

# Study on the Impact of Equity Incentives and R&D Investment on Corporate Financial Performance based on Multiple Linear Regression Model

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## Abstract

As one of the fast-growing enterprises in the innovative high-tech industry, pharmaceutical manufacturing enterprises are facing great opportunities and pressure in operation with the popularization of medical insurance, improvement of people's living standard and promotion of healthy living concept. This paper explores the ways to improve financial performance in terms of corporate governance and corporate technological innovation, and selects the financial data of listed pharmaceutical manufacturing companies from 2015 to 2020, and uses multiple regression analysis to investigate the effects of executive equity incentives and research and development cost (R&D) investment on financial performance, as well as to establish a mediating effect model to explore the mediating role of R&D investment in it. The empirical results show that both executive equity incentive plan and R&D investment have a positive driving effect on the financial performance of listed companies; executive equity incentive has a significant positive effect on R&D investment and positively affects the financial performance of companies through the mediating effect of increasing R&D investment.

## Keywords

Equity Incentives; Financial Performance; Intermediary Effect; R&D Investment.

## 1. Introduction

Innovation is always an important driving force for a country and nation to move forward. To implement the innovation-driven development strategy, it is necessary to adhere to the main position of enterprises in innovation. R&D investment is an important financial support for enterprises' innovation activities, and enterprises can improve their financial performance by developing new products and expanding market share through exploring new markets. For pharmaceutical manufacturing enterprises with rapid technology iteration, necessary R&D investment is the key to maintain sustainable competitive advantage. At the management level, equity incentives for executives can not only improve corporate governance and weaken the negative impact of information asymmetry, but also effectively circumvent the agency problem in R&D investment and promote the smooth development of innovation activities, further regulating the financial performance of enterprises. For pharmaceutical manufacturing companies with high talent turnover rate in the industry, the implementation of equity incentive mechanism can effectively retain corporate management talents.

At present, there is little domestic research on the mediating role played by equity incentives and R&D investment on financial performance, as well as R&D investment in pharmaceutical manufacturing firms. Therefore, based on the financial data of listed pharmaceutical manufacturing enterprises, this paper analyzes the effects of executive equity incentives and R&D investment on the financial performance of enterprises, and the mediating role played by R&D investment, so as to provide reference for the decision of equity incentives and innovative R&D investment of listed pharmaceutical manufacturing

## 2. Theoretical Analysis and Hypothesis Study

### 2.1. Equity Incentives and Corporate Financial Performance

In modern enterprises, the separation of ownership and management gives rise to a principal-agent relationship, and providing equity incentives to executives can effectively reduce the agency costs arising from inconsistent interest objectives and information asymmetry; through the equity incentive plan, executives become direct beneficiaries of corporate performance, and to a certain extent, they will perform their job duties with higher quality, improve the corporate management system, reduce management costs, and thus optimize financial performance. From the above analysis, this paper proposes the hypothesis that. Hypothesis 1: There is a significant positive relationship between executive equity incentives on corporate financial performance, i.e., executive equity incentives promote financial performance.

### 2.2. R&D Investment and Corporate Financial Performance

Wei-Tao Liu found through his study that R&D investment has a significant positive effect on the financial performance of enterprises, but there are industry and equity nature differences, and the difference in elasticity of demand between industries is more reflected in the level of financial performance of enterprises [1]. Wang Lijun proposed that the intensity of R&D investment is negatively related to the financial performance of enterprises in the current period, but has a significant positive effect on the financial performance of enterprises in the lagged period, and the intensity of R&D personnel investment is significantly and positively related to the financial performance of enterprises [2]. From the above research results, it can be concluded that R&D investment has a positive effect on financial performance, and the innovation activities conducted by enterprises through R&D expenditures can have innovative value for enterprises, which in turn improves the current situation of financial performance. Based on the above analysis, this paper proposes the hypothesis that. Hypothesis 2: R&D investment has a positive effect on firms' financial performance, i.e., R&D investment enhances financial performance.

### 2.3. Equity Incentives and R&D Investment

Yong Liu concluded that executive equity incentives and R&D staff size are two important influencing factors of firms' financial performance and have a positive effect [3]. Weiping Zhu found that management incentives and R&D investment have a two-way promotion effect and jointly enhance the financial performance of firms[4]. Executive equity incentive affects financial performance by reducing agency costs and overhead, and by influencing innovative R&D activities through management decisions. R&D investment can bring innovation value to enterprises and improve their financial performance. Based on the above analysis, this paper proposes the following hypotheses. Hypothesis 3: Executive equity incentive has a positive effect on R&D investment, and executive equity incentive is positively related to R&D investment.

### 2.4. The Mediating Effect of R&D Investment in the Relationship between Equity Incentives and Financial Performance

Li Zhankui's study concludes that R&D investment has a mediating role in the process of equity incentives' impact on financial performance and argues that executives' access to equity incentives enhances the intensity of R&D investment through managerial activities, which in turn affects firm development[5]. As mentioned earlier, executive equity incentives influence corporate innovation R&D activities through management decisions, which in turn affects corporate financial performance. Based on this analysis, this paper makes the following hypotheses. Hypothesis 4: There is a mediating effect of R & D investment in the relationship

between equity incentives and financial performance, i.e., executive equity incentives improve financial performance by increasing R & D investment.

### 3. Model Design

#### 3.1. Sample Selection and Data Study

The main source of sample data in this paper is CSMAR and listed companies' financial reports, and the data selection range is the financial data of listed pharmaceutical manufacturing enterprises during 2015-2020. In order to ensure the validity of the data and the accuracy of the data, when selecting the sample enterprises, the enterprises with missing major indicators and ST enterprises were excluded, and 220 listed companies were finally selected as the sample data for this study.

#### 3.2. Variable Definition

Explained variables: The financial indicator total assets benefit ratio  $C_{ROA}$  is used as the dependent variable, which is the ratio of net profit to total assets of a firm over a certain time period (see Table 1). Explanatory variables:  $G_{EI}$  was chosen as the independent variable for this paper for executive equity incentives. Executive equity incentive is the number of shares held by executives/number of shares issued.

**Table 1.** Variable definitions and descriptions

Variable Category	Variable Name	Variable Symbols	Variable Definition
Explained variable	Financial Performance	$C_{ROA}$	Net profit/total assets
Explanatory variable	Executive Equity Incentives	$G_{EI}$	Number of shares held by executives/number of shares issued
Intermediate variables	R&D input	$Y_{R\&D}$	R&D investment/total enterprise assets
Control variables	Return on Net Assets	$J_{NALR}$	Net income/average net assets
	Gearing ratio	$Z_{ALR}$	Total liabilities / total assets
	Total assets turnover ratio	$T_{AT}$	Net operating income / Average total assets
	Profitability	$L_{PM}$	(Current year's net profit - Prior year's net profit)/Prior year's net profit
	Company Size	$A_{SIZE}$	Natural logarithm of total assets
	Shareholding Concentration	$E_{TOP10}$	Number of top ten shareholders' equity

Intermediate variable: R&D investment  $Y_{R\&D}$  is used as the mediating variable in this paper to study the intensity of cost investment in innovation activities of enterprises by the ratio of R&D expenditure/enterprise total assets in the year. Control variables: Based on the Implementation

Rules for Comprehensive Performance Evaluation of Central Enterprises, which stipulate that financial performance is measured in four aspects: profitability, debt, development and operation, respectively, this paper therefore selects return on net assets  $J_{NALR}$ , gearing ratio  $Z_{ALR}$ , total asset turnover ratio  $T_{AT}$ , profitability  $L_{PM}$ , company size  $A_{SIZE}$ , and equity concentration  $E_{TOP10}$  as control variables.

### 3.3. Model Building

Based on the above dependent, independent, mediating and control variables, and in conjunction with the above hypotheses, the following four multiple regression models were constructed.

$$C_{ROA} = \partial_1 G_{EI} + \partial_2 J_{NALR} + \partial_3 Z_{ALR} + \partial_4 T_{AT} + \partial_5 L_{PM} + \partial_6 A_{SIZE} + \partial_7 E_{TOP10} + \beta + \gamma \quad (1)$$

$$C_{ROA} = \partial_1 Y_{R\&D} + \partial_2 J_{NALR} + \partial_3 Z_{ALR} + \partial_4 T_{AT} + \partial_5 L_{PM} + \partial_6 A_{SIZE} + \partial_7 E_{TOP10} + \beta + \gamma \quad (2)$$

$$Y_{R\&D} = \partial_1 G_{EI} + \partial_2 J_{NALR} + \partial_3 Z_{ALR} + \partial_4 T_{AT} + \partial_5 L_{PM} + \partial_6 A_{SIZE} + \partial_7 E_{TOP10} + \beta + \gamma \quad (3)$$

$$C_{ROA} = \partial_1 G_{EI} + \partial_2 Y_{R\&D} + \partial_3 J_{NALR} + \partial_4 Z_{ALR} + \partial_5 T_{AT} + \partial_6 L_{PM} + \partial_7 A_{SIZE} + \partial_8 E_{TOP10} + \beta + \gamma \quad (4)$$

where  $\beta$  is the intercept term,  $\alpha$  is the variable coefficient, and  $\gamma$  is the error term.

Model (1) explores the relationship between executive equity incentives as the independent variable and corporate financial performance; model (2) explores the correlation between R&D investment as the independent variable and corporate financial performance; model (3) explores the correlation between executive equity incentives and R&D investment with executive equity incentives as the independent variable; model (4) verifies that R&D investment mediating effect in the relationship between equity incentives and financial performance.

Based on the method of Chung-Lin Wen to test the mediating effect, the most commonly used stepwise test regression coefficient is applied to test the mediating effect of R&D investment in the relationship between executive equity incentives and financial performance. Firstly, we test whether executive equity incentive and R&D investment are significantly related to financial performance by (1)(2), respectively, and then we test whether there is a significant relationship between executive equity incentive and R&D investment by (3). If the first three models pass the significance test, the R&D input variable is introduced in (1), which becomes (4), and if the correlation between executive equity incentive and corporate financial performance changes from significant in (1) to insignificant in (4), while R&D input still shows a significant correlation to financial performance, it means that R&D input is a fully mediating variable; when executive equity incentive still shows a significant relationship on firm's financial performance, then it indicates that R&D input is a partially mediating variable.

## 4. Empirical Results and Correlation Analysis

### 4.1. Descriptive Statistics

In terms of equity incentives, the maximum value of  $G_{EI}$  is 73% and the minimum value is 0. This indicates that there is a large difference in the implementation of equity incentive plans for executives among listed pharmaceutical manufacturing companies. From the control variables, the standard deviation of  $T_{AT}$  is 0.44, the standard deviation of  $L_{PM}$  is 0.38, and the standard deviation of  $A_{SIZE}$  is 1.04, which indicates that there are large differences among the

listed pharmaceutical manufacturing companies in the above three aspects. From  $Z_{ALR}$ , the minimum value is 4% and the maximum value is 165%, with a large gap among listed companies in pharmaceutical manufacturing, but the industry average is 32%, which is still within the acceptable range, indicating that the overall listed companies have a good level of assets and liabilities.

**Table 2.** Descriptive statistics table

Variable	Minimum value	Maximum value	Average value	Standard deviation
$C_{ROA}$	-0.56	0.35	0.06	0.10
$G_{EI}$	0.00	0.73	0.16	0.21
$Y_{R\&D}$	0.00	0.17	0.03	0.02
$J_{NALR}$	-1.52	0.57	0.08	0.16
$Z_{ALR}$	0.04	1.65	0.32	0.19
$T_{AT}$	0.03	5.80	0.59	0.44
$L_{PM}$	-3.34	1.21	0.07	0.38
$A_{SIZE}$	18.93	25.02	21.99	1.04
$E_{TOP10}$	0.20	0.93	0.60	0.14

#### 4.2. Correlation Analysis

**Table 3.** Results of correlation analysis of each variable

	$C_{ROA}$	$G_{EI}$	$Y_{R\&D}$	$J_{NALR}$	$Z_{ALR}$	$T_{AT}$	$L_{PM}$	$A_{SIZE}$	$E_{TOP10}$
$C_{ROA}$	1								
$G_{EI}$	0.201**	1							
$Y_{R\&D}$	0.209*	0.089*	1						
$J_{NALR}$	0.207**	0.166**	-0.05**	1					
$Z_{ALR}$	-0.360*	-0.177*	-0.071	0.270**	1				
$T_{AT}$	0.316**	0.027	-0.031	0.268**	0.096	1			
$L_{PM}$	0.324**	0.046	-0.563*	0.618**	-0.092	0.103	1		
$A_{SIZE}$	0.032*	0.053	0.357**	-0.064	0.207*	-0.064	-0.244	1	
$E_{TOP10}$	0.104*	0.141*	-0.192*	0.149*	0.032	-0.007	0.146*	-0.668*	1

Note: \*, \*\*, \*\*\* indicate significant at the 10%, 5%, and 1% levels, respectively

From the results in Table 2, it can be seen that executive equity incentive and corporate financial performance have a significant positive effect at the 1% level with a coefficient of 0.201, that is, through the executive equity incentive plan can indeed have a positive impact on financial performance; R&D investment has a significant positive correlation on financial performance at the 1% level with a coefficient of 0.209, that is, increasing the intensity of R&D investment can improve corporate financial performance. From the above analysis, it can be concluded that by implementing executive equity incentive plan and increasing the intensity of R&D

investment can improve the financial performance. Executive equity incentives are significantly and positively correlated with R&D investment at the 1% level with a coefficient of 0.089, i.e., increasing executive equity incentives can increase the intensity of R&D investment and improve research efficiency. All the main control variables selected are significantly and positively correlated with financial performance at the 5% and 1% levels, indicating that the selected control variables are reasonable.

### 4.3. Regression Analysis

As can be seen from Table 3, the regression result of model (1) indicates that the relationship between executive equity incentive and financial performance is significantly positive at the 1% level, indicating that the implementation of executive equity incentive in pharmaceutical manufacturing industry can improve financial performance and test hypothesis 1; the regression result of model (2) indicates that the relationship between R&D investment and corporate financial performance is positive at the 1% level, indicating that listed companies in pharmaceutical manufacturing industry can improve their financial performance by increasing their investment in new. The regression results of model (3) indicate that the relationship between executive equity incentive and R&D investment is positive at the 5% level, indicating that the equity incentive plan for executives can improve the intensity of corporate R&D investment and test hypothesis 3. The mediating effect of R&D investment in the relationship between executive equity investment and corporate financial performance is explored by introducing the R&D investment variable in model (1), which is model (4). The regression results from model (4) show that executive equity incentives still have a significant positive relationship on financial performance, however, the significant level decreases from 1% in model (1) to 5% in model (4), and the level of influence of executive equity incentives on financial performance decreases, meanwhile, the adjusted R-squared increases from 0.9013 in model (1) to 0.9072 in model (4), and the goodness of fit increases, according to the theory of mediating effect, it can be concluded that executive equity incentives enhance corporate financial performance by increasing R&D investment, which verifies hypothesis 4.

**Table 4.** Results of multiple regression analysis

Variables	Model (1)	Model (2)	Model (3)	Model (4)
Explained variable	<i>CROA</i>	<i>CROA</i>	<i>Y<sub>R&amp;D</sub></i>	<i>CROA</i>
Constants	0.241 (-1.18)	0.379 (-0.88)	0.367 (0.90)	0.149 (-1.45)
<i>GEI</i>	0.009*** (2.64)	-	0.019** (2.36)	0.039** (2.08)
<i>Y<sub>R&amp;D</sub></i>	-	0.000*** (4.17)	-	0.000*** (3.82)
<i>J<sub>NALR</sub></i>	0.000*** (11.56)	0.000*** (11.61)	0.178 (1.35)	0.000*** (11.52)
<i>Z<sub>ALR</sub></i>	0.002*** (-3.15)	0.005*** (-2.883)	0.340 (-0.96)	0.003*** (-2.99)
<i>T<sub>AT</sub></i>	0.000*** (4.83)	0.000*** (4.26)	0.026** (2.25)	0.000*** (4.34)
<i>L<sub>PM</sub></i>	0.000*** (10.37)	0.000*** (10.82)	0.206 (-1.27)	0.000*** (10.98)
<i>A<sub>SIZE</sub></i>	0.227 (1.21)	0.429 (0.79)	0.572 (-0.57)	0.164 (1.40)
<i>E<sub>TOP10</sub></i>	0.116 (1.58)	0.089* (1.71)	0.077* (1.78)	0.250 (1.15)
<i>Num.</i>	220	220	220	220
<i>Adj-R2</i>	0.9013	0.9058	0.0800	0.9072
<i>F</i>	288.09	303.17	3.73	269.95

Note: \*, \*\*, \*\*\* indicate significant at the 10%, 5%, and 1% levels, respectively

## 5. Conclusion

This paper explores the relationship between executive equity incentives, R&D investment on enterprise financial performance, and selects the financial data of A-share listed pharmaceutical manufacturing enterprises from 2015 to 2020 for empirical analysis, using enterprise financial performance as explained variable, executive equity incentives as the explanatory variable, and R&D investment as the mediating variable, to explore the relationship between equity incentives and R&D investment and the relationship between equity incentives and R&D investment and the mediating effect of R&D investment. This paper draws the following conclusions.

1. The implementation of equity incentive plans for executives in pharmaceutical manufacturing listed companies improves the level of corporate financial performance, i.e., equity incentives for executives show a positive relationship with financial performance. Due to the emergence of agency relationship, conflicts of interest arise between managers and shareholders, and the equity incentive for executives integrates the goals of managers and shareholders, and executives will adopt more favorable management tools to reduce unnecessary costs and thus improve corporate efficiency. Pharmaceutical manufacturing companies should pay attention to equity incentives for executives to retain executive talent. In addition, pharmaceutical manufacturing industry, as one of the industries with the most serious talent loss, should also pay attention to the equity incentives for core scientific and technological research and development personnel, pay attention to the transformation of scientific research results into economic results, and improve the enthusiasm of core scientific and technological personnel in research and development.

2. R & D investment has a positive effect on the financial performance of enterprises, and the greater the intensity of R & D investment, the more beneficial to the long-term development of enterprises. the greater the intensity of R & D investment, the more it shows that enterprises attach importance to scientific and technological innovation, research and development of new products to meet the people's demand for new pharmaceutical products, develop new markets to expand market share; in conducting scientific research activities of pharmaceutical products, pay more attention to the changes in people's health philosophy and changes in major health diseases, which is conducive to enterprises to occupy competitive advantages in advance. Pharmaceutical manufacturing companies should focus on key investment areas when conducting research and development of new drugs, and use limited funds on the cutting edge. Based on the current situation that the new coronavirus strains are mutating too fast, pharmaceutical manufacturing companies should pay attention to vaccine and special drug research and development to meet people's needs.

3. Executive equity incentives have a positive contribution to the financial performance of listed companies in pharmaceutical manufacturing industry, and R&D investment plays a mediating role in the relationship between executive equity incentives and corporate financial performance. Due to the uncertainty of the results of R&D activities, management generally focuses more on short-term earnings and neglects long-term earnings and new drug development, which is not conducive to the long-term development of the company. With the implementation of equity incentive plan for executives, the identity of management will be changed and executives will support research projects that are beneficial to the sustainable development of the company, avoiding to compromise the long-term development of the company for the sake of short-term gains and improving the financial performance of the company.

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