Research on the influence of enterprise innovation input on stock returns in short- and long-term markets-- Based on the data of listed companies in China's science and technology sector

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Abstract. Based on the data of listed companies in China's science and technology sector from 2014 to 2021, this paper studies the short-term market and long-term market performance of innovation input of these companies. The findings are as follows: (1) In the short-term market, innovation input and stock return are negatively correlated, which may be related to the lagging effect of innovation input on the company. After the lagging of innovation input, the correlation becomes positive and significant. This conclusion is still valid after the change of explanatory variables;(2) In the long-term market, enterprise innovation input and stock return generally show positive correlation, but it may also be affected by the bottleneck period of R&D, resulting in the first decrease and then increase, and this phenomenon is still valid after the change of explanatory variables.

Keywords: R&D; stock return; science and technology sector.

1. Introduction

For an enterprise, innovation is a way to improve its competitiveness, but also to promote the development of the economy.At present, we have proposed to speed up the building of a modern economic system and become one of the innovative countries. Our goal is to achieve high-quality development.The key to achieving this goal is to solve the problem of "innovation".A large number of research results show that financial development and enterprise innovation are the core factors affecting the sustainable development of a country's economy.Enterprises are the main body of high-quality economic development. Innovation has become the decisive force for enterprises to grow and enhance their global competitiveness. Research and development ability is an important symbol of a country's comprehensive national strength and an important embodiment of a country's economic development momentum.However, the R&D cycle is long and the return is slow, so whether the impact of R&D investment on enterprise performance is increased or decreased needs further discussion.In addition, since R&D investment is generally regarded as confidential, it leads to the problem of information asymmetry.Whether the announcement of R&D investment will benefit the market performance of enterprises or lead to poor market performance under the excessive attention of investors, after the increase of R&D investment, the technology and innovation ability of enterprises will be improved, which will also affect the valuation and preference of investors, and thus affect their market returns.Since R&D investment is a long-term process and cannot be directly reflected in the short-term return rate, it is of great significance for this paper to study the impact of R&D investment on the stock return in the long-term and short-term markets.

2. Literature Review

Zhang Xueyong and Zhang Yeqing (2016) introduced the factor of venture capital. Using the data of China's, A-share market from 2002 to 2012, they found that companies supported by venture capital and with strong R&D ability had relatively better market performance at IPO point than companies supported by venture capital but with weak R&D ability. This further confirms the view that the excellent IPO market performance of companies supported by venture capital is driven by the inherent innovation ability, and also demonstrates again the influence and importance of R&D ability on IPO after-market performance.Zhou Mingshan et al. (2017) studied the relationship

between enterprise innovation input and stock market performance through the panel data of listed companies on GEM from 2009 to 2014, using the fixed-effect model and from different perspectives of internal and external enterprises, and from two aspects of internal enterprise performance and external investor concern, and investigated the behavioral decisions of management under this relationship. They found that high enterprise innovation input does not lead to higher stock price crash risk;Zhang Zhihong et al. (2020), based on the IPO data of GEM listed companies from 2009 to 2017, investigated the impact of corporate R&D and innovation on IPO market performance, and whether the impact mechanism is different among companies facing different degrees of financing constraints before IPO, and found that R&D and innovation can promote IPO short-term market performance. However, R&D innovation has a promoting effect on long-term market performance, but it gradually weakens as time goes by.However, as mentioned above, for some companies, there is a negative correlation between R&D investment and market return due to the problem of information asymmetry.Hull et al. (2013) constructed R&D manipulation variables to measure R&D investment and found that insufficient R&D investment is related to the reduction of short-term IPO valuation. Zhou Lu et al. (2020) studied the impact of R&D investment on stock price crash risk based on the data of China's non-financial A-share listed companies from 2007 to 2018. The higher the intensity of R&D investment, the greater the risk of stock price crash of listed companies.

3. Theoretical analysis and hypothesis

The influence of innovation input on stock returns in the short and long term can be explored from internal and external perspectives:

In the first case, innovation input affects stock returns by improving the internal performance and comprehensive strength of the enterprise.For an enterprise, R&D can increase its competitiveness, expand its operation and seize the market. Innovation plays an important role in enterprise performance, and stock returns also reflect the market's estimate of enterprise value to some extent.Enterprise R&D is to improve their performance and gain benefits in the market.While some enterprises spend too much on R&D, which leads to heavy liabilities, resulting in the shortage of cash flow and the decline of earnings.

The second is that enterprises disclose innovative information to affect investors' psychology and thus affect stock returns. Investors often buy stocks after seeing good news and push the stock price up, but some enterprises tend to regard the information as confidential in order to avoid competition, which leads to information asymmetry and negative impact.

Considering that R&D is a long-term investment, the response to corporate stock returns may not be timely, and only continuous R&D can have sustained excess returns.At the same time, considering that R&D can have an impact on the long-term development of enterprises, this paper proposes the following hypothesis:

H1: R&D investment has a negative impact on short-term market stock returns

H2: R&D investment has a positive impact on long-term market stock returns

4. Variable definition and model construction

4.1 Samples and data sources

Taking the listed companies in the science and technology sector from 2014 to 2021 as the research samples, the sample with some missing R&D input data was removed, and finally the data of 10,210 sample companies were obtained.The data came from the RESSET database, and was processed by Matlab and stata.

4.2 Definition of Variables

4.2.1 Interpreted variables

Here, the stock return rate of the short-term market(R) is defined as the annual return rate of the stock. For the long-term market performance, according to the regulations of the exchange, as the controlling shareholder and actual controller of the company, the lock-up period of the stock is 36 months after the listing. Therefore, the stock price is relatively stable in these three years, so buy-and-hold extraordinary yield for years 1,2,3, (BHAR) as a measure of long-term market stock yield:

$$BHAR_i = \prod_{i=1}^{T}(1 + R_{it}) - \prod_{i=1}^{T}(1 + R_{mt})$$

Where, R_{it} is the rate of return of company i at time t, and R_{mt} is the market rate of return weighted by circulating market value considering the reinvestment of cash dividends.

4.2.2 Explanatory variables

Enterprise innovation input is measured by the data of enterprise R&D.

Based on previous studies, the data of the company and some factors affecting the stock market are selected as control variables, including return on assets (ROE), earnings per share (EPS), financial leverage (lev), growth ability (growth), turnover rate of total shares in several years (turn) and cash flow (ocf), and individual dummy variables are set.

4.3 Model construction

Construct a model to test hypothesis 1,2:

$$R = \beta_0 + \beta_1 rd + \beta \sum Controls + \varepsilon$$
$$BHAR_t = \beta_0 + \beta_1 rd + \beta \sum Controls + \varepsilon$$

5. Empirical research

5.1 Descripitive statistics

The descriptive statistical analysis of variables is shown in the table below. From the descriptive statistical table, it can be seen that the maximum and minimum values of long-term market stock returns and short-term market short-term returns of enterprises are quite different.The maximum value of cumulative excess return in the long-term market is large, while the minimum value is relatively average, but the average value is small, which indicates that the cumulative excess return of most enterprises is small.From the perspective of short-term market returns, the difference between the maximum value and the minimum value is larger, but the average value is also close to 0, indicating that there is a large difference among companies.From the perspective of enterprise innovation and R&D investment, some listed companies in the science and technology sector did not have any R&D investment during 2014-2021, but from the average value, it can be seen that the average investment of each company is still relatively large, but the standard deviation is very different, indicating that the R&D investment of each company is very different.From the perspective of control variable turnover rate, these enterprises are still relatively active in the market, but from the perspective of growth and cash flow, the difference between each company is obvious.

Table 1. Descriptive statistics of the main variables

Variable	Obs	Mean	Std.Dev.	Min	Max
BHAR1	13008	022.	547.	1.126	14.626
BHAR2	13008	067.	868.	1.661	15.542
BHAR3	13008	057.	1.029	2.567	37.796
R	13008	108.	629.	- 924.	15.211
OCF	13008	158.	37.	13.278	4.342
growth	13008	18.856	142.394	99.709	8269.918
lev	13008	42.896	22.281	978.	499.524
turn	13008	341.32	294.028	3.162	2292.277
EPS	13008	239.	465.	3.4	19.67
ROE	13008	345.	115.817	6971.681	3050.199
RD	13008	2.39 e+08	8.44 e+08	0	2.94 e+10
size	13008	22.204	1.293	17.954	29.885

5.2 Multiple regression analysis

5.2.1 Short-term market stock yield

The following table shows the regression results of enterprise innovation research and development on short-term market stock returns.It can be seen that with or without control variables, R&D input and short-term market stock returns are significantly negatively correlated, which may be because R&D input cannot improve corporate performance and investors' sentiment in the short term, thus affecting stock returns.

At the same time, it can be seen from the table that earnings per share and turnover rate have a significant positive correlation with the short-term market return of stocks.The higher the turnover rate, it means that the market has different expectations for the stock and different value judgment, resulting in a higher return rate in the turnover.This proves hypothesis 1.

As mentioned above, R&D investment is a long-term variable, which may not have an impact on short-term stock returns, so the explanatory variables will be studied by lagging.

From the comparison of the lagged data in the first column and the last three rows, it can be seen that the relationship between R&D input and stock return turns from negative to positive, which is also significant within the 99% confidence interval, and with the increase of the lagged period, the coefficient becomes larger and larger, indicating that the increase of R&D input will have a more obvious impact on stock return with the increase of time.

Table 2. Short-term stock market base regression

	(1)	(2)	(3)	(4)
	R	R	R	R
rd	0.0146***	0.0183***	0.00940*	0.00968*
	(3.35)	(4.19)	(2.24)	(2.31)
OCF		0.0295	0.0135	0.0190
		(1.76)	(0.84)	(1.13)
growth		0.0000801	0.0000880*	0.0000875
		(1.71)	(1.97)	(1.96)
EPS		0.265***	0.320***	0.320***
		(19.06)	(23.87)	(23.87)
ROE		0.000100	0.000120*	0.000118*
		(1.89)	(2.37)	(2.34)
turn			0.000636***	0.000638***
			(31.01)	(31.01)
lev				0.000307
				(1.08)
_cons	0.397***	0.394***	0.00410	0.0135
	(5.00)	(4.96)	(0.05)	(0.18)
N	10210	9944	9933	9933
Individual	yes	yes	yes	yes

Table 3. Lagged regression of short-term stock market

	(1)	(2)	(3)	(4)
	R	R	R	R
rd	0.0632***			
	(5.06)			
OCF	0.0510*	0.0247	0.0179	0.0294
	(2.20)	(0.96)	(0.79)	(0.76)
growth	0.000125*	0.0000787	0.0000986*	0.000159
	(2.47)	(1.52)	(2.37)	(1.90)
turn	0.000793***	0.000779***	0.000486***	0.000578***
	(30.07)	(26.45)	(16.82)	(15.95)
lev	0.00107	0.00182**	0.00288***	0.00306***
	(1.91)	(2.85)	(4.95)	(3.55)
EPS	0.401***	0.418***	0.302***	0.368***
	(18.20)	(16.52)	(10.76)	(10.07)
ROE	0.000182**	0.000180**	0.0000943	0.000113
	(2.77)	(2.59)	(1.54)	(1.40)
L1rd		0.0538***		
		(3.57)		
L2rd			0.190***	
			(13.98)	
L3rd				0.269***
				(13.90)
_cons	0.842***	1.319***	3.736***	5.150***
	(3.71)	(4.83)	(15.25)	(14.85)
N	9933	7736	5880	4168
Individual	yes	yes	yes	yes

5.2.2 Long-term market stock yield

The following paper will analyze the impact of enterprise R&D on long-term market stock returns. The regression results are shown in the table below.

As can be seen from the table, the influence of R&D input on the long-term market excess return fluctuates greatly with the influence of time.The first is the excess return in the first year. Due to the increase of R&D, the market performance is better.However, in the second year, as the R&D investment is still continuously invested but is likely to enter the bottleneck period of R&D investment, the large amount of R&D investment in the early stage may not see very significant results at this time, resulting in the excess income turned positive to negative, and the company's marginal income also declined.In the third year, the coefficient turns positive again, but it is not significant, because in the third year, the new technology and new products brought by innovation and research and development have entered the mature stage, but at this time, the factors affecting

the three-year excess return have become variable and complex, so even if the coefficient is positive, it is not significant.Hypothesis 2 has been proved.

The relationship between the remaining control variables and the long-term market stock returns is similar to that of the short-term market, so it will not be repeated here.

Table 4. Long-term market base regression

	(1)	(2)	(3)
	BHAR1	BHAR2	BHAR3
rd	0.120***	0.0934***	0.00795
	(3.57)	(4.75)	(1.82)
OCF	0.00598	0.0565	0.0304
	(0.38)	(1.68)	(0.74)
growth	0.00000988	0.0000907	0.0000916
	(0.25)	(1.31)	(1.17)
lev	0.000845**	0.00342***	0.00586***
	(3.10)	(4.13)	(5.71)
turn	0.000293***	0.000537***	0.000357***
	(15.30)	(14.09)	(7.34)
EPS	0.0393**	0.0779*	0.0698
	(3.06)	(2.29)	(1.36)
ROE	0.0000125	0.000100	0.0000109
	(0.27)	(1.08)	(0.10)
_cons	0.0646***	1.530***	0.0535
	(3.93)	(4.25)	(0.90)
N	8421	8520	6731
Individual	yes	yes	yes

5.2.3 Robustness test

Replace the explanatory variable R&D input with the proportion of R&D input to total assets (rd1) for robustness test. Due to space constraints in this paper, the regression results of short-term markets are not shown in tables.

Consistent with the results above, in the short-term market, despite the change of explanatory variables, the investment in innovation and research and development of enterprises still presents a significant negative correlation with the stock return rate, and even the coefficient is larger and the significance is also improved.Hypothesis 1 has been proved.

Next, we will examine the robustness of the situation in the long-term market. Due to space constraints in this paper, the regression results of long-term markets are not shown in tables.

As can be seen from the results, the results of robust test are consistent with those above, but the coefficient in the first year is close to 0, the data in the second year becomes insignificant but still negative, and the data in the third year is also positive but not significant as above, and the general trend is still U-shaped.

6. Conclusions

Based on the data of listed companies in the technology sector from 2014 to 2021, this paper studies the impact of innovation input on stock returns in the long- and short-term markets. The findings are as follows: (1) In the short-term market, innovation input and stock return are negatively correlated, which may be related to the lagging effect of innovation input on the company. After the lagging of innovation input, the correlation becomes positive and significant. This conclusion is still valid after the change of explanatory variables;(2) In the long-term market, enterprise innovation input and stock return generally show positive correlation, but it may also be affected by the bottleneck period of R&D, resulting in the first decrease and then increase, and this phenomenon is still valid after the change of explanatory variables.

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