



ORIGINAL ARTICLE

Impact of Corporate Governance on Research and Development Investment in the Pharmaceutical Industry in South Korea

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Abstract

Objectives: The purpose of this study is to analyze the influence of the corporate governance of pharmaceutical companies on research and development (R&D) investment.

Methods: The period of the empirical analysis is from 2000 to 2012. Financial statements and comments in general, and internal transactions were extracted from TS-2000 of the Korea Listed Company Association. Sample firms were those that belong to the medical substance and drug manufacturing industries. Ultimately, 786 firm-year data of 81 firms were included in the sample (unbalanced panel data).

Results: The shareholding ratio of major shareholders and foreigners turned out to have a statistically significant influence on R&D investment ($p < 0.05$). No statistical significance was found in the shareholding ratio of institutional investors and the ratio of outside directors.

Conclusion: The higher the shareholding ratio of the major shareholders, the greater the R&D investment. There will be a need to establish (or switch to) a holding company structure. Holding companies can directly manage R&D in fields with high initial risks, and they can diversify these risks. The larger the number of foreign investors, the greater the R&D investment, indicating that foreigners directly or indirectly impose pressure on a manager to make R&D investments that bring long-term benefits.

1. Introduction

The pharmaceutical industry is expected to achieve a continuous growth due to an aging population, an extension of the average lifespan, transformation of the disease structure to chronic diseases, increased interest in health and quality of life, and active promotion and

investment by the government and the private sector to fuel such a high value-added business.

Research and development (R&D) investment has been relatively insufficient despite constant industry growth, whereas the percentage of selling, general, and administrative expenses (SG&A), including sales promotion costs, has been high. Going forward, government's reform

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policies will kick into high gear in the pharmaceutical industry. These policies have established in the domestic market relatively high costs of generic medicines compared with those of advanced countries and unfair competition with such as negative rebates. It can be said that a bond of sympathy has developed between the pharmaceutical industry and the government around the need to support R&D investment to promote the industry as a future growth engine.

Deciding a firm's R&D investment scale is both a strategic investment decision related to the firm's long-term value creation and an extremely important decision because it accompanies a certain degree of risk [1]. A firm's corporate governance differs according to its ownership structure, and corporate governance influences decision making. Therefore, a change in the ownership structure influences an enterprise value through discretionary investments such as R&D [2]. A considerable number of studies analyzed the influence of ownership structure on a firm's R&D investment, with a variety of results. Here, previous studies will be examined regarding the relationship between R&D investment and ownership structures such as manager shareholding ratios, foreigner shareholding ratios, institutional investor shareholding ratios, and ratios of outside directors.

The separation between ownership and management expanded information asymmetry between shareholders and managers [3,4]. However, if shares are focused among a minority of shareholders, they tend to have greater ability to monitor the manager's decision-making behavior [1]. Moreover, as they take up a considerable amount of profits from monitoring and controlling the manager, they actively participate in the firm's decision-making processes to reflect their interests and, in some cases, even collaborate with other powers to seize the management right from the manager (or the largest shareholder). The ownership concentration of shares creates interdependence between shareholders and the manager, which can reduce information asymmetry between the manager and major shareholders [5,6]. This interdependent understanding is a factor that reduces information asymmetry between the manager and major shareholders, consequently promoting R&D investment [7]. In an empirical study on North America, Hansen and Hill [8] reported that there is a positive relevance between share ownership intensity and R&D investment.

Generally, foreign investors suppress the manager's opportunistic actions while also relaxing the manager's risk awareness. The fact that quota investment of foreigners relaxes the manager's risk awareness can be explained with the following elements. First, the manager can use the supplementary knowledge of foreign investors. As mentioned above, foreigners have a great deal of professional knowledge about the firms they invest in [9], and tend to actively share such knowledge

[10]. Therefore, the manager can use their knowledge to reduce the uncertainty of R&D investment. Secondly, risk awareness can be relaxed by improved transparency. Foreigners have increased motivation to monitor the manager and tend to have a great monitoring ability [11].

One of the recent changes in the capital market is that the proportion of institutional investors has increased greatly. Institutional investors receive a mission from depositors to maximize long-term profits [1,8]. To accomplish this mission, the firm in which they invest must have a stable flow of current profits, while also ensuring future profitability with appropriate long-term investments such as R&D. Generally, fund managers who are evaluated quarterly or semiannually for operating profits cannot wait for investments with a long gestation period of capital. Therefore, they tend to adjust the portfolio according to short-term market conditions rather than investments with high uncertainty and long gestation periods of capital such as R&D [12]. The other view regards institutional investors as rational investors. Because institutional investors have "the economy of scale" in collecting and evaluating information, they put more emphasis on long-term value change than responding to short-term stock price fluctuations [13]. Therefore, institutional investors have the incentive to promote the firm's long-term value increase by actively monitoring the manager's behavior and participating in decision making. Hansen and Hill [8] determined that there is a positive relationship between the shareholding ratio of institutional investors and R&D investment, and David et al [1] argued that the role of institutional investors based on shareholder activism increases R&D investment for both short- and long-term periods.

Previous studies on the influence of the ratio of outside directors mostly focused on the replacement of the top management team and appropriation of wages that are relatively easy to observe directly; however, studies on a firm's strategic decision making such as their R&D investment are very scarce [14]. A typical strategic decision of a firm is R&D investment. However, as mentioned above, shareholders prefer R&D investment with high profits and high risks, whereas the manager may be passive regarding R&D investment to reduce his own employment risk; thus, shareholders and the manager may have conflicting positions on R&D investment [15,16]. Therefore, in the legal and institutional view that shareholders' profits are protected by securing independence from the board of directors (BOD), it can be expected that if the BOD comprises outside directors, it may protect the interests of shareholders who prefer high-profit and high-risk investments, thereby increasing R&D investment. Empirical studies on the relationship between the ratio of outside directors and R&D investment are very scarce, and it is impossible to confirm the relationship; thus, there is a need for additional empirical studies.

Previous studies showed that the agency theory has different effects according to situational conditions. In other words, conflicts of interest may arise if inside investors, such as managers or controlling shareholders, expropriate the wealth of outside investors, such as minority shareholders or creditors, for their personal gains. Thus, this study analyzes the influence of the corporate governance of pharmaceutical companies on R&D investment.

2. Materials and methods

2.1. Data sources

The period of the empirical analysis is from 2000 to 2012. The targeted firms for analysis are those listed on the stock exchange, and they are all of firm level. Financial statements and comments in general, and internal transactions were extracted from TS-2000 of the Korea Listed Company Association. STATA 12.0 was used as the statistical package for panel analysis. Detailed reasons for extracting the sample period from among analysis periods are as follows. Sample firms were those that belong to the medical substance and drug manufacturing industries. Cases of complete impairment of capital in the relevant year and types of management were excluded, as it may be impossible to compare these with other firms and years due to high risk of bankruptcy. The sample firms included firms that closed accounts at the end of December as well as other settling days, however, firms that changed the settling days were excluded as the result might be distorted due to a short accounting period in the year in which the day was changed. In analyzing data on R&D investment, there were issues of omitted records, inconsistency, and failure of reflected changes in database (DB) of TS-2000 and KISVALUE-III despite the fact that the accuracy of R&D cost-related data was extremely important. Thus, this study collected data from the Data Analysis, Retrieval and Transfer System of the Financial Supervisory Service. Ultimately, 786 firm-year data of 81 firms were included in the sample. Unbalanced panel data with different data inclusion periods of variables, as shown in Table 1, could be obtained according to the availability of data.

2.2. Definition and measurement of variables

2.2.1. R&D investment

R&D investment is often used as an index that can measure the degree of a firm's pursuit of innovation and the manager's pursuit of risk. R&D intensity was used as a dependent variable to eliminate errors due to relative difference according to sales of each firm [17].

2.2.2. Major shareholders

A major shareholder refers to the shareholder with the most shares owned by him or herself as well as his or her family, relatives, and affiliate persons. Information

on the major shareholder announced in the distribution of shareholding size in the business report in the relevant settlement term was used to determine the shareholding ratio of major shareholders.

2.2.3. Foreign ownership

In the view of the efficient monitoring hypothesis, institutional and foreign investors are important agents and external control mechanisms that monitor the business activities of the management as outside shareholders, and they influence corporate innovation in the long-term investment view [18]. Therefore, this study used the data on the shareholding ratio of foreigners of end-of-the-term ordinary shares.

2.2.4. Institutional investors

Outside block shareholders such as institutional investors manage large funds and have a relatively high shareholding ratio, thus having the incentive to monitor corporate management. The shareholding ratio of institutional investors was calculated as the sum of the shareholding ratios of institutional investors.

2.2.5. Outside directors

The ratio of outside directors is an index frequently used in empirical studies on the influence of structural independence of the BOD on corporate performance, value, and strategic decisions. The ratio of outside directors in this study is the value obtained by dividing the number of outside directors in the BOD by the total number of registered directors.

2.2.6. Business scale

Business scale is a significant factor that influences R&D investment. In other words, the bigger the size, the greater the efficiency of asset utilization [19] as well as the motivation for risky investments such as R&D [13]. Therefore, the business scale was controlled in this study [20].

Table 1. Annual distribution of sample firms.

Year	Firms	Share	Cumulative
2000	39	4.96	4.96
2001	42	5.34	10.31
2002	48	6.11	16.41
2003	51	6.49	22.90
2004	52	6.62	29.52
2005	56	7.12	36.64
2006	58	7.38	44.02
2007	62	7.89	51.91
2008	68	8.65	60.56
2009	72	9.16	69.72
2010	77	9.80	79.52
2011	80	10.18	89.69
2012	81	10.31	100.00

2.2.7. Firm age

The age of a firm may influence a firm's strategic decisions. The longer the term after the firm was established and listed, the higher the possibility that investment decisions will be long term. In this study, the years listed (years passed after the firm was listed) were controlled instead of the years established.

2.2.8. Size of the BOD

Seen from the agency theory, the strongest system that can directly control the manager is the system of the BOD [21,22]. Directors can observe the manager's actions and furnish their views by participating in major business-related, decision-making processes. This result indicates that the R&D investment may increase with a greater BOD size. The BOD size was controlled in this study.

2.2.9. Advertising expense

As a firm spends money on advertising as a means to promote profit growth, R&D expenditures can also be seen as an investment to increase profits [23]. Advertising expenses or R&D expenditures can be seen as investment activities to promote profitability. Therefore, advertising expense was controlled in this study.

2.2.10. SG&A

SG&A can display the degree of the agency problem, because wasteful costs, which cannot show the causal relationship, may be incurred in using corporate resources. Thus, SG&A was controlled in this study.

2.3. Research model

We applied the research model for the empirical analysis as follows:

Model: Control variables and corporate governance variables

$$\begin{aligned} RD_{it} = & \alpha + \beta_1 OWN_{it} + \beta_2 FOR_{it} + \beta_3 INS_{it} + \beta_4 ODR_{it} \\ & + \beta_5 SIZE_{it} + \beta_6 YEAR_{it} + \beta_7 BS_{it} + \beta_8 AD_{it} \\ & + \beta_9 SAE_{it} + \mu_i + \varepsilon_{it} \end{aligned}$$

Here, μ_i is an individual specific effect that is not observable and not changeable with lapse of time, and ε_{it} is an ordinary error term.

3. Results

Table 3 shows the descriptive statistics of key variables of all firms used in the empirical analysis. The characteristics of probability distribution and the outliers of key variables are as follows. The dependent variable of R&D investment (RD) appeared to be approximately 6.29%, and the maximum and minimum values show that there are considerable gaps among firms. The average of variables related to corporate governance was the highest for the shareholding ratio of major shareholders (OWN) with 37.03, whereas the shareholding ratio of foreigners (FOR) was 5.57, the shareholding ratio of institutional investors (INS) 1.36, and the ratio of outside directors (ODR) was 23.36. Firm size and firm age, which this study considered as control variables and factors that may influence R&D investment, turned out not to have a major standard deviation compared with the average and, therefore, appeared not to have a significant problem in normal distribution.

Table 4 shows that certain independent variables were inter-related and related to the dependent variables. The following correlations among the dependent variables and between the dependent and independent variables are significant: RD and LIQ (0.232) and SAE (0.242) are significantly positively correlated; RD and ROI (-0.167), OWN (-0.135), INS (-0.099), YEAR (-0.210), and AD (-0.091) are significantly negatively correlated.

Table 2. Summary of variables.

Variable	Definition		
Dependent	R&D investment intensity	RD	(Research costs + ordinary development costs)/sales × 100
Independent	Major shareholders	OWN	(Ordinary shares owned by major shareholders/total ordinary shares) × 100
	Foreign ownership	FOR	(Ordinary shares owned by foreigners/total ordinary shares) × 100
	Institutional investors	INS	(Ordinary shares owned by institutional investors/total ordinary shares) × 100
	Outside directors	ODR	(No. of outside directors/total no. of registered directors) × 100
Control	Business scale	SIZE	ln (total assets)
	Firm age	YEAR	ln (years passed after the firm was listed)
	BOD size	BS	ln (registered directors)
	Advertising expense	AD	(Advertising expense/sales) × 100
	SG&A	SAE	[(SG&A - ordinary development costs)/sales] × 100

BOD = board of directors; R&D = research and development; SG&A = selling, general, and administrative expenses.

Table 3. Descriptive statistics.

Variable	Obs	Mean	SD	Min	Max
RD	786.00	6.29	9.10	0.12	99.07
SIZE	786.00	7.97	0.43	6.98	9.24
YEAR	786.00	1.02	0.43	0.00	1.71
BS	786.00	0.70	0.15	0.00	1.18
AD	786.00	3.53	3.32	0.00	23.32
SAE	786.00	36.33	14.56	3.26	141.77
OWN	786.00	37.03	14.99	2.31	79.50
FOR	786.00	5.57	10.17	0.00	57.79
INS	786.00	1.36	4.45	0.00	45.05
ODR	786.00	23.36	15.84	0.00	83.33

AD = advertising expense; BS = size of board of directors; FOR = foreign ownership; INS = institutional investors; Max = maximum; Min = minimum; Obs = Observations; ODR = outside directors; OWN = major shareholders; RD = research and development investment intensity; SAE = selling, general, and administrative expenses; SD = standard deviation; SIZE = business scale; YEAR = firm age.

To verify how R&D investment differs according to the corporate governance of pharmaceutical companies, this study conducted a panel analysis of the dependent variable of R&D investment and independent variables related to corporate governance, such as the shareholding ratio of major shareholders, the shareholding ratio of foreigners, the shareholding ratio of institutional investors, and the ratio of outside directors (Table 5). In general, if the shareholding ratio of major shareholders is high, the manager makes investments with the goal of increasing long-term enterprise value rather than obsessing about shortsighted investments by increasing short-term accounting benefits. Therefore, it is expected that companies with a high shareholding ratio of major shareholders will make more R&D investment than those that do not have a high shareholding ratio of major shareholders. The shareholding ratio of foreigners has been found to have a statistically significant influence on R&D investment. The result was similar to the prediction that a higher shareholding ratio of foreigners will

lead to a greater R&D investment, and that foreign investors will prefer R&D companies that are actively engaged in R&D investment. No statistical significance was found in the shareholding ratio of institutional investors and the ratio of outside directors.

4. Discussion

This study conducted an integrated analysis of the factors influencing R&D investment in the Korean pharmaceutical industry, through a detailed review of the corporate governance in this industry in Korea. TS-2000 was used for the analysis data in this study. The study was conducted in two phases, targeting the “medical substance and drug manufacturing industries” between 2000 and 2012. The findings of this study have significant implications for the flow of investment by pharmaceutical companies into R&D. The author saw corporate governance as an important factor that influences R&D, because the agency problem affects R&D investment.

First, it was found in this study that the higher the shareholding ratio of major shareholders, the greater the R&D investment. The results of verifying the correlation between corporate governance and R&D investment showed that the shareholding ratio of major shareholders, which is a proxy variable of corporate governance, has a positive influence. Thus, it is necessary to manage the uncertainty and risks of the outcomes of R&D investment. Moreover, there will be a need to establish (or switch to) a holding company structure. Holding companies can directly manage R&D in fields with high initial risks, and they can diversify these risks. Further, long-term approaches to R&D investment can be promoted through such holding companies.

Second, this study showed that the shareholding ratio of foreigners has a positive relationship with R&D investment. This result systematically supports the argument [10,11] that foreigners have an outstanding ability to monitor and control a manager’s opportunistic

Table 4. Pearson’s correlation coefficients.

	RD	OWN	FOR	INS	ODR	SIZE	YEAR	BS	AD	SAE
RD	1									
OWN	-0.1354*	1								
FOR	0.003	-0.0184	1							
INS	-0.0997*	-0.1134*	-0.0143	1						
ODR	-0.0246	-0.1056*	0.1301*	-0.066	1					
SIZE	0.0389	-0.2141*	0.4314*	0.0978*	0.4349*	1				
YEAR	-0.2109*	-0.2721*	0.2522*	0.1154*	0.3659*	0.5650*	1			
BS	-0.0075	-0.0575	0.1943*	0.0979*	0.3092*	0.4694*	0.3439*	1		
AD	-0.0914*	-0.1019*	0.0991*	0.1582*	0.0279	0.2471*	0.1575*	0.0786*	1	
SAE	0.2426*	-0.1339*	-0.1069*	-0.0447	0.0096	-0.0728*	0.1075*	0.0034	0.3469*	1

* $p < 0.1$. AD = advertising expense; BS = size of board of directors; FOR = foreign ownership; INS = institutional investors; ODR = outside directors; OWN = major shareholders; RD = research and development investment intensity; SAE = selling, general, and administrative expenses; SIZE = business scale; YEAR = firm age. $p < 0.05$. $p < 0.01$.

Table 5. Results.

	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
SIZE	3.987*	1.165	3.867*	1.181	4.150*	1.204	4.452*	1.166	3.195*	1.223
YEAR	2.049 [†]	0.936	1.493	0.910	1.402	0.913	1.251	0.931	2.142 [†]	0.953
BS	-2.417	1.585	-1.708	1.582	-2.036	1.589	-2.013	1.596	-2.289	1.594
AD	-0.114	0.0822	-0.0942	0.0824	-0.0925	0.0835	-0.101	0.0834	-0.0943	0.0835
SAE	0.0351 [‡]	0.0197	0.0281	0.0196	0.0254	0.0199	0.0279		0.0322	0.0200
OWN	0.0591*	0.0195							0.0584*	0.0196
FOR			0.0553 [†]	0.0215					0.0542 [†]	0.0216
INS					-0.0392	0.0353			-0.0125	0.0358
ODR							0.00657	0.0139	0.00535	0.0139
Constant	-28.93*	8.732	-25.84*	8.911	-27.32*	9.183	-29.86*	8.838	-23.16 [†]	9.248
Adj R ²	0.084		0.08		0.073		0.072		0.093	
Obs	786		786		786		786		786	
ID	81		81		81		81		81	

* $p < 0.01$; [†] $p < 0.05$; [‡] $p < 0.1$. AD = advertising expense; Adj = adjusted; BS = size of board of directors; Coef. = coefficient; FOR = foreign ownership; ID = Company; INS = institutional investors; Obs = Observations; ODR = outside directors; OWN = major shareholders; RD = research and development investment intensity; SAE = selling, general, and administrative expenses; SE = standard error; SIZE = business scale; YEAR = firm age.

behavior. Foreign investors have significantly changed the business practices of companies based on their superior business-monitoring techniques. The findings of this study, which indicate that the higher shareholding ratio of foreigners leads to greater R&D investment, indicate that foreigners directly or indirectly impose pressure on a manager to make investments in R&D that lead to long-term benefits [24].

Limitations of the present research are described below. Such limitations should be considered when understanding and applying the results, and are significant in providing a direction for future studies. Measurement error could possibly have been included in the financial metrics used as a proxy variable of an agency control device. For example, in the case of a principal stockholder who performs the role of controlling the agency costs, the measurement is made by using the stock holdings of the largest shareholder and an affiliate person based on the annual reports disclosed by each firm. It is thus possible that there could be a measurement error due to the data's credibility, a disguised dispersion of the holding rate, etc. Therefore, development of a proxy variable that can more accurately measure the agency costs incurred as a result of the manager's voluntary decision making would be a future challenge that needs to be addressed.

Conflicts of interest

All contributing authors declare no conflicts of interest.

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