.000b
Residual	5.819	1449	0.004		
Total	6.218	1454			

a. Dependent Variable: ROA
b. Predictive Variable: (constant), SUB, SEX, DEV, SIZE, RD

Table 20. Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Standard error	Trial Version		
(constant)	0.120	0.046		2.632	0.009
SIZE	-0.002	0.002	-0.023	-0.878	0.380
SEX	-0.018	0.016	-0.029	-1.129	0.259
DEV	0.019	0.002	0.205	7.944	0.000
RD	-0.181	0.033	-0.166	-5.484	0.000
SUB	0.074	0.032	0.070	2.351	0.019

a. Dependent Variable: ROA

The t-value is 2.351, and p-value is 0.019, less than 0.05. Therefore, government subsidies is positively correlated with business performance. And R & D investment is negatively correlated with corporate performance because the t-value of RD is -5.4841, and p-value is 0.000, less than 0.05. According to the correlation test, we can know that government subsidies have no significant impact on business performance, but the existence of R & D investment results in a significant positive correlation between government subsidies and business performance. Therefore, government subsidies will have a certain impact on business performance through R & D investment, which is consistent with hypothesis 3.

5. Conclusions

The results show that, (1) government subsidies is significantly positively correlated with R & D investment. This may be because most of the GEM enterprises are small and medium-sized enterprises who face high capital cost and risk due to independent R & D investment, while the government subsidies will make it very different. Additional funds can well alleviate the above problems, which greatly encourages and stimulates enterprises to increase investment in R & D. (2) When the R & D investment intensity of GEM enterprises increases, the business performance of enterprises is not as good as the managers expected in the current and the following two years, and even there is a significant negative correlation between them. This may be because R & D requires strong supports of time and personnel and most GEM enterprises are small and medium-sized enterprises, the number or capacity of whose R & D personnel may be limited. In short-term, the income from R & D investment is significantly lower than that from other investments. (3) There is no obvious correlation between government subsidies and business performance of GEM enterprises. However, through R & D investment, government subsidies have a significant positive impact on business performance.

6. Suggestions

To sum up, we can draw the following suggestions:

(1) For the government, government subsidies can significantly stimulate the R & D investment of enterprises. Therefore, the government should continue to strengthen the guiding role of government subsidies for GEM enterprises.

(2) For GEM enterprises, due to the lag effect on business performance of R& D investment , the managers of enterprises are likely to reduce the R & D investment because of the short-term interests. Therefore, the government should adopt some incentive measures to encourage enterprises to increase the investment in R & D personnel training, so as to improve the overall quality of R & D personnel and shorten the R & D period of GEM enterprises as far as possible.

References

[1] Liu Hong, Xiao Meifeng, Tang Qingquan. “Incentive and Crowding out Effects of R & D Subsidies on R & D Expenditure of Enterprises -- An Empirical Analysis Based on the Data of Chinese Listed Companies”, Business Management, 34(04). 19-28. 2012.

[2] Zhang Xiaohong, Lu Yuduo. “An Empirical Research of the Impact of Government Subsidies on Enterprises' R & D Investment”, Science and Technology Management Research, 34(15). 204-209, 2014.

[3] Shen Pengyuan, Zou Haifeng. “Government R & D Subsidies and R & D Investment of Enterprises-Based on Chinese Listed Manufacturing Companies”, Shanghai Journal of Economics, (08). 84-93. 2018.

[4] Eui Young Lee,Beom Cheol Cin. “The Effect of Risk-sharing Government Subsidy on Corporate R&D Investment: Empirical Evidence from Korea”. Technological Forecasting & Social Change, 2010.

[5] SaulLach. D. “R&D Subsidies Stimulate or Displace Private R&D? Evidence from Israel”. The Journal of Industrial Economics,2003

[6] Leonard, W.N. “Research and Development in Industrial Growth”. Journal of Politics, 1971.

[7] Qi Mei. “Empirical Research on R & D Investment and Corporate Performance-Based on Listed Companies on SME board”, Communication of Finance and Accounting (06). 49-51. 2013.

[8] Zhang Jian, Zhang Linghong. “The Impact of R & D Investment on Business Performance: Empirical Evidence from Chinese Listed Companies from 2009 to 2011”, Scientific Decision Making, (01). 54-72. 2014.

[9] Baruch Lev, Theodore Sougiannis. “The Capitalization, Amortization, and Value-relevance of R&D”, Journal of Accounting and Economiacs, (21).107-138. 1996.

[10] Jordi McKenzie,W. David Walls. “Australian films at the Australian box office: performance, distribution, and subsidies”. Journal of Cultural Economics. (2). 2013.

[11] Zhuang Wanting, Li Fangfeng, Li Anlan. “Research on the impact of government subsidies on Enterprise Performance -- Based on the mediating effect of enterprise R & D investment”. Communication of Finance and Accounting. (30). 53-57. 2018.