https://doi.org/10.5392/JKCA.2018.18.04.444

국제 금융위기 이후 국내 유가증권시장 상장기업들의 연구개발비에 대한 분위회귀분석 연구

Conditional Quantile Regression Analyses on the Research & Development Expenses for KOSPI-listed Firms in the Post-era of the Global Financial Turmoil

김한준
호서대학교 사회과학대학 경영학부

Hanjoon Kim(khj723@hoseo.edu)

요약

본 연구의 주제는 재무분야 중 기업의 연구개발비 지출에 대한 결정요인에 대한 분석이다. 국가별 연구개발비 비중 기준, 국내 자본시장은 국제적인 측면에서 최고의 수준으로 평가되고 있으며, 사기업들의 연구개발비 비중에서 대기업들은 큰 비중을 차지하고 있다. 이와 관련하여, 본 연구에서는 국제금융위기 이후 유가증권시장 상장기업들을 표본자료로 활용하여, 연구개발비의 재무적 결정요인을 분석하기 위한 분위별 회귀분석 방법론이 첫째 가설에서 시행되었다. 둘째 가설에서는 연구개발비 지출 기준 상위 그룹과 하위 그룹 간의 재무적 상대적 차이점이 검정되었고 추가적인 검정에서는 언급한 상위, 하위 그룹들에 속한 표본기업들 뿐만 아니라, 표본기간 중 연구개발비 지출이 없었던 그룹들을 포함한 총 3개 그룹들 간의 차이점을 재무적 관점에서 규명하였다. 연구결과 관련, 전년도의 연구개발비 수준, 기업규모, 부도 위험도 그리고 광고비 등이 현재 연구개발비 수준을 결정하는 재무적 요인들로서 종합적으로 판명되었다. 본 연구는 연구개발비의 결정요인들을 종합적 관점에서 분석한 기존 연구(즉, [1])의 추가적 심층연구로서 의미도 있다고 판단하며, 향후 국내 자본시장을 포함한 신흥자본시장과 선진자본시장의 연구개발비 최적 수준 분석에 응용되어 주주의 부의 극대화에 기여할 수 있을 것으로 기대된다.

■ 중심어 : | 국제금융위기 | 다중로짓분석 | 분위회귀분석 | 연구개발비 | 유가증권시장 상장기업 |

Abstract

The study addresses the analysis on the financial determinants of corporate research and development (R&D) expenditure in finance. Overall level of R&D spending was estimated as one of the top-tier on a global basis and a majority of the expenditure was invested by large domestic firms in private sector. Consequently, financial factors that influence R&D intensity were empirically tested in the first hypothesis by using conditional quantile regression model for firms listed in KOSPI stock market in the post-era of the global financial turmoil. Firms in the groups of high- and low-R&D intensity were statistically compared to detect financial differences in the second hypothesis which was accompanied by the test of multi-logit model that included firms without R&D outlay. Concerning the results of the hypothesis tests, R&D spending of the prior fiscal year, firm size, business risk and advertising expense overall showed statistically significant impacts to determine the level. As an extended study of [1] that had examined financial factors of R&D intensity at the macro-level, the results of the present study are anticipated to contribute to maximizing shareholders' wealth in advance or emerging capital markets, when applied to find an optimal level of R&D expenditure.

■ keyword : | Global Financial Turmoil | Multi-logit Analysis | Conditional Quantile Regression | Research and Development Expenditure | KOSPI-listed Firms |

접수일자 : 2018년 02월 06일
수정일자 : 2018년 03월 05일
심사완료일 : 2018년 03월 14일
교신저자 : 김한준, e-mail : khj723@hoseo.edu

I. Introduction

The study addresses one of the financial aspects in relation to corporate investments or expenditures such as research and development (hereafter, R&D) by the firms listed in the KOSPI (Korea Composite Stock Price Index) in the domestic capital market. From the perspectives of academics and practitioners, it seems that over- or under-investments in corporate R&D activities are financial issue of concern, which may be associated with any moral hazard incurred by incumbent management, as presented in [1]. Given that it is essential to attain an optimal level of corporate R&D spending to maximize firm value, the present study is to identify financial factors to determine the level as a research objective. By identifying financial factors estimated on a absolute and relative basis as described later, it is anticipated for most firms may control or adjust the level of each factor to enhance firm value.

The followings are the primary motivations to empirically conduct the study, which may differ from the previous studies inclusive of [1]. First, the results of [1] as an antecedent of the present study, are further examined in different empirical settings to identify financial factors on the R&D intensity for consistency and robustness. Specifically, in the present study, KOSPI-listed firms during the post-period of the global financial turmoil, are grouped into separate categories in terms of the level of R&D outlay. It was reported by [2] that the proportion of total corporate R&D expenditure made by top 5 corporations (in terms of sales) accounted for 37.2%, while top 10 and top 20 domestic firms constituted 41.7% and 49.3% during the year, 2015. Therefore, it may be necessary to re-examine financial determinants of corporate R&D intensity for KOSPI-listed firms that are differentiated by each group of the sample firms on the basis of the level of R&D intensify. Second, there are relatively abundant researches on the R&D investments, whose subjects had been mostly involved in the relationship between the overall level of intensity and the rate of stock return, and operating earnings as reviewed in the next section. In constrast, little attention has been paid to the subject of corporate R&D intensity, whose levels are categorized into subgroups to be separately tested to determine significant factors on an absolue or a relative basis, as described later. Results obtained from each category will be compared to detect any commonalities and distinctions among the subgroups, which may mainly differ from the findings in the preceding research. Finally, results with validity are expected to be practically applied to domestic firms with headquarters in other capital markets such as advanced and emerging capital markets, when searching for their optimal levels of R&D expenditures, as also described in [1]. Likewise, the findings of the study may be interchangeably utilized for foreign firms which establish their corporate policies of overseas subsidiaries in the Korean capital market in relation to R&D activities. This may also contribute to maximizing firm value through the effective R&D investments, as similarly presented in [3].

II. Literature Review

As for the study performed by [4] with utilizing the sample data comprising total 438 U.S. firms during the period from 1977 to 1987, one of the fundamental assumptions was postulated as corporate manager may choose R&D investment opportunities based on the cases of three scenarios: the second scenario assumed that manager should consider to make investments with the amount of a part of all of the

R&D investment opportunities, when the difference between anticipated corporate earnings before R&D and its income target, is smaller than total amount needed to invest all the opportunities. Based on these scenarios, the study posited a hypothesis whether relative R&D outlay for the second scenario is less than those for the other two scenarios. The results provided evidence that corporate R&D was overall smaller in the second scenario than their counterparts in the first and the second scenarios. The study of [5] tested that corporate earnings may adjusted by management in the short run, if projected earnings are likely to be deviated from its original target goal for the same fiscal year. They tested a primary hypothesis that changes in R&D expenditures may be associated with those in corporate earnings, presenting that management adjusts R&D costs to achieve its original goal in terms of corporate income. A positively significant linkage between the two variables (i.e., unexpected R&D and unexpected income) were found. [6] hypothesized whether or not there exists a significant relationship between R&D expenditures and corporate benefits of corporate earnings. Concerning the results from the model to examine a relationship between annual operating income and R&D expenditures, it was estimated that average duration of benefit after R&D investments for the chemical and pharmaceutical industry was 9 years, whereas the duration in the scientific instruments industry was the shortest as 5 years. The study conducted by [7] tested for U.S. market reaction in terms of long-term stock rate of return and operating performance since corporate R&D expenditure is announced. Concerning the results to examine a statistically significant abnormal rate of return for the sample cases, the alphas estimated in the models showed their importance as a measure for the abnormal return across all sample groups. Meanwhile, for the full sample covering from 1951 to 2001, there was a positively significant difference in operating income, indicating higher rate of operating performance for the firms with R&D expenditure, in comparison with those without the outlay. Finally, in the study of [1], financial determinants that may influence R&D intensity are tested for the sample firms during the period from 2010 to 2015. In another hypothesis, financial components to discriminate between firms in high-growth sector (inclusive of high-tech industries) and low-growth sector are also tested. Concerning the results of the hypotheses, the explanatory variables such as one-period lagged R&D intensity (i.e., Lag_RD), interaction term between the Lag_RD and type of industry in terms of growth stage, and advertising expenses showed pronounced discriminating power to affect R&D expenditure. Moreover, it was demonstrated that high-growth firms maintained higher Lag_RD, profitability and foreign ownership in equity than their counterparts of low-growth sectors. low-growth firms overall possessed higher market-value based debt ratio and advertising expense.

III. Data Collection and Primary Hypotheses

3.1 Sampling Data and Proxy Variables

Since the study is an extended study of [1], the criteria to select the sample observations are the same as those described in [1].

Table 1. Data Sampling Criteria

1. Data for each variable employed in the study are available for at least six years from 2010 to 2015.
2. Sample firms were listed in the KOSPI stock market at the end of the fiscal year, 2015.
3. Data should be included in the whole population of the KisValue database sourced from the NICE.
5. Firms in the financial and regulated industries are excluded in the final sample data.

Total number of the sample firms which meet the above criteria, are finalized as 613 firms selected by total 24 domestic industries. To illustrate as in [1], all the financial data for the study were selected from consolidated financial statements based on K-IFRS, if applicable.

Table 2. List of variables employed

Definition	Symbol	Measurement
R&D Intensity of the previous fiscal year: [1], [13],[17]	Lag_RD	(R&D Expenses)t-1 / Salest-1
Interaction between high-growth Firm and R&D Intensityt-1 : [1],[13]	INTERRD	Dummy Variable on High-growth Firm x (R &D Expensest-1 / Salest-1)
Firm Size: [1],[13],[18]	SIZE	Natural Logarithm of Sales Amount
Market-value Based Leverage: [1], [14]	MLEVER	Book value of liabilities / (Book Value of Liabilities + Book Value of Preferred Equity + Market Value of Common Equity)
Profitability: [1],[6],[18]	PROF	[EBIT (i.e., Earnings Before Interest & Taxes) + Depreciation & Amortization + R&D Expenses)] / Total Assets
Growth	GROWTH	(Market Value of Common Equity + Book Value of Preferred Equity) / Book Value of Equity
Change in Cash Liquidity	CASHHOLD	[(Cash & Cash Equivalents)t − (Cash & Cash Equivalents)t-1] / Total Assets
Foreign Ownership: [1]	FOS	Foreign ownership in common Equity
Business Risk: [18]	VOLATILITY	3.3 x (EBIT / Total Assets) + 1.0 x (Sales / Total Assets) + 1.4 x (Net Income / Total Assets) + 0.6 x (Market Value of Equity / Book Value of Equity)
Change in Tangible Assets: [17],[18]	TANASSET	(Tangible Assetst − Tangible Assetst-1 / Total Assetst)
Advertising Expenses: [6]	ADVERTISE	Advertising Expenses / Total Assets

Dependent variable (DV) employed to represent corporate R&D intensity is defined as R&D expenses scaled by sales, which was also used in the previous literature such as [1] and [4] for comparability. For confirm validity the empirical results, the same explanatory variables (i.e., the eleven ones) as those in [1] were also employed in the first hypothesis to account for the level of corporate R&D outlay for KOSPI-listed firms. On the other hand, total 16 explanatory variables were employed in the second hypothesis test by adding six new variables in the corresponding models. That is, besides four time (or year) dummy variables such as F2012, F2013, F2014 and F2015, NETINVEST as a substitute for TANASSET, that is defined as changes in working capital, tangible assets and other investments that are scaled by total assets and a squared variable of the Lag_RD (i.e., Slag_RD) that may account for non-linearity were entered into the models for the second hypothesis. In stead of book-value based leverage, the study adopted market-value based debt ratio to accommodate the definition in the classical Miller & Modigliani (M&M) theory.

3.2 Hypotheses and Econometric Estimations

Two primary hypotheses in association with corporate R&D spending are formulated to investigate financial characteristics of the level of R&D on a absolute and a relative basis. That is, when they are postulated, the hypotheses tested in the preceding study of [1], may be indirectly used in order to further examine pronounced financial factors between or among firms beloning to each subsample groups in the study.

<The First Hypothesis>

$H1_0$: There may not exist any statistically discriminating financial determinants to influence corporate R&D expenditure for KOSPI-listed firms which are grouped into categories by conditional quantile regression

(CQR) model during the post-period of the global financial turmoil.

As outlined in [8] and [9] for the underlying rationale of the CQR, let (yi, xi), i=1,. . .,n be a sample from some population where x_i is a (K x1) vector of regressors. Assuming that the Θth quantile of the conditional distribution of y_i is linear in x_i, the CQR model can be formulated as follows: $y_i = x_i'\alpha\Theta + \mu\Theta_i$

$\text{Quant}\Theta\ (y_i \mid x_i) \equiv= \{y: Fi(y \mid x)\Theta\} = x_i'\alpha$

$\text{Quant}\Theta\ (\mu\Theta_i \mid x_i) = 0$

, where $\text{Quant}\Theta\ (y_i \mid x_i)$ indicates the Θth conditional quantile of y_i on the regressor vector of x_i'. αΘ is the unknown vectors of parameters to be estimated for varying values of Θ in (0,1). μΘ is the error term which is assumed to have a continuously differentiable c.d.f. FμΘ (.|x) and a density function fμΘ (.|x). Fi(.|x) denotes the conditional distribution function of y. By varying the value of Θ from 0 to 1, we trace the entire distribution of y conditional on x. The estimator for αΘ is obtained from: min

$$\sum_i^n \rho\theta(Yi - Xi'\alpha\theta)$$

, where ρΘ(μ) is the check function as ρΘ(μ) = Θμ if μ ≥ 0, (Θ−1)μ, otherwise.

The check function denotes that positive and negative values are asymmetrically assigned varying weights according to the positive and negative residuals, which is presented in [10].

<The Second Hypothesis>

H2-1₀: By utilizing binary dependent variable models, KOSPI-listed firms with higher R&D intensity may not possess any financial factors that are statistically different from their counterparts with lower R&D intensity during the sample period.

To implement the empirical procedure, total sample observations with R&D expenditure during the examined period were divided into two subgroups on the basis of their median of R&D intensity as 0.0041152. Moreover, estimations by the models such as logit, probit and complementary log-log (CLOG) models, were adopted for the validity of the outcome, as also done in [1]. The functional form of the logistic regression model is as follows. [15]

$$P(\text{high R\&D}) = e^{a+b'x} / (1 + e^{a+b'x})$$

, where P(high R&D) is the probability that a firm will be classified in the group of higher level of R&D intensity, which is bounded between 0 and 1. It labels α and β as the intercept and vector of slope parameters, respectively. x is a vector of independent variables for each year.

Moreover, the CLOG regression method may be more effective than the former two methods to accommodate the assumption of an extreme-value distribution of a disturbance term, as in [16]. The probability modeled is '1' assigned to the subsample group with higher R&D intensity ratio that is above the median.

H2-2₀: KOSPI-listed firms whose R&D intensity is in the mid-range of the intensity measured for all the sample observations, may not have financially discriminating components in comparison to those in the high- or low-range in the statistical context.

Since three subgroups are tested in the multi-logit regression model for the aforementioned hypothesis, categorical numbers such as '0' and '2' were separately assigned to the subgroup of firms without any R&D outlay and with R&D intensity larger that the median (=0.0041152), respectively. (The categorical number (i.e., CATEG) for the subgroup in the mid-range, was set to '1' as a reference group.)

IV. Financial Analyses and Discussion

4.1 Analyses on the Results From Hypotheses

Table 3. Results of the Estimated Coefficient of the Explanatory Variable on Corporate R&D Intensity for KOSPI-listed Firms by Applying Conditional Quantile Regression (CQR) Models

Variable	Test for Equal Coefficient Across Quantiles	Quantile (20%)	Quantile (40%)	Quantile (60%)	Quantile (80%)
Constant	〈N.A.〉	−0.002*(−3.25)	−0.0006(−1.20)	0.0012(1.87)	0.0044*(3.97)
Lag_RD	58.90*	0.59*(19.89)	0.86*(30.76)	0.9818*(34.20)	1.07*(32.97)
INTERRD	10.36*	0.21*(6.15)	0.08*(2.55)	0.0422(1.44)	0.09*(2.93)
SIZE	44.34*	0.0001*(3.35)	0.0001(1.67)	−0.0001(−1.06)	−0.0001*(−2.99)
MLEVER	3.57	−0.0001(−0.25)	−0.0002(−1.69)	−0.0003(−1.91)	−0.001(−1.93)
PROF	14.49*	0.002*(2.81)	0.001(1.30)	−0.0001(−0.10)	−0.003(−1.64)
GROWTH	6.01	−0.0001(−1.06)	0.0001(0.61)	0.0001(0.99)	0.0002(1.83)
FOS	3.39	−0.0004(−1.31)	−0.0001(−0.38)	−0.0001(−0.30)	−0.0002(−0.32)
CASHHOLD	0.33	−0.0005(−0.68)	−0.0004(−0.67)	−0.0003(−0.47)	0.0002(0.15)
VOLATILITY	5.04	−0.0001(−1.72)	−0.0001(−1.83)	−0.0001*(−2.02)	−0.0002*(−2.04)
TANASSET	0.17	0.0001(0.19)	0.0001(0.18)	0.0001(0.19)	−0.0004(−1.00)
ADVERTISE	20.11*	0.0053*(2.33)	−0.001(−0.28)	0.0003(0.10)	0.005(0.78)

〈Note〉 * indexes a statistically significant estimate at the 5% level and the number in parentheses denotes t-statistic.

Table 4. Results to Identify Discriminating Factors of Corporate R&D Expenditure Between Firms with higher R&D Intensity and Their Counterparts with Lower one

Variable	Logit	Probit	CLOG
constant	−1.38	−0.73	−1.16
Lag_RD	603.8*	271.2*	186.5*
INTERRD	47.95	9.41	−33.67*
SIZE	−0.05	−0.02	−0.003
MLEVER	−0.64	−0.32	−0.24
PROF	−0.01	−0.003	0.001
GROWTH	0.09	0.05	0.08
FOS	0.47	0.51	0.82*
CASHHOLD	−1.12	−0.66	−1.43*
VOLATILITY	−0.19	−0.11	−0.16*
ADVERTISE	12.58*	8.21*	10.99*
Slag_RD	−3243.2*	−1414.0*	−851.8*
NETINVEST	714.3	245.3	177.2
F2012	0.23	0.10	0.11
F2013	0.001	−0.03	0.01
F2014	0.29	0.12	0.07
F2015	0.05	−0.10	−0.48*
Goodness of Fit	1620.71*	1510.76*	1182.92*

〈Note〉 Each coefficient was estimated by the maximum likelihood method. Test for overall goodness of fit was performed by the likelihood ratio test, while the Wald test was used to test for a significance of each individual coefficient. * also indicates a significance at the 5% level.

In [Table 3]. amongst the eleven regressors in the model, only 5 explanatory variables showed their significant differences across the categories or quantiles at the 5% level. (i.e., Lag_RD, INTERRD, SIZE, PROF and ADVERTISE in the second column of the table.) Moreover, the variables such as Lag_RD and INTERRD showed their positively significant effects to determine the R&D expenditure for KOSPI-listed firms across all or the majority of the quantiles, whereas SIZE and VOLATILITY were statistically pronounced factors of the expenditure in a half of all quantiles as reported in [Table 3]. Concerning the first sub-hypothesis of the second hypothesis to identify financial factors to discriminate between firms with higher and lower R&D intensity, the results are reported in [Table 4].

Regarding the analyses of the first sub-hypothesis, all models statistically corroborated the importance of financial factors such as Lag_RD, Slag_RD and ADVERTISE to discriminate between the firms in terms of the level of R&D intensity, as reported in [Table 4].

Table 5. Results of the Multi-logit Analysis for Firms on R&D intensity During the Post-era of the Global Financial Turmoil

Parameter	CATEG	Estimate	Chi-square	p-value
constant	0	5.24	30.10	〈0.0001
constant	2	-1.71	1.63	0.202
Lag_RD	0	-942.4	118.54	〈0.0001
Lag_RD	2	460.4	191.70	〈0.0001
INTERRD	0	261.0	7.12	0.008
INTERRD	2	53.41	2.74	0.098
SIZE	0	-0.16	16.07	〈0.0001
SIZE	2	-0.02	0.18	0.670
MLEVER	0	-0.44	3.10	0.078
MLEVER	2	-0.59	2.19	0.139
PROF	0	0.01	0.04	0.849
PROF	2	-0.01	0.03	0.874
GROWTH	0	-0.01	0.04	0.833
GROWTH	2	0.09	1.50	0.221
FOS	0	0.50	1.23	0.266
FOS	2	0.64	0.98	0.321
CASHHOLD	0	-0.77	1.35	0.245
CASHHOLD	2	-1.40	3.08	0.079
VOLATILITY	0	-0.01	0.02	0.880
VOLATILITY	2	-0.17	2.43	0.119
ADVERTISE	0	5.04	1.68	0.195
ADVERTISE	2	12.53	8.04	0.005
Slag_RD	0	3556.5	117.52	〈0.0001
Slag_RD	2	-2531.3	182.33	〈0.0001
NETINVEST	0	117.0	0.11	0.743
NETINVEST	2	523.7	1.64	0.201
F2012	0	-0.14	0.83	0.362
F2012	2	0.43	3.39	0.065
F2013	0	-0.08	0.34	0.561
F2013	2	0.22	0.83	0.362
F2014	0	-0.17	1.18	0.278
F2014	2	0.42	3.15	0.076
F2015	0	-0.07	0.18	0.67
F2015	2	0.18	0.55	0.458
Goodness of Fit	〈N.A.〉	〈N.A.〉	2944.52	〈0.0001

〈Note〉 Each coefficient was estimated by the maximum likelihood method. Test for overall goodness of fit was performed by the likelihood ratio test, while the Wald test was used to test for a significance of each individual coefficient.

As reported in [Table 5], it was analyzed at the 5% level that four and three regressors were differentiated between firms without R&D outlay (i.e., CATEG=0) and firms in the reference group (i.e., CATEG=1), and between the latter ones and firms with higher R&D intensity (i.e., > 0.0041152) as CATEG=2, respectively. For instance, the probability to be grouped in CATEG=2 will enlarge if Lag_RD gets larger in comparison with CATEG=1, while the probability will decrease to be CATEG=1 against CATEG=0 if the same variable becomes larger. Moreover, a one unit increase of ADVERTISE, is associated with a 12.53 increase in the relative log odds of being in CATEG=2 vs. CATEG=1, as described in [12].

4.2 Discussion

First, the outcome of Lag_RD that is statistically significant across all quantiles in [Table 3] is in conformity with the consequence of [1]. Therefore, KOSPI-listed firms overall seemed to have a tendency to maintain their persistent levels of R&D outlay over the sample period, which may be detrimental to firm value in case of sudden or instable changes of economic stage as presented in [1]. Second, the interaction effect of INTERRD showed its positively significant impacts in the majority of the quantiles in relation to current R&D intensity. In other words, the study also corroborated the result obtained from [1], in that the prior year's R&D intensity of the high-growth firms in the sample data are positively associated with the intensity of the current fiscal year. Therefore, it may be concluded that Lag_RD is one of the most significant financial factors to determine the level of corporate R&D outlay for KOSPI-listed firms that belong to the high-growth sector in a statistical perspective. Finally, it was interesting to detect the finding in the study that firm size, SIZE, may affect the level of R&D spending, that had been identified as an insignificant factor in the preceding study of [1]. That is, the significance of size effect in relation to the dependent variable was only applicable to two extreme quantiles (i.e., 20% and 80%) as reported in [Table 3] with an opposite direction.

Regarding the consequences associated with the second hypothesis as reported in [Table 4] and [Table

5], there are a few explanatory variables to significantly account for financial differences between or among the subsample groups in either binary or trinary dependent variable model. In line with the persistent importance of the variable of Lag_RD across the models, Slag_RD with a negative sign, also showed its financial influence to differentiate between firms with higher R&D intensity and their counterparts with lower one, that is reported in [Table 4]. This phenomenon may suggest that the probability to be classified into the subsample of firms with a higher R&D ratio may increase if the level of R&D intensity of a prior year becomes larger. However, the tendency for KOSPI-listed firms to be grouped into the aforementioned subsample decreases, as indicated by the squared term, Slag_RD, with its negative sign. Furthermore, it is noteworthy that the tendency linked to Slag_RD seems to revert to or be centered on the reference group (i.e., CATEG=1) from both groups such as CATEG=0 and CATEG=2., which is implied by the estimated signs of Slag_Rd in [Table 5]. Meanwhile, aa for ADVERTISE, the probability to be grouped in firms with higher level of R&D ratio (i.e. CATEG=2) will get larger, if the advertising expense increases with its positive signs of estimated coefficient across the models in [Table 4]. The empirical result was corroborated by the finding of the statistically significant estimate of ADVERTISE as 12.53, when applying the multi-logit model in [Table 5]. Based on the conventional theory of finance involved in agency cost of equity, both R&D and advertising expenses may offset each other with considering the limitations of raising capital. Both of them are classified into the same class of corporate capital as intangible one. Given the positive association between corporate R&D and advertising expenses found in the study, moral hazard incurred by the incumbent management in relation to spending in intangible capital, may not be a serious issue for KOSPI-listed firms on a relative basis.

V. Concluding Remarks

The study as an extended one of [1] further investigated possible financial attributes of corporate R&D outlay for KOSPI-listed firms on a absolute and relative bases. From academic and practical perspecitves, the study may differ from those in the previous literature in that it attempts to further examine financial characteristics of corporate R&D expenditure on the basis of each categorized level. Moreover, any statistical differences among the subgroups of the sample data inclusive of firms without any R&D spending during the investigated period, were simultaneously tested in the multi-logistic model for a comprehensive analysis. Amongst total 12 proposed variables, only a few ones such as Lag_RD, INTERRD, SIZE and VOLATILITY generally revealed their statistically significant impacts to determine the level of R&D outlay in the first hypothesis. In the second hypothesis applying binary and trinary dependent models, Slag_RD as a proxy variable of non-linearity and ADVERTISE showed their significant influence to discriminate between or among the subsamples of KOSPI-listed firms that were categorized by the level of R&D intensity. It is anticipated that the study provides further insight into identifying financial factors in the domestic capital market, which may also be beneficial for firms in advanced or emerging capital markets to search for their optimal levels of R&D expenditure.

참 고 문 헌

[1] H. Kim, "Further Examinations on the Financial Aspects of R&D Expenditure for Firms Listed in the KOSPI Stock Market," Unpublished Working Paper, 2018.

[2] http://www.msit.go.kr/web/msipContents/contents.do?mId=NzM=

[3] H. Kim, "Financial Profile of Growth Engine For Corporations Headquartered in Chungcheong Province in the Republic o Korea," J. of International Trade & Commerce, Vol.12, No.1, pp.21-33, 2016.

[4] W. Baber, P. Fairfield, and J. Haggard, "The Effect of Concern about Reported Income on Discretionary Spending Decisions: The Case of Research and Development," The Accounting Review, Vol.66, No.4, pp.818-829, 1991.

[5] S. Perry and R. Grinaker, "Earnings Expectations and Discretionary Research and Development Spending," Accounting Horizons, Vol.8, No.4, pp.43-51, 1994.

[6] B. Lev and T. Sougiannis, "The Capitalization, Amortization, and Value-relevance of R&D," J. of Accounting and Economics, Vol.21, pp.107-138, 1996.

[7] A. Everhart, W. Maxwell, and A. Siddique, "An Examination of Long-term Abnormal Stock Returns and Operating Performance Following R&D Increases," J. of Finance, Vol.59, No.2, pp.623-650, 2004.

[8] H. Kim, "Investigations on the Financial Determinants of Profitability for Korean Chaebol Firms by Applying Conditional Quantile Regression (CQR) Model," J. of Contents Association, Vol.14, No.12, pp.973-988, 2014.

[9] B. Fattouh, P. Scaramozzino, and L. Harris, "Capital Structure in South Korea: a Quantile Regression Approach," J. of Development Economics, Vol.75, pp.231-250, 2005.

[10] W. Nelson and B. Arshanapalli, "Using Quantile Regressions to Examine the Capital Structure Decision of US Firms," Global Conference on Business and Finance Proceedings, Vol.9, No.1, pp.321-328, 2014.

[11] H. Kim, "Categorical Financial Analyses on the Level of Corporate Cash Reserves for Korean Chaebol Firms in the Post-Era of the Global Financial Crisis," J. of Contents Association, Vol.16, No.2, pp.729-739, 2016.

[12] https://stats.idre.ucla.edu/sas/output/multinomial-logistic-regression/

[13] S. Chan, K. Martin, and J. Kensinger, "Corporate Research and Development Expenditures and Share Value," Journal of Financial Economics, Vol.26, pp.255-276, 1990.

[14] H. Quin, K. Zhong, and Z. Zhong, "Seasoned Equity Issuers' R&D Investments: Signaling or Overoptimism," Journal of Financial Research, Vol.35, No.4, pp.553-580, 2012.

[15] R. Ramanathan, *Introductory Econometrics with Applications* (2nd edition), The Dryden Press, 1992.

[16] P. Allison, *Logistic Regression Using SAS: Theory and Application* (2nd ed.), SAS Institute, 2012.

[17] L. Chan, J. Lakonishok, and T. Sougiannis, "The Stock Market Valuation of Research and Development Expenditures," Journal of Finance, Vol.56, No.6, pp.2431-2456, 2001.

[18] C. Shi, "On the trade-off between the future benefits and riskness of R&D: a bondholders' perspective," Journal of Accounting and Economics, Vol.35, pp.227-254, 2003.

저 자 소 개

김 한 준(Hanjoon Kim) 정회원

- 1985년 : 연세대학교(학사), 서울
- 1987년 : 조지워싱턴대학교(경영학석사), 미국
- 1999년 : 보스턴대학교(경영학박사, 재무관리 전공), 미국
- 현재 : 호서대학교 사회과학대학 경영학부 전임교원

<관심분야> : 기업재무 (기업가치평가, 인수합병(M&A), 자본구조 등), 국제금융론 등