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Examining the Interactive Endogeneity Relationship between R&D Investment and Financially Sustainable Performance: Comparison from Different Types of Energy Enterprises

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Abstract: This paper employs the cluster analysis to classify the energy sector into three types, namely, technology-, capital-, and labor-intensive energy company. It then studies the interactive endogenous relationship between R&D investment and financially sustainable performance and the moderate effect of the executive incentive through three-stage least squares (3SLS) of the simultaneous equations model (SEM). The results show that for the technology-intensive energy company, an increase in the previous period in R&D investment improves the current period of financially sustainable performance, and the improvement in the current period in financially sustainable performance results in a decline in financially sustainable performance in the next period, which demands an increase in R&D investment subsequently. In contrast, for the capital-intensive energy company, R&D investment can significantly improve the financially sustainable performance in the current period, and the improvement in financially sustainable performance can also promote the intensity of next period R&D investment. For the labor-intensive energy company, R&D investment depends on the company's previous period returns, while R&D investment has no significant impact on the financially sustainable performance in the current period and the next period. In addition, the salary incentives for executives have a significant positive moderate effect on the relationship between R&D investment and financially sustainable performance, especially in the technology-intensive energy company, while equity incentives for executives do not show any significant effect in the sample for different types of companies.

Keywords: R&D investment; financially sustainable performance; executive incentive; endogenous relationship; energy enterprises

1. Introduction

Nowadays, the energy system in the world is mainly based on fossil fuels, nuclear energy and hydropower [1,2]. This system has been highly resilient against external shocks over the past few decades, but is facing a variety of challenges at present. In the wake of the 1970s oil crisis and owing to ascending carbon dioxide concentrations in the atmosphere, concerns about the security of supply and the sustainability of the concurrent regime are rising. In addition, after relentless nuclear accidents in Chernobyl in 1986 and Fukushima in 2011, several countries decided to opt out of nuclear power [3]. All of these cases expedite the on-going transformation of the energy system and the strengthening development of renewable energy technologies [4]. One of the driving forces behind this transformation is innovation [5]. Faced with complex environments and the changing market demand, the energy industry should strive to increase investment in innovations [6,7] and explore an effective executive incentive system to enhance its core competitiveness and promote corporate sustainable development [8].

As modern enterprises, most energy companies, however, have a principal-agent problem of ownership-management separation. Shareholders tend to pursue high returns of technological innovation, and realize the long-term development of companies through innovations, and finally achieve the goal of maximizing corporate value [9]. In contrast, managers are more inclined to focus on activities related to short-term interests such as their own salaries and benefits. Therefore, managers are likely to avoid technological innovations in pursuit of short-term benefits due to the characteristics of technological innovation such as uncertainty, high risk, and a long profit cycle [10]. This results in insufficient investment in corporate R&D projects, which is unfavorable to the sustainable growth of energy companies [11]. Therefore, how managers balance the relationship between the short-term profits and the sustainable development becomes a main factor affecting the decision-making of R&D investment.

The existing literature suggests that R&D investment can promote corporate financially sustainable performance [12–14]. However, few studies focus on whether corporate R&D intensity can be maintained, or whether current corporate performance can trigger managers' short-sighted behaviors such as reducing R&D expenditure. According to the principal-agent theory, managers may prefer to have behaviors that are beneficial to their positions and interests but not for the maximization of corporate value in an information asymmetrical environment [10]. Financially sustainable performance appraisal is one of key indicators determining the managers' retention [13,15]. Therefore, the managers usually try to increase corporate profits while cutting costs to achieve current target performance [16]. This phenomenon will undoubtedly induce managers to deliberately reduce the current cash expenditures in R&D investment and other activities with high uncertainties in order to achieve target financial performance, thus jeopardizing the long-term development objectives of the company. Therefore, it is necessary to study the impact of R&D investment on financially sustainable performance and the interactive endogenous relationship between R&D investment and financially sustainable performance.

Managers play a leading role in innovation activities of energy companies. The effective executive incentive mechanism is a critical factor ensuring corporate R&D investment [17]. Since managers' return is mainly derived from the short-term salary income and the salary income depends on the short-term financial performance of the energy companies, managers are often not in favor of R&D projects due to the high risks and uncertainty [18]. Therefore, it is an important choice for shareholders to implement the executive incentive to improve the risk-taking ability and enhance the core competitiveness of energy companies. In recent years, a lot of studies have focused on the impact of equity incentives and salary incentives of executives on R&D investment and financially sustainable performance [19–21], but no consistent conclusions have been drawn. In addition, there is little literature on the interactive endogenous relationship between R&D investment and financially sustainable performance. Some questions need to be asked. Will other production factors impact on the economic returns from point of the view of R&D investment in the energy sector? How is financially sustainable performance reversely reflected by the period and intensity of R&D investment? Are the moderate effects of different types of executive incentive on the relationship between R&D investment and financially sustainable performance consistent? Therefore, all these issues need to be further discussed to expand the research field of innovation performance and beneficial to optimize and update the energy industry structure.

The contribution of this paper is as follows. First, this paper studies the interactive endogenous relationship between R&D investment and financially sustainable performance and focuses on the reverse effect of financially sustainable performance on R&D investment. This will fill the gap of research on the effect of financially sustainable performance on R&D investment in the existing literature. Secondly, we explore the moderate effect of different types of executive incentive on the relationship between R&D investment and financially sustainable performance. Finally, the three-stage least square method (3SLS) of the simultaneous equation method (SEM) is employed in this paper. This can not only control the endogeneity of variables but also exclude the subjectivity of the choice of instrumental variables to make the empirical results more realistic and robust. The second part presents a literature review and the hypotheses, and the third part contains the methodology. The fourth part is the empirical results, and the final part is the conclusions and suggestions.

2. Literature Review and Hypotheses

2.1. Relationship between R&D Investment and Financially Sustainable Performance

The direct target of innovation investment is to obtain profits, and enterprises introduce new production technology to improve financially performance and achieve excess returns. Most studies have shown that innovation investment has a significant positive effect on corporate performance. Stam and Wennberg [22] found that innovation investment improves the performance of start-up high-tech enterprises. Yunis et al. [23] found that there is a significant positive correlation between innovation investment and enterprise performance. However, some scholars argued that there is a non-significant positive relationship between innovation investment and corporate performance. Rosenbusch et al. [24] investigated the relationship between innovation investment and corporate performance in high-tech enterprises and found that there is a weak negative correlation between them. Hsu et al. [25] found that there is an inverted U-shaped relationship between innovation intensity and enterprise performance under the control of technical indicators. Naranjo-Valencia et al. [26] found that although there is a significant positive correlation between innovation investment and corporate performance, there is no significant relationship between the number of innovation personnel and corporate performance.

In terms of the lag effect of innovation investment, Ciftci and Cready [27] found that innovation investment is positively correlated with the company's future profit, and significantly positively correlated with the change in stock price lagging by one year, but not with the change in stock price in the current period. Falk [28] found that there is a significant positive correlation between innovation investment intensity and sales growth rate of lagging two periods, but this positive effect gradually decreases with time. Zabala et al. [29] explored the impact of innovation investment on financially sustainable performance from the perspective of property right heterogeneity. The results show that innovation investment has a positive impact on current period financial performance, and the positive correlation between innovation investment and lag financial performance gradually decreases.

Most of the existing literature measures financial performance directly by the indicators such as return on total assets and return on net assets, lacking distinction between short-term performance and long-term performance. The R&D period of the energy industry is long [30], and the corporate profitability indicator is hard to reveal the effect of technological innovation in the short term. In the meantime, because the short-term financial performance is related to the performance assessment of the management, the management will choose less innovation investment to pursue corporate profits for their own interests driven by the psychology of risk aversion. Therefore, the short-term performance of innovation investment is difficult to improve rapidly, while the improvement in long-term performance and value of technological innovation could be more significant.

2.2. The Impact of Executive Incentive on R&D Investment and Financially Sustainable Performance

According to the principal-agent theory, managers will not only pursue the goal of monetary income, but also obtain some non-monetary income. In a relatively perfect market environment, investors can establish a portfolio to avoid risks, while executives cannot disperse their human capital to obtain portfolio income, and only use operation performance in exchange for short-term returns such as compensation and benefits. Therefore, the management, especially the risk-averse management, will focuses on the projects that can improve the short-term performance, avoid the innovative R&D projects with high uncertainty, and adopts the appropriate incentive and constraint mechanism. For the executives, the key is to increase their innovation investment and improve the sustainable performance.

In terms of salary incentive, most scholars believed that salary incentive is positively related to financial performance, and it will strengthen the role of innovation investment in promoting sustainable performance. Coles et al. [31] found that salary incentive could effectively solve the principal-agent problem and enhance the motivation of management to engage in venture capital projects. Jacobsen and Andersen [32] found that salary incentives improve corporate performance significantly and positively moderate the relationship between innovation investment and corporate performance. However, some studies demonstrated that there is no significant positive correlation between salary incentive and corporate performance. Lui et al. [33] found that innovation investment has a significant positive effect on financial performance, and the positive moderate effect of equity incentive is excellent, but the moderate effect of salary incentive is poor. Lu et al. [34] found that there is an inverted U-shaped relationship between salary incentive and innovation investment.

In terms of equity incentive, Fong [35] believed that executive ownership can significantly increase the investment in innovation projects to improve the enterprise innovation level. The "interest alignment hypothesis" proposed by Jensen and Meckling [36] holds that with the increase in the proportion of executives' shareholding, the consistency of their own interests and corporate interests will also be improved. Therefore, equity incentives are conducive to reducing the first type of agency problem between shareholders and managers and urging executives to increase innovation investment to improve financial performance. Xu et al. [37] found that equity incentives can significantly moderate the positive correlation between innovation investment and financially sustainable performance. However, some scholars believed that the relationship between innovation investment and corporate performance is non-linear or even negative under the moderator of equity incentive. Alessandri and Pattit [38] found that salary incentives have a moderate negative effect on the relationship between innovation investment and financially sustainable performance, while equity incentives have a moderate positive effect. Zattoni and Minichilli [39] found that equity incentives do not improve financially sustainable performance. They argued that improving the corporate governance mechanism is an essential way to promote development of the equity incentive system. Polder and Veldhuizen [40] found that equity incentives are positively related to financial performance, but have an inverted U-shaped relationship with innovation investment.

The existing research has not formed a unified conclusion on the moderate mechanism of executive incentives between innovation investment and financially sustainable performance. The reasons could be as follows: first, the research objects are quite different, as some scholars select the whole industry enterprises as samples, while other studies take state-owned enterprises, private enterprises, high-tech enterprises as samples. Second, the application of executive incentive mechanisms in China is short, which may have a deviation on the impact of innovation investment and financial performance. Finally, there are gaps in the R&D cycle and innovation risks in different industries, and the moderate effects of executive incentives are also different. Therefore, the research on the effect of executive incentive and innovation investment in the energy industry needs further analysis.

2.3. Hypotheses

Since Schumpeter [41] proposed the innovation theory, innovation performance has been a research hotspot. Innovation investment not only improves the core competitiveness of the enterprise, but also significantly improves the productivity of the enterprise [42]. Meanwhile, it brings new products or new technology to the enterprise, which makes the enterprise operate differently and beneficially to improve the market share of the enterprise. On the one hand, due to the long cycle and uncertainty of innovation and R&D, especially in the field of advanced technology, the economic returns brought by innovation investment may lag many operation years [43], but in the long run, its cumulative effect will significantly promote the improvement in enterprise performance. On the other hand, based on the principal-agent theory and the management defense hypothesis, the decision-making behavior of management is subject to annual performance appraisal, while high-risk innovative projects may lead to higher R&D expenditure. To pursue the improvement of financial performance during the term of office, management may limit the scale of R&D expenditure, resulting in short-sighted behavior of self-interest, which is not conducive to the long-term development of enterprises. Therefore, this paper argues that there is an endogenous relationship between corporate innovation investment and sustainable financial performance.

As different industries have different forms of R&D, the extent of performance improvement brought by innovation investment will be different. For technology-intensive energy enterprises, their development is based on technological innovation, which is the source of enterprise life, thus the input-output benefit of innovation is obvious; for capital-intensive energy enterprises, scale effect should be an important strategy for their development; and for labor-intensive energy enterprises, service mode change and management process innovation could bring more profits for enterprises. This leads to the phenomenon of some enterprises investing a lot in innovation while others do not have R&D activities. Therefore, it is necessary to analyze the relationship between innovation investment and financial performance from the industry level. Based on the above analysis, this paper proposes the following hypotheses:

H1: *Innovation investment has a positive effect on financially sustainable performance, and this effect is the most significant in technology-intensive energy enterprises*.

H2: *There is an interactive endogenous relationship between innovation investment and financially sustainable performance, and financially sustainable performance has a reverse effect on innovation investment, and the reverse effect is the most significant in technology-intensive energy enterprises*.

From the perspective of the principal-agent theory, the management will adopt the egoism behavior that pays attention to the short-term economic benefit based on their own interest, and ignore or avoid the innovative RD investment that has risk uncertainty but is helpful to improve the sustainable operation ability of enterprises. Therefore, enterprises must implement some incentive policies to enhance the motivation of management to make innovative RD decisions, such as increasing short-term compensation returns or implementing equity incentive plans, so that their personal interests and the company's interests converge. Based on the above analysis, this paper proposes the following hypotheses:

H3: *Salary incentives have a significantly positive moderating effect on the relationship between RD investment and financially sustainable performance*.

H4: *Equity incentives have a significantly positive moderating effect on the relationship between RD investment and financially sustainable performance*.

3. Proposed Methodologies

3.1. Energy Enterprises Background

With the continuous development of the economy, the production factor density is widely used in the research field of enterprise classification. It was first proposed by Heckscher and Ohiln in H-O theory [44], which mainly refers to the degree of influence on production and management activities and the degree of dependence on various production input factors in the production process. The classification method of production factor intensity categorizes enterprises into three types, including technology-intensive, labor-intensive and capital-intensive enterprises. This classification could not only reveal the productivity and resource advantages of enterprises, but also reflect the changes in the proportion of production input factors brought about by technological progress.

Technology-intensive enterprises refer to enterprises with large investment in technical knowledge, high costs for RD, high cultural and technical level of workers, and high added-value of products, including, for example, renewable energy enterprises; capital-intensive enterprises refer to enterprises with large investment capital and great influence on production and operation activities, including, for example, electric power enterprises; labor-intensive industries refer to enterprises with large labor input and great influence on production and operation activities, including, for example, coal enterprises.

3.2. Data Source

Based on the CSMAR database, this paper collected data from the energy sector in the stock market. The executive incentive data and enterprise financial performance data were all from the CSMAR database; the RD investment data were obtained from the annual reports of each enterprise; some missing data of financial indicators were obtained through the sorting of the Tonghuashun database; and other relevant missing data were obtained from the WIND database and www.cninfo.com.cn. The statistical analysis was performed using Stata and Excel statistical software.

We used Ward linkage method in the cluster analysis to classify samples. According to the proportion of fixed assets, enterprises with a larger proportion of fixed assets belong to the capital-intensive companies, indicating that the capital is of higher importance. In terms of the RD expenditure-salary ratio, enterprises with higher ratios belong to the technology-intensive companies, indicating that the technological is of higher importance and others belong to the labor-intensive companies.

3.3. Variables

3.3.1. Financially Sustainable Performance

The existing literature focusses on financially sustainable performance from different perspectives and there is no unified conclusion based on measurement methods. Different measurement methods have their own advantages and disadvantages. Considering the data characteristics and the comprehensiveness of the evaluation indicators, we used the factor analysis method to measure financially sustainable performance. According to the article by Sher and Yang [45], this paper divided financially sustainable performance into two dimensions: short-term profitability and long-term development capacity.

- Short-term profitability (STP). Profitability refers to the ability of a company to make a profit. The fundamental goal of a company's survival is to obtain profits. The acquisition of profits is the guarantee of the realization of investors' interests and the basis for the sustainable growth of companies [46]. If the company has a lower profitability, and even suffers from continuous losses, the survival of the company will be threatened. The high-quality profitability is the basis for the company to maintain its sustainable growth. In this paper, the measurement of profitability is mainly based on some financial performance indicators, namely total return on assets (ROA), return on net assets (ROE), and operating profit margin (OPM).
- Long-term development capacity (LTD). The existing literature has argued that managers are concerned about the improvement of business performance [47–49], while investors are more inclined to realize the long-term profit [50]. Therefore, this paper selects three indicators, including net profit growth rate (NPGR), earnings per share growth rate (EPS), and total asset growth rate (TAGR), as the measurement indicators of the company's long-term development capacity.

First, we performed KMO and Bartlett tests on the sample data. The results show that the value of KMO is 0.695, which is greater than 0.5, indicating that the factor analysis method is appropriate. The Bartlett test has a p value of 0.000, which also indicates that the sample data are valid for factor analysis. Second, we extracted the common factor and performed dimension reduction of the principal components. The results are shown in Table 1. The cumulative contribution rate of the two principal component factors reached 90.119%, indicating that the indicator system retains most information of original variables. Finally, we established a load matrix for the two principal components factors.

The results are shown in Table 2. Then we built the following comprehensive indicators of short-term profitability and long-term development capacity.

$$STP = (0.893ROA + 0.842ROE + 0.851OPM)/3 \quad (1)$$

$$LTD = (0.961EPS + 0.907NPGR + 0.912TAGR)/3 \quad (2)$$

Table 1. Total variance explained.

Component	Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	3.162	56.102	56.102
2	2.934	34.017	90.119

Table 2. Rotated component matrix.

Factors	Component	
	1	2
EPS	0.037	0.961
NPGR	0.015	0.907
TAGR	0.012	0.912
ROA	0.893	0.057
ROE	0.842	0.059
OPM	0.851	−0.019

3.3.2. RD Investment

The RD investment includes a series of investments such as scientific and technological talents, RD funds, and mechanical equipment. We follow Cumming et al. [51] and used the proportion of RD expenditure in operating revenue to represent RD investment.

3.3.3. Executive Incentives

This paper defined enterprise executives as all supervisors, directors, managers, presidents, and board secretaries [37]. The long-term equity incentives (EI) are represented by the sum ratio of executives' shareholdings (in millions RMB). The short-term salary incentives (SI) are represented by the total annual salary of executives.

3.3.4. Control Variables (C)

This paper mainly considered the following variables: the company size (Size), leverage ratio (Lev), ownership concentration (Own), the nature of ownership (State), the proportion of independent directors (Indep), board size (BS), industrial (Industry) and annual (Year) fixed effect [52–54].

3.4. Modeling

This paper used the simultaneous equations method to test the relationship between RD investment and financially sustainable performance and performs 3SLS to build Models (3)–(6).

$$RD_{i,t} = a_0 + a_1 STP_{i,t} + a_2 STP_{i,t-1} + a_3 STP_{i,t-2} + \theta_l \sum\nolimits_{i=1}^{i=l} C_{i,t} + \mu_{i,t} \quad (3)$$

$$RD_{i,t} = a_0 + a_1 LTD_{i,t} + a_2 LTD_{i,t-1} + a_3 LTD_{i,t-2} + \theta_l \sum\nolimits_{i=1}^{i=l} C_{i,t} + \mu_{i,t} \quad (4)$$

$$STP_{i,t} = \beta_0 + \beta_1 RD_{i,t} + \beta_2 RD_{i,t-1} + \beta_3 RD_{i,t-2} + \theta_m \sum\nolimits_{i=1}^{i=m} C_{i,t} + \varepsilon_{i,t} \quad (5)$$

$$LTD_{i,t} = \beta_0 + \beta_1 RD_{i,t} + \beta_2 RD_{i,t-1} + \beta_3 RD_{i,t-2} + \theta_m \sum_{i=1}^{i=m} C_{i,t} + \varepsilon_{i,t} \quad (6)$$

To examine the impact of executive incentive on the relationship between RD investment and financially sustainable performance and avoid the endogenous interaction between RD investment and financially sustainable performance, we used the dependent variable of the lag period and the interaction term between RD investment and executive incentive to explore the impact of executive incentive. Then, Models (7) and (8) were created as follows.

$$STP_{i,t} = \gamma_0 + \gamma_1 RD_{i,t-1} + \gamma_2 RD_{i,t-2} + \gamma_3 SI_{i,t-1} + \gamma_4 EI_{i,t-1} + \gamma_5 INI_{i,t-1} * SI_{i,t-1} + \gamma_6 RD_{i,t-1} * EI_{i,t-1} + \theta_n \sum_{i=1}^{i=n} C_{i,t} + \varphi_{i,t} \quad (7)$$

$$LTD_{i,t} = \gamma_0 + \gamma_1 RD_{i,t-1} + \gamma_2 RD_{i,t-2} + \gamma_3 SI_{i,t-1} + \gamma_4 EI_{i,t-1} + \gamma_5 RD_{i,t-1} * SI_{i,t-1} + \gamma_6 RD_{i,t-1} * EI_{i,t-1} + \theta_n \sum_{i=1}^{i=n} C_{i,t} + \varphi_{i,t} \quad (8)$$

4. Results, Nalyses and Discussion

4.1. Descriptive and Correlation Analysis

The descriptive analysis results are shown in Table 3. To eliminate the influence of extreme values, this paper uses the Winsorize method to deal with continuous variables according to 1% and 99%. The results in Table 3 demonstrate that the mean of RD investment is 0.031, indicating that the RD investment of enterprises is insufficient. The mean of salary incentives is 6.14 million RMB, but the difference between the minimum value and the maximum value is large, which shows that there is a significant difference in executive incentives. The mean of equity incentive is 0.105, but there are also extreme cases in which managers have no shares or executives hold more than 0.721 shares. Therefore, Chinese energy enterprises have implemented different equity incentives.

Table 3. Descriptive analysis.

Variables	Mean	Std.	Min.	Max.
STP	0.124	0.085	−0.639	1.145
LTD	0.261	0.552	−0.874	3.814
RD	0.031	0.035	0.001	0.195
SI	6.14	7.415	0.601	32.457
EI	0.105	0.251	0.000	0.721
Size	21.817	1.441	17.632	24.502
Lev	0.541	0.198	0.095	0.915
Own	0.351	0.154	0.025	0.751
State	0.623	0.474	0.000	1.000
Indep.	0.359	0.055	0.094	0.805
BS	2.251	0.233	1.421	2.941

The correlation analysis results are shown in Table 4. The Spearman correlation coefficient between RD investment and financially sustainable performance (STP, LTD) is significantly positive at the levels of 1% and 5%, respectively, while Pearson correlation coefficient is not significantly negative, which indicates that RD investment and financially sustainable performance may not be a one-way relationship, and their relationship needs further study. In terms of executive incentives, salary incentives and equity incentives are positively related to short-term profitability and long-term development capacity, which shows that executive incentives are conducive to the improvement of financially sustainable performance. In addition, there is no significant correlation between salary incentives and equity incentives, which helps to examine the role of the two in Models (7) and (8). The other correlation coefficients in Table 4 are small, indicating that there is no multicollinearity between variables.

Table 4. Spearman and Pearson correlation analysis.

Variables	STP	LTD	RD	SI	EI	Own	State	Indep.	BS
STP	1	0.281 **	0.171 **	0.352 ***	0.253 **	0.069 **	−0.254 **	−0.064 **	−0.015
LTD	0.321 *	1	0.143 ***	0.315 **	0.103 **	0.072 **	−0.175 **	−0.075 **	−0.038
RD	−0.007	−0.015	1	0.061 **	0.95 ***	−0.103 **	−0.148 **	0.003	−0.077 **
SI	0.197 ***	0.088 *	0.035 ***	1	0.081	0.064 **	0.015	−0.025	0.225 ***
EI	0.087 *	0.095 ***	0.009 *	−0.038	1	−0.105 **	−0.227 **	0.037 *	−0.037 *
Own	0.077 ***	0.125 *	−0.062 **	0.041*	−0.013	1	0.284 **	0.019 ***	0.038 ***
State	−0.127 ***	−0.081 **	−0.076 **	−00.51 **	−0.415 ***	0.351 **	1	0.018	0.161 ***
Indep.	−0.067 **	−0.215 **	0.015	0.043 **	0.027	0.035	0.035	1	0.035
BS	0.013	0.027	−0.041 **	0.271 **	−0.051 *	0.059 **	0.171 **	−0.391 **	1

Note: The upper and lower triangle are Spearman and Pearson correlation coefficient, respectively; ***, **, * Significant at 1%, 5%, and 10% levels, respectively.

4.2. Endogenous Test

The above analysis shows that executives could improve the current period performance through reducing RD innovation expenditure. However, the increase in RD investment will inevitably enhance the market competitiveness of energy enterprises, thus improving the financially sustainable performance. Therefore, there may be an endogenous relationship between RD investment and financially sustainable performance, which leads to the endogenous deviation in the results of the ordinary least square method. Therefore, this paper first tests the endogeneity of these two variables. We employed the Hausmann endogeneity test, and the results are shown in Table 5. ε_1 and ε_2 are the residuals obtained by linear regression of all exogenous variables with RD investment in Equations (3) and (4), respectively. Then this paper introduces them into Equations (5) and (6), respectively. The regression coefficients are −2.808 and −2.359, respectively. The coefficients significance shows that there is an endogenous relationship between RD investment, short-term profitability and long-term development capacity. Therefore, we need to use simultaneous equation model to estimate the relationship between RD investment and financially sustainable performance.

Table 5. The results of the Hausman test.

Item	Coefficient	*p* Value	Adj-R^2
ε_1	−2.808	0.000	0.225
ε_2	−2.359	0.000	0.248

4.3. Regression Analysis of Full Samples

The full sample regression results in Table 6 show that, from the perspective of the relationship between RD investment and financially sustainable performance, the results of 3SLS estimation are partially opposite to those of ordinary least square (OLS) estimation, because OLS estimation does not solve the endogenous problem. The 3SLS estimation could effectively solves the endogenous problem of RD investment and financially sustainable performance. In the aspect of RD investment affecting financially sustainable performance, the results show that the current period's RD investment has a significant negative impact on short-term profitability and long-term development capacity, which means that the increase in RD expenditure in the current period will reduce profits. Meanwhile, RD investment in lag period I and II has a positive impact on the current period's financially sustainable performance, but the coefficient is not significant. The reason could be that different types of RD project produce actual economic benefits at different times.

Table 6. The results of three-stage least square (3SLS) and ordinary least square (OLS) regression based on the full sample.

	3SLS Estimation				OLS Estimation			
Equation	(3)	(4)	(5)	(6)	(3)	(4)	(5)	(6)
Variables	RD	RD	STP	LTD	RD	RD	STP	LTD
STP_t	0.401 ** (2.43)				−0.054 *** (−3.43)			
STP_{t-1}	−0.559 *** (−5.07)				0.055 *** (2.65)			
STP_{t-2}	−0.122 *** (−2.59)				−0.018 (−0.97)			
LTD_t		0.851 * (2.86)				−0.077 *** (−4.34)		
LTD_{t-1}		−0.423 ** (−6.51)				0.088 *** (3.34)		
LTD_{t-2}		−0.357 *** (−2.65)				−0.127 (−2.34)		
RD_t			−1.275 *** (−2.85)	−1.605 ** (−4.51)			−0.132 (−1.19)	−0.325 (−2.35)
RD_{t-1}			0.243 (0.95)	0.354 (1.25)			−0.094 −0.65)	−0.116 (−1.54)
RD_{t-2}			0.087 (0.63)	0.151 (0.89)			0.087 (0.85)	0.145 (3.23)
_Cons	0.802 (0.35)	0.205 (0.39)	−0.035 (−0.51)	−0.157 (−0.45)	−0.051 (−0.34)	−0.203 (−0.74)	−0.327 ** (−7.24)	−0.536 ** (−9.28)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year and Industry Fixed Effects	-	-	-	-	Yes	Yes	Yes	Yes
N	1520	1520	1520	1520	1520	1520	1520	1520
R^2	0.343	0.359	0.466	0.472	0.457	0.455	0.445	0.447
Adj. R^2	-	-	-	-	0.431	0.427	0.419	0.424

Note: ***, **, * Significant at 1%, 5%, and 10% levels, respectively; () of 3SLS estimation and () of OLS estimation represent z value and t value, respectively.

In the aspect of financially sustainable performance reverse affecting RD investment, the short-term profitability and long-term development capacity of the current period are positively correlated with RD investment, while the lag period I and II of short-term profitability and long-term development capacity are negatively correlated with RD investment. This shows that RD investment decision-making has a time lag. In the case of better financially sustainable performance in the current period, the company lacks motivation for future RD innovation. On the contrary, poor financially sustainable performance in the current period will promote RD investment. At this stage, we believe that financially sustainable performance lags behind RD investment, so it is less likely that financially sustainable performance will reverse affect RD investment. Therefore, this is only a measurement result and has no practical significance.

4.4. Regression Analysis of Different Type Energy Companies

The results of 3SLS estimation for different types of energy companies are shown in Table 7. For technology-intensive energy companies, the short-term profitability and long-term development capacity of lag period I and II are significantly negative correlated with RD investment. The RD investment in lag period I and II has a positive impact on the short-term profitability and long-term development capacity. The coefficient of lag period I is significant at the level of 1%, and has a significant negative correlation with the short-term profitability and long-term development capacity of the current period. This means that the economic benefits of RD investment have an obvious lag effect, which is consistent with the characteristics of technology-intensive energy companies. In addition, the current RD investment has a negative impact on the financially sustainable performance.

Table 7. The results of 3SLS regression based on industry.

Industry	Technology				Capital				Labor			
Equation	(3)	(4)	(5)	(6)	(3)	(4)	(5)	(6)	(3)	(4)	(5)	(6)
Variables	RD	RD	STP	LTD	RD	RD	STP	LTD	RD	RD	STP	LTD
STP_t	1.417 ***				−0.247 ***				−0.325 ***			
	(3.81)				(−2.86)				(−4.17)			
STP_{t-1}	−0.445 **				0.145 ***				0.421 **			
	(−2.25)				(3.49)				(1.28)			
STP_{t-2}	−0.559 ***				−0.035				−0.031			
	(−4.91)				(−1.71)				(−0.35)			
LTD_t		0.1384 **				−0.255 **				−0.401 **		
		(3.94)				(−3.17)				(−5.51)		
LTD_{t-1}		−0.543 **				0.135 **				0.243 **		
		(−6.92)				(3.16)				(2.51)		
LTD_{t-2}		−0.635 **				−0.015				−0.024		
		(−5.48)				(−1.16)				(−0.05)		
RD_t			−0.323 **	−0.441 ***			10.914 **	4.151 ***			0.354	0.404
			(−2.85)	(−5.25)			(3.42)	(1.73)			(0.35)	(0.59)
RD_{t-1}			0.197 ***	0.235 ***			−8.013 **	−5.509 **			−1.141	−1.245
			(2.79)	(3.57)			(−2.81)	(−2.15)			(−1.24)	(−2.05)
RD_{t-2}			0.085 *	0.115 *			−5.124 **	−4.619 **			0.367	0.465
			(1.75)	(2.36)			(−2.62)	(−3.65)			(0.72)	(1.35)
_Cons	−0.149	−0.045	−0.027	−0.029	0.015	0.015	−0.941 *	−0.345 *	−0.512 **	−0.135 *	−0.159	−0.175
	(−0.36)	(−0.39)	(−0.54)	(−0.65)	(0.08)	(0.16)	(−2.53)	(−4.17)	(−3.05)	(−4.25)	(−1.24)	(−2.23)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	630	630	630	630	380	380	380	380	510	510	510	510
R^2	0.278	0.275	0.359	0.351	0.277	0.279	0.355	0.346	0.439	0.447	0.242	0.235

Note: ***, **, * Significant at 1%, 5%, and 10% levels, respectively; () of 3SLS estimation represents z value.

For the capital-intensive energy companies, the result is quite different from that of technology-intensive energy companies. The short-term profitability and long-term development capacity of lag period I are significantly positively correlated with the current period's RD investment. RD investment in the current period has a significant positive impact on short-term profitability and long-term development capacity. The input is proportional to the output, which is also in line with the characteristics of capital-intensive energy company. However, the RD investment in the lag periods I and II significant restrains the short-term profitability and long-term development capacity of the current period, which may be due to the increase in the depreciation and amortization ratio brought by the RD investment in the previous period, thus reducing the enterprise's revenue.

For labor-intensive energy companies, the short-term profitability and long-term development capacity of lag period I have a significant positive correlation with RD investment at the level of 10%, which is similar to capital-intensive energy companies. Only with better financially sustainable performance in the previous stage can energy companies invest their profits in future RD. There is no significant correlation between RD investment and short-term profitability and long-term development capacity, which could be related to low RD investment and innovation efficiency of labor-intensive energy companies.

4.5. The Moderating Effect of Executive Incentives

RD investment and executive incentives in the lag period are used as independent variables and introduced into Equations (7) and (8). The results are shown in Table 8. In the context of the full sample, the RD investment in the lag period has a positive effect on short-term profitability, and the impact in the lag period I is significant, which is consistent with the previous results. After the introduction of the interaction between the lag period executive incentives and RD investment, it is found that salary incentives could significantly improve the short-term profitability and long-term development capacity, and the interaction term coefficient with RD investment is also significantly positive, which means that salary incentives can promote the increase in the previous period's RD investment. It has a positive moderate effect on the relationship between RD investment and financially sustainable performance.

Table 8. The moderating effect of executive incentive based on industry.

Industry	Full Sample		Technology		Capital		Labor	
Equation Variables	(7) STP	(8) LTD	(7) STP	(8) LTD	(7) STP	(8) LTD	(7) STP	(8) LTD
RD_{t-1}	0.087 *	0.085 *	0.076 **	0.081 **	−0.285	−0.403	−0.874 *	−0.805 *
	(1.71)	(2.52)	(2.37)	(2.53)	(−0.56)	(−0.65)	(−2.17)	(−2.35)
RD_{t-2}	0.065	0.047	0.162 **	0.225 **	−0.138	−0.131	0.068	0.091
	(1.45)	(0.72)	(2.51)	(4.36)	(−0.27)	(−0.27)	(0.15)	(0.28)
SI_{t-1}	0.135 ***	0.614 **	0.118 *	0.157 *	0.057 *	0.078 *	0.017	0.054
	(3.81)	(6.41)	(1.85)	(1.41)	(0.75)	(0.88)	(0.24)	(0.59)
EI_{t-1}	−0.061	−0.085	0.016	0.082	−0.028	−0.015	−0.085	−0.046
	(−0.81)	(−2.45)	(0.29)	(0.51)	(−0.14)	(−0.07)	(−1.26)	(−1.41)
RD_{t-1} * SI_{t-1}	1.704 *	1.857 **	2.512 **	2.241 **	1.573 ***	1.331 **	1.831 ***	1.803 **
	(1.71)	(2.85)	(2.67)	(2.46)	(2.27)	(4.24)	(3.14)	(2.51)
RD_{t-1} * EI_{t-1}	2.253	1.385	0.853	0.827	0.825	0.816	6.143 **	5.046 ***
	(1.82)	(1.45)	(0.35)	(0.54)	(0.19)	(0.17)	(2.18)	(2.51)
_Cons	−0.095 **	−0.547 *	−0.048	−0.064	−0.288 **	−0.245 *	−0.159 *	−0.251
	(−1.94)	(−6.58)	(−0.57)	(−0.63)	(−2.34)	(−2.25)	(−1.65)	(−1.74)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year and Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1520	1520	630	630	380	380	510	510
R^2	0.379	0.378	0.445	0.447	0.469	0.452	0.415	0.413
Adj. R^2	0.332	0.335	0.427	0.392	0.392	0.384	0.338	0.345

Note: ***, **, * Significant at 1%, 5%, and 10% levels, respectively; () of OLS estimation represents t value.

In the context of the enterprise level sample, the technology-intensive energy companies further verify the role of salary incentives. However, for the capital-intensive energy companies and labor-intensive energy companies, although the lag period RD investment may inhibit the current period's financially sustainable performance due to depreciation and amortization, the salary incentive still plays a catalytic role, which can significantly moderate the positive impact of RD investment on short-term profitability and long-term development capacity. However, for equity incentive, no matter the full sample or the enterprise level sample, RD investment has no significant impact on short-term profitability and long-term development capacity.

5. Conclusions and Policy Implications

The results demonstrate that the previous period's sustainable financial performance has a significant negative impact on the current period RD investment. Meanwhile, the current period's RD investment has a significant negative impact on the current period's financially sustainable performance, while the previous period's RD investment has a positive impact on the current period's financially sustainable performance with no significant level. In the context of different types of energy company, for technology-intensive energy companies, the previous period's financially sustainable performance has a significant negative impact on the current period RD investment. For capital-intensive energy companies, the result is the opposite compared to technology-intensive energy companies. The financially sustainable performance in the previous period is positively correlated with the RD investment in the current period, and the RD investment in the current period is significantly positively correlated with the financially sustainable performance in the current period. However, the previous RD investment has a significant negative impact on the current period financially sustainable performance. For labor-intensive energy companies, the impact of financially sustainable performance on RD investment is similar to that of capital-intensive energy companies, while the positive effect of RD investment on financially sustainable performance is not significant.

In the moderate effect of executive incentives, salary incentives could significantly improve financially sustainable performance, and has a moderate positive effect on RD investment and on financially sustainable performance. In the context of different types of companies, for technology-intensive energy companies, salary incentives can improve the executive motivation of RD investment and enhance the future profitability of the company. For capital-intensive energy companies and labor-intensive energy companies, although the previous period's RD investment may have a negative impact on the current period's financially sustainable performance, the increase in executive incentives is conducive to the smooth operation of energy companies and the improvement of financially sustainable performance. Therefore, this paper believes that salary incentives have a significant positive moderate effect on the relationship between RD investment and financially sustainable performance. In contrast, equity incentives are not significant in the regression results of the full sample, which means that equity incentives have no significant moderate effect on the relationship between RD investment and financially sustainable performance.

The implications of this paper are as follows: first, energy enterprises should improve their incentive mechanisms for executives—on the one hand, improving the level of salary incentives could stimulate managers' motivation to serve the company, and on the other hand, improving the level of equity incentives can reduce the conflict of interests between managers and shareholders and improve energy enterprise's financially sustainable performance by reducing the managers' short-sighted behavior and the cost of principal-agent problems. Second, energy companies should enhance their awareness of technological innovation and increase RD investment. In the increasingly fierce market competition, although technological innovation activities are uncertain and high-risk, most scholars believe that RD investment can bring sustainable growth to enterprises. Innovation-oriented energy enterprises have greater potential for sustainable growth and increase investment in RD activities. Therefore, technology-intensive energy enterprises rely on more innovation activities than non-technology-intensive energy enterprises, and they should pay more attention to RD investment than that of general energy enterprises. Finally, energy companies should attach importance to the combination of executive incentives and RD investment. The results indicate that the impact of RD investment on financially sustainable performance will be moderated by executive incentives. According to the theory of competitive advantage, the resources owned by an enterprise are the source of its own advantages. The effective utilization of resources can be transformed into unparalleled competitive advantage.

This paper uses short-term profitability and long-term development capacity to measure financially sustainable performance. However, future research could use different methods, such as the sustainable growth model proposed by Colley et al. [55], to measure financially sustainable performance to expand the robustness and consistency of the research model.

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