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GREEN FINANCE, R & D INVESTMENT, AND CORPORATE PERFORMANCE

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Abstract: This paper studies the relationship between green finance, R & D investment and enterprise performance in 2019-2021 to study the relationship between green finance, R & D investment and enterprise performance. The study finds that: R & D investment plays a significant role in promoting the performance of enterprises, green finance has a positive relationship with enterprise performance, and green finance improves the level of green RESEARCH and development investment to improve the performance of enterprise performance.
Keywords: Green finance; R&D investment; Enterprise performance

1. Introduction and Review of the literature

Over the years, although the extensive economy has greatly promoted the rapid growth of China's economy, it has also brought serious problems such as excessive energy consumption, serious environmental damage and excessive greenhouse gas emissions, thus affecting the sustainable development of the economy. These problems have also become the bottleneck of the long-term development of micro enterprise performance. In recent years, the concept of green, sustainable and high-quality development has gradually gained popularity, and "green finance" has been widely reported by major media. Green finance refers to the financial to protect the ecological environment and save energy as the main goal, with the help of relevant policies, environmental hazards potential benefits, risk and cost as a key factor into the decision-making and daily work, at the same time the social development of economic resources into the ecological environment protection, correct guidance in promoting the sustainable development of financial way. Green finance has developed earlier in foreign markets, but in recent years, it has also developed rapidly in green finance in China, which has become a highlight of the supply-side reform of China's financial industry in recent years. At the same time, the long-term development of an enterprise cannot be separated from continuous innovation, especially the improvement of the current performance requires competitive products and high market share, which are inseparable from the reasonable R & D investment of the enterprise. Reasonable R & D investment is the continuous driving force for innovation, and R & D investment needs the support of continuous finance, especially green finance, to make comprehensive efforts to improve enterprise performance. Existing scholars have conducted research on the relationship between R & D investment and enterprise performance, green finance and enterprise performance.

On R & D investment and enterprise performance. The impact of existing R & D investment on enterprise performance is diverse, mainly in three situations: positive correlation, lag and uncertainty: (1) positive correlation. Chinese scholars have also studied a lot of the relationship between R & D investment and enterprise performance, and found that R & D investment can improve enterprise performance. Zhang Fusheng, Zhang Lisheng and Wang Xiaoxue (2019) proposed that among the R & D investment and performance, the relationship between the two is obviously positively related under the role of internal management and control[1]. (2) Lag lag. There is some lag in the impact of R & D investment on enterprise performance. Lu Keying (2017) is a listed company, and the enterprise performance of its listed company is relatively good than that of other enterprises, mainly for information companies. The results mainly show that the R & D investment lags behind, but it has a positive impact[2]. (3) Uncertainty. Liu Xuezhi, Wang Xiaohui, Zhang Dong and Huang Jing (2017) proposed that bivariate control can effectively verify the relationship between R & D investment and enterprise performance, and the sample data selected after different indicators will also be different, and verify the relationship between the two more diversified, so as to draw the conclusion of inverted U-shaped relationship[3].

Research on the relationship between green finance and enterprise performance. Scholars at home and abroad have rich research on green finance and corporate performance, including the importance, mechanism and effect test of green finance on corporate performance: (1) In terms of importance, Awawdeh et al. (2022) shows that technological innovation affects environmental performance and has a positive impact on corporate performance. The role of green financing on environmental performance is also important and positive[4]; (2) In terms of mechanism, HanminDong et al. (2022) discussed the impact and mechanism of green finance on enterprise performance. Their research found that green finance can improve overall corporate performance by 1.65%; potential mechanisms include internal green patents and external social reputation, overall effects vary by different ownership and eco-geographic location; green bonds motivate renewable energy related companies to achieve better

performance[5]; (3) In terms of effect inspection, Chen Zhigang et al. (2022) used DID method to test the impact of green finance on enterprise performance, and found that green finance was not completely correlated with enterprise performance[6].

to sum up, The above research on the relationship between R & D investment on enterprise performance and green finance on enterprise performance is the basis of further research in this paper, But, after the analysis, It is found that the existing literature still has the following deficiencies: (1) the existing domestic and foreign studies often mainly focus on the two of them, Such as green finance and corporate performance or R & D investment and corporate performance, Less to include green finance, R & D investment and enterprise performance into the unified framework for research; (2) The internal mechanism of R & D investment impact on enterprise performance is not clear, The role of green finance in the two sides needs to be further clarified. Therefore, this paper selects the data of listed companies in the three years from 2019 to 2021, integrates green finance, RESEARCH and development investment and enterprise performance into the unified framework for analysis, and specially studies the regulating role of green finance on R & D investment and enterprise performance, in order to enrich the existing literature research.

2. Theoretical analysis and research hypothesis

(1) Green finance and enterprise performance

In recent years, the financial tsunami has increasingly highlighted the basic role of the real economy. With the continuous adjustment of credit policies, the path selection of China's sustainable development has become the focus of attention, and this issue has also been paid attention to by the government departments. The implementation of the green credit for green enterprise the influence of the overall cash flow and net profit is positive, positive signal to financial markets, influence the financial market resources in the green enterprise and "projects" (high pollution, high emissions) in the enterprise configuration, increase the supply of green enterprise direct financing, thus reduce the cost of direct debt financing (even lily, 2015)[7]. In recent years, with the efficient progress of modernization and urbanization construction, the problem of environmental pollution is increasingly not optimistic. To maintain the national policy of "saving energy" and protecting the environment ", promote the changing new development concept, unswervingly follow the green development path of efficient clean-up, safety and harmony and low-carbon cycle, and promote the basic construction of beautiful homes, has become the only way to integrate into and promote the new normal. As an important external factor for the survival and development of enterprises, the government realizes linkage between government departments and financial departments to share environmental information. The financing cost of banks for heavy polluting enterprises will be significantly higher than that of non-heavy polluting enterprises (Su Dongwei and Lian Lili, 2018)[8]. Because non-heavy polluting enterprises are more able to obtain financial support from the government, with the support of public opinion, to obtain lower financing costs, making it more convenient for enterprises to obtain funds, thus increasing the business performance of enterprises. Based on the above analysis, hypothesis 1 is proposed:

Hypothesis 1: Green finance and non-heavily polluting enterprises are positively correlated.

(2) R & D investment and enterprise performance

Through reasonable increase in R & d investment, so as to improve their production technology and efficiency, and produce better quality and lower cost advantage; through continuous innovation, technology, technology is for better products and services, only with good products can compete, otherwise there is no substantial ability to compete, so technology, products are also the core elements in the competition, should pay attention to, form technical advantage, have more new products, so as to beat the competitors, expand the market, and to a certain extent, monopoly, market. In the process of research, scholars have a positive proportion in the relationship between research investment and enterprise performance, so R & D investment is still very important. By improving the ability of technological innovation, forming a competitive advantage in the market, so that the sales of enterprises can be steadily increased, so that the current surplus will have great room for improvement. In short, to increase the performance, product sales should be guaranteed, among which R & D investment is a strong support for product sales. Therefore, Hypothesis 2 is proposed.

Hypothesis 2: With other relationships unchanged, R & D investment is positively correlated with enterprise performance.

(3) The regulatory role of green finance

Green finance has an important impact on today's enterprise innovation and enterprise performance. Green finance further affects the performance of enterprises through the process of R & D investment. The internal mechanism is mainly due to the capital attribute of green finance itself and the guiding and demonstration effect of green finance policy. R & d process in addition to the human factors, whether research and development instruments, equipment and other "hardware" especially high-end advanced import equipment purchase, or the introduction of high-end complex technology, academic exchange "software" costs need a lot of money to support, green finance with green credit, green bonds, green stock for r & d to provide diversified funding channels. At the same time, green finance, as a policy-oriented mechanism, conveys the future development prospects of the industry to the market, is the strategic vane of the industry, and further promotes the enthusiasm of the financial market to invest in enterprise R & D. Xie Qiaoxin et al. (2021) believe that the development of green finance plays an important role in the decision-making of enterprise R & D investment and the selection of R & D investment direction, and the development of green finance helps to provide strong financing support for enterprises' green R & D investment projects[9]. Therefore, the development of

green finance can promote R & D investment, while R & D investment can promote enterprise performance, and green finance can penetrate into the development of enterprise performance. In order to better explore the relationship among the three, hypothesis 3 is proposed based on the above analysis:

Hypothesis 3: Green finance can improve business performance by promoting R & D investment.

The specific research framework is shown in Figure Figure 11.

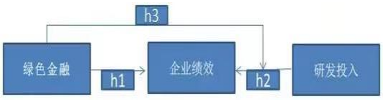

Figure 1 . theoretical model

3. Study design

(1) Samples and data sources

In this paper, the listed companies in Shanghai and Shenzhen are the research subjects, based on the data provided by the annual reports of listed companies from 2019 to 2021, but the data acquisition has some To test hypothesis 1, develop the following model (1):

$$ROA=\alpha_0+\alpha_1*Ent+\alpha_2*Size+\alpha_3*Lev+\alpha_4*Growth+\alpha_5*SF+\alpha_6*Age+\varepsilon$$

To test hypothesis 2, build a model (2):

The following are the important variables measured in this paper:

（1）green finance

According to the existing literature, the common content analysis method of green finance and the green investment method measure the GDP ratio. This paper adopts the practice of Xie Qiaoxin (2021), and measures the coupling and coordination degree of financial development and green development[9].

（2）research input

Generally, the intensity of R & D investment can be measured by the proportion of R & D expenditure in total assets, the proportion of R & D expenditure in the previous operating income, and the proportion of R & D investment in the main business income. According to the actual research in this paper, the r & D investment intensity of Zheng Haiyuan et al. (2018) will represent the proportion of r & d expenses in the average number of total assets at the end of the beginning of the year.

uncontrollable factors, the data must be analyzed, the reasons and selection are as follows: First, in the obtained data projects, some items are incomplete, so such data should be excluded; second, excluding financial enterprises, mainly due to the large differences in economic indicators. Third, because there are more than one shares of listed companies, so A shares are used. Fourth, there is no ST company within the sample data. The data in this paper are mainly obtained from CSMAR and CNRDS databases, and the data are combed in two forms: computer software and manual, the former is mainly SPSS 19 software..0 At the same time, in order to ensure the validity of the data and eliminate the impact of outliers on the study, we treated Winsorize for 1% of the outliers of the sample.

The statistical sample data are shown in Table 1, where a total of 8367 samples were counted.

(2) Model setting and variable definition

After multiple selection, this paper decided to analyze green finance, R & D investment and enterprise performance by multiple regression analysis. The model established in this paper is as follows:

$$ROA=\alpha_0+\alpha_1*RD+\alpha_2*Size+\alpha_3*Lev+\alpha_4*Growth+\alpha_5*SF+\alpha_6*Age+\varepsilon$$

To test hypothesis 3, model: (3):

$$ROA=\alpha_0+\alpha_1*Ent+\alpha_2*Ent*RD+\alpha_3*RD+\alpha_4*Size+\alpha_5*Lev+\alpha_6*Growth+\alpha_7*SF+\alpha_8*Age+\varepsilon$$

（3） Enterprise performance

Generally, return on assets (ROA) or rate of return on shareholders' equity (ROE) can be used to represent the performance of an enterprise. This paper refers to the literature of Sun Voluntary et al. (2019), and takes the return on assets (ROA) as the measure of enterprise performance.

Definitions of the specific study variables are shown in Table Table 1.

Table 1. Definition of the study variables

type of variable	Variable name	variable-definition
explained variable	Enterprise Performance (ROA)	2 * Net profit / (total assets of the enterprise at the beginning of the year + total assets at the end of the year)
explanatory variable	Green Finance (Ent)	The coupling and coordination degree of financial development and green development
	R & D investment (RD)	2 * R & D expenses / (total assets of the enterprise at the beginning of the year + total assets of the enterprise at the end of the year)
controlled variable	Enterprise size (Size)	Natural logarithm of the total assets
	Debt ability (Lev)	Total asset-liability ratio
	Growth ability (G rowth)	increase rate of business revenue
	Equity Concentration Rate (SF)	The largest shareholder shareholding ratio
	Enterprise Age (Age)	The number of years the enterprise is listed

4. Empirical analysis

(1) Descriptive statistics

In this paper, we conduct descriptive statistical analysis of explanatory variables, explained variables and control variables, and also demonstrate the association between the data. The results are shown in Table 2.

Table 2. Descriptive statistical results

	MIN	MAX	MEAN	SD
ROA	-1.859	0.473	0.040	0.076
Ent	-8.994	18.120	0.000	0.627
RD	0.000	0.321	0.020	0.022
Size	17.806	28.520	22.348	1.322
Lev	0.009	1.687	0.419	0.203
Growth	-0.982	87.484	0.280	2.003
SF	0.030	0.890	0.336	0.147
Age	0.000	28	11.01	7.428

As shown in the collation and calculation results of the data in Table 2, the results and standard deviations of the maximum, minimum and mean of enterprise performance (ROA) are 0.473, -1.859,0.040 and 0.076 respectively, indicating that the enterprise performance of the selected enterprises has a small gap. From the perspective of green finance (Ent), the maximum value is 18.120, the minimum value is-8.994, the average tends to 0, and the standard deviation is 0.627, indicating that most of the sample enterprises do not pay much attention to green finance, and the gap between enterprises is large. From the perspective of R & D investment (RD), the gap between the maximum and the standard deviation and the gap between the mean and the minimum value, the maximum value and the standard deviation, and the R & D investment data in the sample enterprises is relatively low, indicating that its intensity is not strong and is still low. The three base values and standard deviation of the maximum and minimum value of the enterprise size (Size) are 28.520, 17.806, and 22.348 and 1.322, It shows that the size of the sample enterprises varies greatly, With the solvency (Lev), -0.194,1.484,0.216 are the minimum value, the maximum value and the deviation of the mean and the standard deviation respectively, Three data by themselves did not show higher levels, The phenomenon of showing negative numbers in the gap, It shows that the asset-liability ratio of most enterprises is still relatively low, There was no insolvency, Strong solvency, But some companies still have more debt than their assets, There is an occurrence of insolvency phenomenon. From the perspective of growth ability (Growth), the minimum value, maximum value, mean value and standard deviation are-0.982,87.484,0.280 and 2.003 respectively. The data show that the growth ability gap is large, and good ability will naturally be better than weak ability and develop rapidly. From the perspective of equity concentration (SF), the minimum value is 0.030, the maximum value is 0.890, the average value is 0.336, and the standard deviation is 0.147, indicating that the gap between the shareholding ratio of the first shareholder is large. From the perspective of enterprise age (Age), there is a big difference between the minimum value, maximum value, mean value and standard deviation of 7.428, indicating that there is still a certain gap in the number of listed years of enterprises.

(2) Correlation analysis

The relevant analysis was conducted based on the above-mentioned hypothesis and then combined with the software to verify the analysis of the variables and related indicators, and the results are shown in Table 3.

Table 3. Correlation analysis

	RO A	Ent	RD	Size	Lev	Growth	SF	Age
RO A	1							
Ent	0.047**	1						
RD	0.166**	0.020	1					
Size	0.014	0.115**	-0.201**	1				

Lev	-0.298**	0.080**	-0.206**	0.526**	1			
Growth	0.028*	0.023*	-0.07	0.013	0.058**	1		
SF	0.140**	0.061**	-0.110**	0.204**	0.072**	-0.032**	1	
Age	-0.111**	0.079**	-0.282**	0.362**	0.328**	0.018	-0.018	1

Note: * * and * indicate the significance levels of 1% and 5%, respectively.

Table 3 shows that corporate performance (ROA) and green finance (Ent) have a significant positive correlation of 1%, which indicates that the better green finance, the higher their corporate performance. Hypothesis 1 has been preliminarily confirmed. There is a significant positive correlation between enterprise performance (ROA) and R & D investment (RD) at a significant level of 1%, which proves that the relationship between enterprise performance and R & D investment is also positively correlated. The greater the R & D investment index, the stronger the higher the enterprise performance. Therefore, Hypothesis 2 has been preliminarily verified. The value of enterprise performance (ROA) and solvency (Lev) is-0.298, indicating a negative correlation at the 1% level. The coefficient value of enterprise performance (ROA) and growth ability (Growth) is 0.028, which is in a positive correlation at the significant level of 1%. That is to say, the better the growth ability index of the enterprise, the better the growth ability and the higher the performance level of the enterprise. The value of enterprise performance (ROA) and equity concentration (SF) is 0.140, showing a positive correlation, but there is a dependent condition, that is, when the significant level is at 1%, that is, the higher the equity concentration of the enterprise, the better the enterprise performance. The coefficient of green finance (Ent) and R & D investment (RD) is 0.020, indicating there is a positive correlation. At the same time, there is also a significant positive correlation between green finance (Ent) and enterprise size (Size), solvency (Lev), growth ability (Growth), equity concentration (SF) and enterprise age (Age). The correlation coefficients are 0.115,0.080,0.023,0.061 and 0.079. In order to more clearly study the correlation between the various variables, the multiple regression model was used to conduct an empirical analysis.

(3) Multiple regression analysis

In order to better confirm the previous hypothesis, the multiple regression model was used, and the results are shown in Table 4. The analysis is as follows:

Table 4. Test results

	(1)	(2)	(3)
Ent	0.006***		0.003**
	(4.978)		(2.274)
RD		0.471***	0.435***
		(16.223)	(12.128)
Ent*RD			0.088***
			(5.257)
Size	0.013***	0.013***	0.013***
	(17.577)	(18.575)	(18.376)
Lev	-0.155***	-0.150***	-0.149***
	(-34.029)	(-32.968)	(-33.003)
Growth	0.002***	0.002***	0.002***
	(5.206)	(5.363)	(5.274)
SF	0.064***	0.073***	0.072***
	(11.832)	(10.296)	(13.270)
Age	-0.001***	0.000**	0.000**
	(-5.367)	(-2.154)	(-2.461)

R2	0.153	0.168	0,172
adj_R2	0.152	0.167	0.171
F	251.233	280.668	217.288
N	8367	8367	8367

Note: (1) * * *, * * and * represent the significant levels of 1%, 5% and 10% respectively; (2) t is the value obtained in parentheses.

From table 4 shows the results, in the model (1), R square and F value of 0.153 and 251.233 respectively, green finance (Ent) before the coefficient of 0.006, enterprise performance (R O A) and green finance (Ent) is certain relationship, but still have certain precondition, is significant level at 1%, the relationship between the two can be clear positive correlation, directly verified the hypothesis 1, make it.besides, Debt paying capacity (Lev), equity concentration (SF) and growth capacity (Growth) are all involved, But also based on certain criteria, Is that when the significant level is at 1%, The coefficients are-0.155,0.064, and 0.002, That the higher the asset-liability ratio, The solvency of the representative will be relatively weakened, The failure of enterprises to effectively repay the debt is bound to affect their performance, So the higher the asset-liability ratio is, The lower the debt repayment, The lower the performance level, The whole picture presents an inverse relationship, And growth ability produces the opposite effect from the previous positive correlation, The same goes for equity concentration, That is, the stronger the growth ability or the higher the equity concentration, Corporate performance will also be going up.

In model (2), the R square is 0.168 and the F value is 280.668. The coefficient before R & D investment (RD) was 0.471, and enterprise performance (R O A) and R & D investment (RD) were significantly positively related at 1%, which again proves that hypothesis 2 is true. Thus indicating that the enterprise R & D investment has a significant role in promoting the performance of enterprises, that is, to improve the intensity of R & D investment in enterprises, the enterprise performance will also improve. From the perspective of control variables, enterprise size (Size), growth ability (Growth), equity concentration (SF) and enterprise performance were significantly positively correlated at 1%, while asset-liability ratio (Lev) and return on assets were significantly negatively correlated at 1%.

Based on the above setting, the cross term Ent * RD is also set, and the data is centralized. In the model (3), the R square is 0.172 and the F value is 217.288. The coefficient before green finance (Ent) is 0.003, the coefficient before R & D investment (RD) is 0.435, and the coefficient before green finance and R & D investment (Ent * RD) is 0.088, so these three items are significantly positively correlated with enterprise performance (ROA) at a significant level of 1%. It can be concluded that green finance can strengthen the role of R & D investment on enterprise performance, that is, Hypothesis 3 has been verified.besides, It can be observed that enterprise size (Size), solvency (Lev), growth capacity (Growth), equity concentration (SF) and enterprise performance (ROA) are significant at 1%, The coefficients are: 0.0138, -0.149,0.002,0.0721, This also illustrates that, to some extent, These control variables can make changes in enterprise performance, And the solvency and enterprise performance show an inverse comparison trend, When the former increases and the latter decreases, And enterprise scale, growth ability and equity concentration are directly proportional to enterprise performance, Explain the improvement of the first three, Will improve enterprise performance.

(4) Robustness test

In order to test the stability of the empirical conclusion of this paper, we start from three aspects: variables, samples and research methods: (1) from the variables, the ROE (return on equity) is used to replace ROA (return on assets).(2) In terms of sample, the sample companies are divided into two groups: Shenzhen and Shanghai according to geographical area; (3) In terms of research method, multiple regression may exist. Considering the above data is a short panel, hausmann test was used. Finally, the random effect was significantly rejected, the fixed effect model was used, and the sample regression was used.(Limited to space, results are not provided in this part) The results found that among the three robustness tests, except for the size of each coefficient and the degree of significance, the direction of each coefficient did not changed and passed the similar significance test, which further shows that the validity of the conclusion of this paper has certain stability.

Five, the conclusion

This paper mainly focuses on a-share listed companies in Shenzhen and Shanghai, and conducts statistical analysis based on the data from 2016-2018. The main statistical analysis is multiple linear regression analysis, descriptive statistical analysis and so on, so as to verify the relationship between green finance, R & D investment and enterprise performance through data. The study found that: (1) green finance has a positive impact on enterprise performance, showing a positive effect, that is, green finance can promote the development of enterprises and improve their performance.(2) There is also a relationship between the R & D investment and the enterprise performance, mainly a positive correlation, that is, the high performance of the enterprise as the R & D investment intensity increases.(3) Green finance has a positive regulating effect between R & D investment and enterprise performance, that is, green finance can strengthen the role of R & D investment in improving enterprise performance.

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