Analysts' Attention and R&D Expenditure: The Mediating Role of Financial Constraints

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Abstract. Analyst plays an important role in the development of an enterprise. Meanwhile, during the process of this development, it is important to gain financial support. Analysts' opinions can change public investors' behavior and sentiments dramatically. However, the relationship between the three factors is still waiting to be discussed. This article focuses on the relationship between analysts' attention, corporate finance, and corporate innovation, using OLS and Panel FE estimation methods to analyze the problem, and finally concludes that analysts' attention can reduce financial constraints and then have a positive influence on corporate innovation. Moreover, compared with a large company, middle and small-sized enterprises are influenced more by this attention. Based on the research result, this article proposed that companies, especially the middle and/ or small-sized companies, should pay attention to making the third party (i.e., the analysts) interested in them and increase their exposure among the analysts and the public.

Keywords: Analysts' Attention; Corporate innovation; Financial constraint.

1. Introduction

Not all firms grow equally, and very few enterprises find opportunities to grow and flourish [1]. Under the background of the III scientific revolution, corporate innovation is one of the most significant issues faced by enterprises. Most privately owned companies are suffering from the problem of lack of innovation [2]. The reason why middle and small-sized enterprises are facing problems in innovation is the lack of innovation resources such as talent, patents, etc. And it is difficult to gain financial support during their growth, especially for scientific enterprises [3]. Finance is crucial for the survival and growth of micro, small and medium enterprises in developing and developed countries. It helps in promoting and expanding the business which helps in national economic and social growth [4]. Decreasing the financial constraints has a positive influence on corporate innovation [5].

Analysts are mainly responsible for analyzing and researching various factors related to the securities market, including research, and forecasting the value and changing trends of the securities market and securities varieties, and issuing securities research reports, investment value reports, etc. to investors in written or Professionals who orally provide investors with the above reports and services such as analysis, forecasts, or recommendations [6]. The analysis result issued by authorized security analysts will influence investor sentiment and behavior. Although main investors and executives can have an impact on public behavior, security analysts will influence the public investor more due to their special status in the market, their ability, and the fame of the organization they work for [7]. Cases on analysts' impact appear continuously. For example, no matter commercial media or authority, everyone thinks the reason for the internet bubble of USA in 20th century is the comment of analysts [8].

In the previous study, it is easy to see that analyst and attention play an important role in the development of an enterprise. Corporate innovation, as well as corporate finance, is also two of the most significant topics in the process of company growth. However, whether there is any relationship between these three factors or not is still under discussion. Therefore, this article will design a model to answer this question and then bring about related suggestions for enterprises in their development process.

In this article, OLS analysis will be used to indicate the relationship between corporate innovation and attention to the enterprise. During the analysis process, the data source will be introduced first,

and then there will be a general overview of the model as well as the variables. The result of the model will be shown afterward. In order to test the analysis, heterogeneous test and robustness test will be done and at the same time, mechanism analysis will be used to find out how attention will influence the corporate innovation.

The following parts will be organized as follows: Part 2 is identification strategy, including data sources, model specification, and summary statistics; Part 3 states the empirical results, in which benchmark regression, heterogeneity analysis, robustness test, and mechanism test are used to test the model and analyze the result; Part 4 is the conclusion of the passage, summarizing the main topic and found of this article- analyst attention will reduce the financial constraints and then increase the innovation and R&D level of the whole company.

2. Identification Strategy

2.1 Data sources

In this thesis, data from 2009 to 2019 of China A-share companies are used and the provider of the data is CSMAR, which is a database that Guotai An draws on the professional standards of internationally renowned databases such as CRSP of the University of Chicago, S&P Compustat, New York Stock Exchange TAQ, I/B/E/S, Thomson, etc. This database starts from the needs of academic research and develops an economic and financial model based on China's actual national conditions. The CSMAR economic and financial database combines empirical research topics to classify massive data according to research directions to meet the needs of different researchers, helps researchers build research models in the fastest and most convenient way, and solve the empirical research needs of universities and 5 million academic customers, getting the trust of various top financial institutions both in domestic and abroad [9].

In this thesis, the samples are selected based on the following criteria: (1) The sample of companies in the financial industry was excluded; (2) The samples of companies subject to ST and *ST were excluded; (3) Samples with missing values for variables were excluded; (4) Considering the influence of extreme values, the method of winsorize is used to carry out 1% bilateral shrinkage of the main continuous variables; (5) Reserved for small and medium-sized enterprises whose stock code starts with 002.

2.2 Model Specification

This article considers the impact of attention on the investment in R&D and the financing constraints. The model is as follows:

$$R\&D\ Expenditure_i = \alpha_0 + \alpha_i \times Attention\ Varibale + \boldsymbol{x_i'\beta} + \varepsilon_i \quad (1)$$

Here, $R\&D\ Expenditure$ stands for the dependent variables, showing the investment status of the companies. The dependent variable is R&D. It stands for the investment in research and development in a company, showing the degree of corporate innovation in the analyzed enterprises. In this model, it is calculated in logarithm.

Later, in order to analyze how attention variables, influence the dependent variable, R&D, SA index will be introduced in this model as another dependent variable. For SA index, it is from the practice of Hadlock & Pierce, in which SA index is used to measure the financing constraints of a company [10]. The calculation of SA index is as follows:

$$SA\ index = 0.737 \times Asset + 0.043 \times Asset^2 - 0.040 \times Age \quad (2)$$

In formula (2), asset is the natural logarithm of the company's total assets (in million Yuan) and age is the company's time to market. Normally, SA is negative. However, this article uses the absolute

value of SA. The larger the SA value is, the more the company is restricted by the financing constraints.

Attention variables are the core explanatory variables, which consist of analyst attention and report attention. For analyst attention, it indicates how many analysts (teams) have tracked the company's stock in a year. The amount is counted based on the number of teams rather than the number of team members. For report attention, it shows how many research reports have tracked and analyzed the company within a year. x_i are control variables, including financial status in the aspect of asset, debt, etc. The table below shows the detail of the definition of control variables in this model.

Table 1. Variables' definition

Variables	Variable type	Definition
R & D	Dependent variable	Investment in research and development in a company
SA index	Dependent variable	Measure the financial constraints SA = 0.737 × Asset + 0.043 × Asset2 - 0.040 × Age
Analyst Attention	Core explanatory variable	The number of analysts (teams) who have tracked the company's stock in a year
Report Attention	Core explanatory variable	The number of research reports has tracked and analyzed the company within a year
Asset	Control variable	Total assets at the end of the period
Debt	Control variable	Total debt at the end of the period
Age	Control variable	The length of time that the company has gone public
top1	Control variable	The shareholding ratio of the largest shareholder（%）
SOE=1	Control variable	State-owned enterprise=1，otherwise=0
Foreign=1	Control variable	Foreign enterprise=1，otherwise=0
Board Size	Control variable	Board Size
No. of Independent Director	Control variable	Number of Independent Directors
Salary, unit: 10000 Yuan	Control variable	Executive salary
ROA, %	Control variable	Return on Assets equals net income divided by total assets

2.3 Summary Statistics

The table below shows that for one middle or small-sized enterprise, there are approximately 8 teams that have analyzed the enterprise and when it comes to the report that includes the enterprise, the number is around 16. Compared to different enterprises, report attention that an individual enterprise get various more than the case in report attention.

For the control variables, the mean value of asset is 5016 million and the mean value of debt is 2480, nearly half of the asset. Therefore, it is easy to see that in middle and small-sized enterprises, debt ratio is around 50%. From 2001 to 2020, the debt ratio of public enterprises in China is 92.432% based on the report issued by China Securities Regulatory Commission (CSRC) [11]. Comparing these two data, it is obvious that the debt ratio in middle and small-sized public enterprises are significantly lower than the average data in all public enterprises, showing that due to a lack of financial security and support as well as confidence from other organization, middle and small-sized enterprises have a severe financial constrain, thus leading to the problem of lack of investment in innovation. Therefore, when finishing the test of all analyses of test, further mechanism test should be performed on the aspect of corporate finance regarding the constraints of finance. Moreover, the

variety of asset and debt among different companies are large, showing that circumstances might vary for different-sized company.

For the analysis of other control variables, most of them are in the same range and the standard deviations are close to zero, showing that the companies are in similar circumstances in those aspects. Namely, in most middle and small-sized enterprises, the shareholding ratio of the largest shareholder is around 34%, 15% of them are state-owned companies, 5% of them are foreign companies, there are 8.4 people on their board, and 3 independent directors per company, the salary for executives is 3 million and ROA is around 0.05.

Table 2. Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
R & D, in thousand	7775	90429.147	172431.4	0	1480018
SA index	7775	3.3081	.1672	2.8429	3.758
Analyst Attention	7775	8.0989	9.1628	0	41
Report Attention	7775	15.8988	20.8321	0	101
Age	7775	5.1684	3.5079	0	15
Asset, in millions	7775	5016.8099	10668.858	186.5798	254594.73
Debt, in millions	7775	2483.901	7413.9681	36.2757	209922.34
top1	7775	34.3934	14.4261	4.15	86.49
SOE=1	7775	.154	.3609	0	1
Foreign=1	7775	.0539	.2258	0	1
Board Size	7775	8.4253	1.4584	5	15
No. of Independent Director	7775	3.0999	.4598	2	5
Salary, in millions	7775	3.3454	3.1149	.1577	24.1108
ROA	7775	.0478	.0667	-.3281	.2342

3. Empirical Results

3.1 Benchmark Regression

It can be seen from the benchmark regression estimation results that analyst attention has a significant positive impact on the R&D investment expenditure of enterprises. In column (1), the coefficient of analyst concern is 0.4889, which is significant at the 1% level. In order to avoid the influence of omitted variables, the coefficient is 0.1562 after adding control variables in column (2). The results show that, on average, the number of analyst attention increases by 1%, the R&D expenditure of enterprises increases by 15.62%, and the coefficient is significant at the 1% level. Similarly, the attention to research reports increases by 1%, the R&D investment expenditure increases by 13.62%, and the coefficient is significant at the level of 1%. The above results show that analyst attention can promote enterprises' investment in innovation. From the estimation of control variables, it can be proven by the result that age, change rate of asset, change rate of debt, and the change of salary are significant at the 1% level. The absolute values of the slope coefficients of ln asset and ln debt can be rounded to 0.7 and 0.3 respectively, which are higher than those of other control variables, showing that these two control variables have more impact on the model than others.

Table 3. Benchmark regression

VARIABLES	(1) OLS R & D	(2) OLS R & D	(3) OLS R & D	(4) OLS R & D
Ln Analyst Attention	0.4889***	0.1562***		
	(0.0463)	(0.0565)		
Ln Report Attention			0.4115***	0.1362***
			(0.0368)	(0.0450)
Age		0.2399***		0.2342***
		(0.0551)		(0.0552)
Age-sq		-0.0119***		-0.0115***
		(0.0039)		(0.0039)
Ln asset		0.6950***		0.6936***
		(0.1628)		(0.1624)
Ln debt		-0.3029***		-0.3064***
		(0.1100)		(0.1100)
top1		-0.0051		-0.0051
		(0.0041)		(0.0041)
SOE=1		-0.4252**		-0.4222**
		(0.1717)		(0.1718)
Foreign=1		0.0735		0.0771
		(0.2247)		(0.2246)
Board Size		0.0452		0.0451
		(0.0508)		(0.0508)
No. of Independent Director		0.1245		0.1256
		(0.1682)		(0.1681)
Ln salary		0.5547***		0.5516***
		(0.0927)		(0.0927)
ROA		1.8825*		1.7929*
		(1.0100)		(1.0121)
Constant	11.8802***	-4.5479**	11.8478***	-4.4198**
	(0.5053)	(1.9756)	(0.4990)	(1.9735)
Observations	7,775	7,775	7,775	7,775
R-squared	0.3419	0.3561	0.3425	0.3562
Date	Unbalanced	Unbalanced	Unbalanced	Unbalanced
Year Dummy	Yes	Yes	Yes	Yes
Industry Effect	Yes	Yes	Yes	Yes

3.2 Heterogeneity Analysis

In order to analyze if the impact of attention on large enterprises and medium and small enterprises is heterogeneous, this thesis performed a heterogeneity analysis. The definition of dummy is that when the total asset of a company is under 50^{th} percentile, the dummy is set as 1 and that otherwise, namely if the total asset is above 50^{th} percentile, the dummy is set as 0. The estimated coefficient of the dummy describes that the investment in R&D in a small-sized company is 95% lower than in a large-sized enterprise. From the aspect of interaction term coefficient, it is obvious that the analyst's attention influences more in the R&D investment in small-sized enterprises. In the second and fourth columns, the coefficients are 13.09% and 8.38% respectively.

Table 4. Heterogeneity analysis

VARIABLES	(1) OLS R & D	(2) OLS R & D	(3) OLS R & D	(4) OLS R & D
Ln Analyst Attention	0.4524***	0.1436**		
	(0.0488)	(0.0581)		
Dummy	-1.4158***	-0.9718***	-1.3745***	-0.9527***
	(0.2395)	(0.2518)	(0.2388)	(0.2510)
Ln Report Attention			0.3833***	0.1272***
			(0.0388)	(0.0462)
Dummy # Ln Analyst Attention	0.0223***	0.1309***		
	(0.0006)	(0.00063)		
Dummy # Ln Report Attention			0.0266***	0.0838***
			(0.0043)	(0.0052)
Constant	12.1191***	-3.5681*	12.1191***	-3.5681*
	(0.5004)	(2.0440)	(0.5004)	(2.0440)
Observations	7,775	7,775	7,775	7,775
R-squared	0.3436	0.3567	0.3436	0.3567
Data	Unbalanced	Unbalanced	Unbalanced	Unbalanced
Control	No	Yes	No	Yes
Industry Effect	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes

3.3 Robustness test

Panel FE is used in robustness test. The estimated coefficients are positive and are significant at the 1% level, indicating that both analyst attention and report attention positively influence the R&D investment and the test result in the previous part of this article is robust.

Table 5. Robustness test

VARIABLES	(1) Panel FE R & D	(2) Panel FE R & D	(3) Panel FE R & D	(4) Panel FE R & D
Ln Analyst Attention	0.3547***	0.0425***		
	(0.1073)	(0.0064)		
Ln Report Attention			0.3127***	0.0595***
			(0.0882)	(0.0061)
Constant	12.5987***	-4.4343	12.5263***	-4.0345
	(0.4223)	(6.1120)	(0.4245)	(6.1299)
Observations	2,904	2,904	2,904	2,904
R-squared	264	264	264	264
Date	Balanced	Balanced	Balanced	Balanced
Control	No	Yes	No	Yes
Year Dummy	Yes	Yes	Yes	Yes
Industry Effect	Yes	Yes	Yes	Yes

3.4 Mechanism Test

As stated in the previous part of the thesis, SA test is introduced in the mechanism test. The coefficient of the independent variables is negative, indicating that the attention can release the financing constraints. From the significance of the result, it is obvious that attention has a positive influence on the investment in R&D by reducing the constraints in seeking financial support.

Table 6. Mechanism test

	(1)	(2)	(3)	(4)
	OLS	OLS	OLS	OLS
VARIABLES	SA index	SA index	SA index	SA index
Ln Analyst Attention	-0.0177***	-0.0028***		
	(0.0015)	(0.0007)		
Ln Report Attention			-0.0165***	-0.0018***
			(0.0012)	(0.0005)
Constant	2.9820***	2.5390***	2.9774***	2.5330***
	(0.0442)	(0.0514)	(0.0440)	(0.0513)
Observations	7,775	7,775	7,775	7,775
R-squared	0.3833	0.8840	0.3875	0.8839
Data	Unbalanced	Unbalanced	Unbalanced	Unbalanced
Control	No	Yes	No	Yes
Industry Effect	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes

4. Conclusion

Under the background of finding out the relationship between corporate innovation, analysts' attention, and corporate finance, this article from a multi-linear regression model, using OSL analysis and finally came to the conclusion that analysts' attention has a positive influence on corporate innovation. In setting the variables, analysts' attention was divided into two aspects - analysts' attention and report attention, while R&D investment was used to measure corporate innovation. Afterward, a mechanism test was used to analyze the way that corporate finance influences innovation, showing that it is the release of financial constraints that make more budget for R&D investment.

For the enterprises themselves, drawing people's attention is important. It is necessary to have some third party issue a report on their business. Looking at the result of the analysis, analysts' attention has an obvious effect on releasing their financial constraints and boosting their innovation investment. Meanwhile, attention should be paid to the financial status of the company. The fewer financial constraints the company has, the more corporate innovation there will be. This result is most suitable for scientific enterprises in which innovation is essential in their development process.

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