

코스닥 제약기업의 연구개발투자와 소유구조 간의 관계

The Relationship between R&D investment and Ownership Structure in KOSDAQ Pharmaceutical Firms

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요약

본 연구는 우리나라 코스닥 제약기업을 대상으로 소유구조가 제약기업의 연구개발투자(R&D)에 미치는 영향을 분석하였다. 실증분석을 위한 표본은 2000년부터 2012년까지 상장된 기업들 중 코스닥 제약기업을 대상으로 하였으며 사용된 전체 표본은 13개년 자료로써 358개 관측치를 가진 불균형패널자료이다. 본 연구에 사용된 주요 변수들 중 개별기업 별 재무자료는 상장회사 협의회 TS-2000을, 임원현황 및 주주분포 등은 금융감독원 전자공시 시스템의 각 기업 사업보고서 자료를 통해 자료를 직접 수집하였으며 기업나이, 기업크기 등은 NICE신용평가정보의 KISVALUE-III 등의 자료를 참고하였다. 연구결과, 첫째 주요주주율과 외국인투자율은 연구개발투자에 긍정적인 영향을 미쳤다. 둘째, 사외이사율은 연구개발투자에 부정적인 영향을 미쳤다. 셋째, 기관투자율은 통계적으로 유의한 결과를 미치지 못했다.

■ 중심어 : | 제약기업 | 연구개발투자 | 소유구조 | 패널연구 | 코스닥 |

Abstract

The purpose of this study is to analyze the influence of the financial structure of pharmaceutical companies on R&D investment. 358 pharmaceutical firms listed in the KOSDAQ market from 2000 to 2012. Financial statements and comments in general and internal transactions were extracted from TS-2000 of the Korea Listed Company Association (KLCA), and data related to stock price was extracted from KISVALUE-III of NICE Information Service Co., Ltd. STATA 12.0 was used as the statistical package for panel analysis. The summary of the findings and the interpretation of the significance of this are as follows: First, the shareholding ratio of major shareholders and foreigners had a positive influence on R&D investment. Second, the ratio of outside directors had a negative influence on R&D investment. Third, the shareholding ratio of institutional investors did not have a significant influence on R&D investment.

■ keyword : | Pharmaceutical Firms | R&D Investment | Ownership Structure | Panel Study | KOSDAQ |

I. Introduction

Pharmaceutical companies tend to develop new

drugs to treat new diseases through R&D investment to create a next-generation profit source, or develop relatively cost-effective drugs to maximize enterprise

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value. R&D in the pharmaceutical industry has the characteristic of continuously requiring high investments. Studies that have empirically analyzed R&D investment in the pharmaceutical industry largely clarify factors that have positive relevance for R&D investment. DiMasi, Hansen[1] assumed that it costs \$802 million to develop a new drug and release it into the market. Grabowski and Vernon[2] determined that there is a positive relevance between a firm's internal cash flow and R&D costs among pharmaceutical companies. Jo[3] figured out how much influence pharmaceutical price regulation policy has on R&D investment and the sales of 32 pharmaceutical companies in countries that actively enforce pharmaceutical price regulation policy as well as in the U.S., where there is almost no regulation. His aim was to understand the firm-level factors that influence profitability and the amount of R&D investment of pharmaceutical companies, and study the differences caused by these factors between the two aforementioned groups. As a result of conducting a metric analysis based on data formed by Compustat, KISINFO, PhRMA, and JPMA, it was discovered that anticipated profits and liquidity are major factors that determine a firm's R&D intensity. Moreover, the U.S. results with almost no pharmaceutical price regulation implied a four to seven times greater possibility of producing profits than other advanced countries with regulations.

A firm's R&D investment is externally influenced by the market in which the firm operates as well as the economic environment faced by the firm, and internally influenced by ownership structure[4][5]. A firm's corporate governance differs according to ownership structure, and corporate governance influences decision making. Therefore, a change in the ownership structure influences enterprise value through discretionary investments such as R&D. To

analyze the influence of a firm's ownership structure on R&D investment, Lee and Kim[6] conducted a study on 969 listed manufacturing firms from 1997 to 2000, verifying whether their risk aversion incentive alleviated or deteriorated according to an increase in ownership shares of inside managers after the foreign exchange crisis and analyzing the influence of a change in ownership shares of outside block shareholders on the firm's R&D investment. The empirical analysis result showed that an increase in the CEO's ownership shares increases the risk aversion incentive and deflates the firm's R&D investment activities. On the other hand, an increase in the shareholding ratio of outside block shareholders had a significantly positive effect on R&D investment. To promote long-term, high-risk investments such as R&D and its driving force for economic growth, based on this result the government must implement active ownership diversification policies to reduce a risk aversion incentive in major shareholders. Kim and Cho[7] examined 272 firms listed on the KOSDAQ market, that disclosed information related to R&D investment, through fair disclosure from Nov. 1, 2002 through Dec. 31, 2005, and studied what market response is caused by disclosure of R&D investments according to the characteristics of corporate ownership structure. The result showed that if the shareholding ratio of major shareholders and affiliate persons in the KOSDAQ market is high, disclosure of R&D plans had a significantly negative influence on market response, while the shareholding ratio of foreigners and institutional investors did not have a significant influence; thus, the value of R&D investment can be evaluated discriminately in the market according to ownership structure. This study aims to clarify the factors that have a positive influence on the R&D investment of pharmaceutical companies. It analyzes the influence of the ownership

structure of pharmaceutical companies on R&D investment.

II. Materials and Methods

1. Methods

The period of the empirical analysis is from 2000 to 2012. The targeted firms for analysis are those listed in the KOSDAQ market, 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 (KLCA), and data related to stock price is extracted from KISVALUE-III of NICE Information Service Co., Ltd. STATA 12.0 was used as the statistical package for panel analysis. In analyzing data on R&D investment, there were issues of omitted records, inconsistency, and failure of reflected changes in DB of TS-2000 and KISVALUE-III despite the fact that 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, 358 firm-year data of 44 firms were included in the sample.

2. Variables and Measurements

2.1 Dependent Variables

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. This study measured it based on research costs and ordinary development costs on income measurement. R&D intensity was used as a dependent variable to eliminate errors due to relative difference according to sales of each firm[8].

2.2 Independent Variables

Major shareholders : 1 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. The major shareholder information 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.

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(Rhee & Cho, 2001). Therefore, this study used the data of the shareholding ratio of foreigners of end-of-the-term ordinary shares.

Institutional investors: Outside block shareholders such as institutional investors manage large funds and have a relatively high shareholding ratio, and thus have the incentive to monitor corporate management. According to the efficient monitoring hypothesis, the higher shareholding ratio of institutional investors diminishes the manager-agent issue; but according to the conflict-of-interest hypothesis or strategic alliance hypothesis, it cannot diminish the issue. The shareholding ratio of institutional investors was calculated as the sum of the shareholding ratio of institutional investors.

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 from dividing the number of outside directors in the BOD by the total number of registered directors.

2.3 Control Variables

Profitability: A firm's performance is a variable closely related to R&D investment; thus, if a firm has abundant resources, the capacity for R&D investment increases. Hoskisson, Hitt[9] discovered that profits generated by a firm have a positive correlation with R&D investment. This study used ROI as the proxy variables of profitability.

Growth: Firms with increased sales can be considered to have higher growth than those with the same or decreased sales, and these firms are likely to carry out more active R&D activities as a strategy to lead the market[10]. Therefore, this study also assumed that firms with high growth will be more active in R&D investment, and used the rate of sales increase as the proxy variable for growth.

Liquidity: This ratio is included to measure the liquidity level formed by a firm's internal financing. In particular, firms are reluctant to share their R&D plans or progress with the supplier of external funds in terms of R&D costs due to strategic issues with competitors. Therefore, external financing is more difficult and requires higher costs than internal financing. Consequently, firms tend to prefer internal financing to external financing due to information asymmetry. This study used current ratio as the proxy variable for liquidity.

Leverage: Making strategic decisions such as R&D investment may be restricted by financial resources available in the company, and thus it is necessary to examine the capacity of external financing of the company[11]. Hoskisson, Hitt[9] discovered that there is a negative relationship between debt-equity ratio and R&D intensity. However, David, Hitt[12] came up with the result that higher debt-equity ratio increases the manager's risk appetite and efforts, thereby increasing R&D investment. This study used debt-equity ratio.

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[13], as well as greater motivation for risky investments such as R&D[11]. If the scale is huge, there are relatively more resources, thereby increasing the capacity to endure investments with long payback periods such as R&D[14]. Therefore, business scale was controlled in this study[15].

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) was controlled instead of years established.

Size of the board of directors (BOD): Previous

Table 1. 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	Profitability	ROI	(current net income/total assets) × 100
	Growth	SG	(current sales/previous term sales) × 100
	Liquidity	LIQ	(current assets/ current liabilities) × 100
	Leverage	LEV	(total liabilities /equity capital) × 100
	Business scale	SIZE	$\ln(\text{total assets})$
	Firm age	YEAR	$\ln(\text{years passed after the firm was listed})$
	BOD size	BS	$\ln(\text{registered directors})$

studies saw the size of BOD as an important factor that determines the manager’s risk appetite. Golden and Zajac[16] determined that the BOD size has a positive relationship with a firm’s strategic transformation. This result indicates that the R&D investment may increase with a greater BOD size. The BOD size was controlled in this study.

3. Research Model

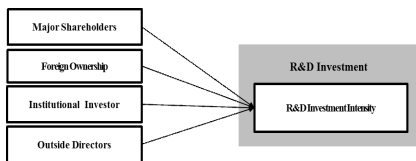
We applied the research model for the empirical analysis as follows:

- Model 1: Control variables only

$$Q_{it} = \alpha + \beta_1 ROI_{it} + \beta_2 SG_{it} + \beta_3 LIQ_{it} + \beta_4 LEV_{it} + \beta_5 SIZE_{it} + \beta_6 YEAR_{it} + \beta_7 BS_{it} + \mu_i + \epsilon$$

- Model 2: Independent variables and Control variables

$$Q_{it} = \alpha + \beta_1 OWN_{it} + \beta_2 FOR_{it} + \beta_3 INS_{it} + \beta_4 ODR_{it} + \beta_5 ROI_{it} + \beta_6 SG_{it} + \beta_7 LIQ_{it} + \beta_8 LEV_{it} + \beta_9 SIZE_{it} + \beta_{10} YEAR + \beta_{11} BS_{it} + \mu_i + \epsilon$$



Control Variables: Profitability, Growth, Liquidity, Leverage, Business Scale, Firm Year, BOD

Fig. 1. Research Model

III. Results

1. Descriptive Data

[Table 2] 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 8.24%, and the maximum and

minimum values show that there are considerable gaps among firms. The average of variables related to ownership structure was the highest for the shareholding ratio of major shareholders (OWN) with 41.08, while the shareholding ratio of foreigners (FOR) was 2.74, the shareholding ratio of institutional investors (INS) 0.44, and the ratio of outside directors (ODR) was 16.56. The average of the variables related to financial structure was lowest in profitability (ROI) with a value of 5.15, while the average for growth (SG) was 13.13, and that for Leverage (LEV) was 44.73. The average of liquidity (LIQ) was the highest with 486.60, and the maximum and minimum values show that there are considerable gaps among firms. Firm size, firm age and BS which this study considered as control variables and factors that may influence R&D investment, turned out not to have a great standard deviation compared to the average and, therefore, appeared not to have a significant problem in normal distribution.

Table 2. Descriptive Statistics

Variable	Obs	Mean	SD	Min	Max
RD	358.00	8.24	12.48	0.12	99.07
OWN	358.00	41.08	14.44	2.31	79.50
FOR	358.00	2.74	7.10	0.00	57.79
INS	358.00	0.44	2.75	0.00	45.05
ODR	358.00	16.56	15.56	0.00	83.33
ROI	358.00	5.15	8.93	-63.34	32.11
SG	358.00	13.13	32.03	-48.72	501.81
LIQ	358.00	486.60	361.10	35.20	2269.89
LEV	358.00	44.73	39.78	2.72	344.90
SIZE	358.00	7.69	0.33	6.98	9.24
YEAR	358.00	0.70	0.34	0.00	1.32
BS	358.00	0.63	0.12	0.48	1.04

2. Correlations

The analysis of the correlation between each independent variable of the listed firms showed significant correlation between the independent variables[Table 3]. In the analysis of the RD variable and OWN (-.313), ROI (-.297), LIQ (.210), SIZE (.153) showed significant correlation.

Table 3. Pearson's correlation coefficients

	RD	OWN	FOR	INS	ODR	ROI	SG	LIQ	LEV	SIZE	YEAR	BS
RD	1											
OWN	-0.3138*	1										
FOR	0.0785	0.0044	1									
INS	-0.0569	0.0976	-0.0617	1								
ODR	-0.0252	-0.0337	-0.0063	-0.5077*	1							
ROI	-0.2972*	0.2653*	-0.1253*	-0.0453	-0.0603	1						
SG	0.0126	-0.1253*	0.0113	-0.013	0.1256*	0.0618	1					
LIQ	0.2103*	-0.0453	0.0387	0.0654	-0.2198*	0.0815	-0.0617	1				
LEV	0.0588	-0.0603	-0.1403*	-0.0619	0.1069*	-0.3885*	-0.0063	-0.5077*	1			
SIZE	0.1533*	-0.1034	0.3888*	-0.0149	0.4193*	0.1033	0.0657	-0.2650*	0.2014*	1		
YEAR	-0.0999	-0.0995	0.0175	-0.0864	0.2706*	-0.1851*	-0.0211	-0.0603	0.1074*	0.3615*	1	
BS	0.0703	-0.0017	-0.0397	-0.0564	0.1243*	-0.0269	0.0883	-0.0989	0.0145	0.0596	0.0341	1

3. Panel Regression

We suggested a fixed effects model based on the Hausman test results. This study conducted a panel analysis with the dependent variable of R&D investment and independent variables related to ownership structure 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. The results are presented in [Table 4]. 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 over 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. The shareholding ratio of foreigners turned out to have a statistically significant influence on R&D investment. The result was similar to the prediction that the higher shareholding ratio of foreigners will lead to greater R&D investment, and that foreign investors will prefer companies actively engaged in R&D investment. The ratio of outside directors and R&D investment ratio showed a statistically significant negative relationship. No statistical significance was found in the shareholding ratio of institutional investors.

IV. Conclusion

1. Discussion

Table 4. Result

Fixed Model	Coef.	S.E	Coef.	S.E
OWN			0.141***	0.0510
FOR			0.396***	0.0869
INS			-0.059	0.102
ODR			-0.0830**	0.0339
ROI	0.0437	0.172	-0.0186	0.165
SG	-0.0168*	0.0101	-0.0152	0.00962
LIQ	0.00148	0.00123	0.00174	0.00118
LEV	-0.00754	0.0152	-0.00663	0.0154
SIZE	-0.151	2.959	-3.308	2.957
YEAR	3.060*	1.735	6.667***	1.817
BS	-2.03	3.685	1.896	3.670
constant	8.962	22.24	21.87	22.32

This study conducted an integrated analysis on the factors influencing R&D investment in the KOSDAQ pharmaceutical firms, through a detailed review of the ownership structure in this industry in Korea. To explain the factors influencing R&D investment in pharmaceutical companies, this study reviewed previous theories that have been developed, and then examined the logical basis and validity concerning the application of the financial structure theory and the ownership structure theory to pharmaceutical companies. 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 first phase was concerned with determining the factors influencing 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. This result indicates that if a manager owns many shares, he or she would select an R&D investment plan that is expected to enhance long-term value even when there is great uncertainty in terms of outcome (that is, even if there is an increased risk of job insecurity and compensatory reduction). One of the key assumptions of the agency theory is that if the manager owns shares, his or her motivation for risk preference increases[21]. Though this assumption was proved in numerous studies[8][17-21], it was also challenged by quite a few studies in Korea as well as overseas[22-25]. However, the findings of this study imply that the relationship between the shareholding ratio of major shareholders and R&D investment is carried out through the agency theory. Further, it leads to the inference that the assumption that "the management practice related to ownership structure in Korea has been significantly changed since the financial crisis" is valid. The findings regarding the relationship between the shareholding

ratio of major shareholders and R&D investment drawn by this study can be the facilitator for future comparative studies on business practices as well as on other aspects of ownership structure, such as the compensation system, market, law, and administrative regulations beyond just ownership structure.

Second, this study showed that the shareholding ratio of foreigners has a positive relationship with R&D investment. This result indicates that the logic of this study is valid in its argument that if there is a higher shareholding ratio of foreigners—who are free from the pressures faced by the manager, have a strong will to monitor the manager, have great monitoring ability, and tend to make long-term investments—there is more investment in R&D that leads to long-term value enhancement. Moreover, this result also systematically supports the argument[25][26] that foreigners have an outstanding ability to monitor and control a manager's opportunistic behaviors. Of course, one cannot exclude the possibility that foreign investors may have invested in companies with low agency costs. Yet, even in this case, foreign investors have the effect of leading improvement in the ownership structure in Korean pharmaceutical companies, which is expected to contribute to the enhancement of competitiveness in the long run. 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 bring long-term value. This is ex post proof that the policy to enhance a company's transparency and competitiveness by opening the capital market is a valid strategy regardless of whether the listed market is utilized. Thus, this study implies that it is necessary to

establish various plans to attract investment from foreigners in order to enhance enterprise value.

Third, the ratio of outside directors is a structural variable that protects shareholders' benefits by enhancing the independence of the board of directors. Its effectiveness is supported by many empirical studies on the relationship between the ratio of outside directors, R&D investment, and enterprise value[8][27]. However, obligations of outside directors at companies with an asset size of less than are not determined, and thus legal regulations are insufficient. Therefore, such directors are considered to represent the interests of the company managers rather than the interests of shareholders since they are recommended by the managers, have personal relationships with them, or their employment is tied to the them[28][29]. In other words, surveillance and supervision of listed companies has not been carried out properly, causing certain repercussions. Investors appear to want more reinforced surveillance and supervision than the minimum requirement, and there is a need for pro-active steps to be taken. Therefore, policy-making authorities must improve the outside director system to better perform the role of controlling and monitoring a manager's opportunistic behaviors. This also implies that it is necessary to approach R&D-related policies for industrial development at large corporations, small and medium-sized enterprises (SMEs), and venture businesses discriminately. Therefore, the following factors should be considered for future policies that support pharmaceutical companies.

2. Limitations

The 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.

There was a limitation in generalizing the major findings because the research subjects were limited to the Korean pharmaceutical industry. It is necessary to conduct an in-depth analysis on the uniqueness of the pharmaceutical industry by performing a comparative analysis between the pharmaceutical industry and other industries where R&D intensity is high. And as panel data analysis was conducted on firms from which data for measuring both the financial and ownership structures could be collected, a difference between the firms was found because the number of sample firms decreased. Thus, it would be necessary to conduct additional analysis by separately analyzing the financial structure and the ownership structure, or by analyzing according to the characteristics (size, pharmaceuticals on sale, etc.) of the firms. Despite its limitations, this recent study is the first one to analyze the influence of financial structure, ownership structure, and the characteristics of the market on R&D investment in the pharmaceutical industry. Thus, the significance of this study is that it has laid the foundation for future studies to be actively conducted on a similar theme.

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