

A Financial Comparison of Corporate Research & Development (R&D) Determinants: The United States and The Republic of Korea

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한국과 미국 자본시장에서의 연구개발비 비중에 관한 재무적 결정요인 분석

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Abstract Given the ongoing debate in many aspects of finance, more attention may need to focus on corporate R&D expenditures. This study empirically tests financial determinants of R&D expenditures for NYSE-listed and KOSPI-listed firms. Three major hypotheses were postulated to test for corporate R&D outlay. First, proposed variables such as one-year lagged R&D expenditures, market value based leverage, profitability and cash holdings showed significant influence on corporate R&D costs for the sample firms. Moreover, financial factors inclusive of squared one-year lagged R&D expenditures, the interaction effect between one-lagged R&D expenditures and high-growth firm, non-debt tax shield, Tobin's q and a dummy variable to explain differences in accounting treatment between the U.S. and Korea, revealed significant differences between the two samples. Finally, in the conditional quantile regression (CQR) analysis for the R&D-related variables in relation to corporate growth rate, it was found that the NYSE-listed firms had a statistically significant linkage between growth potential and one-year lagged R&D expenditures at lower quantile levels. This study may shed new light on identifying financial factors affecting differences between the U.S. market (as an advanced market) and the Korean market (as an emerging market) regarding the optimal level of R&D investments for shareholders.

요 약 현대 기업재무와 관련된 관심 주제들 중, 본 연구에서는 학문적, 실무적인 측면에서 추가 연구가 지속적으로 요구된다고 판단되는 연구개발비 지출에 관한 내용이 분석되었다. 즉, 뉴욕증권거래소와 국내 유가증권시장에 상장된 기업들을 표본자료로 활용하여 연구개발비의 재무적 결정요인에 대한 실증적 분석이 시행되었다. 설정된 3가지의 가설 관련하여, 첫 번째 가설에서는 한국과 미국의 기업들을 포함하는 표본자료들 기준, 전기의 연구개발비 비중, 부채비율, 수익성 그리고 현금유동성 등의 설명변수들이 동 연구개발비 비중에 유의한 영향을 주는 재무적 요인들로서 판명되었다. 두 번째 가설검정에서는 한국과 미국 기업들간의 상대적인 관점에서의 실증분석이 시행되어 비선형 형태의 전기의 연구개발비 비중, 고성장성 기업, 비이자성법인세감면효과, 성장성 그리고 한,미 간의 연구개발비의 회계 처리 방법 등이 양국 간의 표본기업들의 재무적 차이를 나타내는 요인들로 판명되었다. 추가적으로 분위회귀모형을 활용한 (연구개발비 관련 변수들을 포함한) 설명변수들과 기업 성장성과의 관계에서 뉴욕증권거래소에 상장된 기업들의 경우 낮은 분위들에서만 전기의 연구개발비 비중과 성장성 간에 통계적인 유의성을 나타내었다. 본 연구결과에서 판명된 미국의 선진자본시장과 한국의 신흥자본시장 간의 연구개발비 결정요인 상 유사점과 차이점은 주주 측면에서 적정 연구개발비 비중에 도달하기 위한 새로운 발견을 제시할 수 있다고 판단된다.

Keywords : Financial Determinants, Global Financial Turmoil, KOSPI, NYSE, R&D Expenditures

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Received April 30, 2018

Revised May 23, 2018

Accepted July 6, 2018

Published July 31, 2018

1. Introduction

The study addresses one of the conventional subjects in corporate finance, but still controversial in theory and practice which may need to be further investigated with empirical procedures. In other words, it examines inter-country analyses on corporate research & development (hereafter, R&D) expenditure for firms with headquarters in the U.S. and Korea. In finance, optimal level of R&D investments is associated with a trade-off relationship between benefits and risk involved in R&D outlay. That is, proponents to support active investments in corporate R&D opportunities also deem to take into account any possibilities of adverse effects associated with excessive expenditures which may then cause to aggravate corporate profit in the long-run. In this respect, it is a major objective of the study to identify any financially unique or common factors to determine the optimal point of corporate R&D intensity for firms in the U.S. classified as an advanced capital market and their counterparts in Korea as emerging one. In terms of the magnitude of a national R&D expenditure announced by Ministry of Science and ITC (Information, Communication and Technology) of Korean government, total amount of R&D expenditures were reported at KRW 65.9594 trillion (US\$ 58.3billion) and KRW 69.4055 trillion (US\$ 59.8billion) in the years, 2015 and 2016, respectively, which were estimated as the top 6th and the top 5th rank among the OECD(Organization for Cooperation and Development) member nations.[1],[2] The proportion of R&D expenditure scaled by national GDP (Growth Domestic Product) was estimated as 4.23% and 4.24%, respectively, which ranked 1st and 2nd in a global basis. Motivations to conduct the study were as follows: First, there are very few research to identify financial characteristics of corporate R&D spending in the context of inter-country analysis. Second, in the models of the study for empirical estimations, financial determinants of the dependent variable (i.e., R&D

intensity) are tested on an absolute and relative basis, respectively. By doing so, any financial commonalities to determine the regressand are expected to be identified in the relevant models for the sample firms in the two different markets on an absolute basis, whereas any discriminating factors are also detected between firms in the markets on a relative basis, as described below. Finally, as an extension of preceding studies such as [3]and [4], the present study attempts to identify financial factors of corporate R&D intensity across the two capital borders, which may adopt the same or analogous proxy variables (as regressors) as those in the previous literature. Throughout a wide spectrum of econometric estimations, validity of the results in terms of corporate R&D determinants are to be enhanced, that may then be applied to the real field of finance.

2. Literature Review

First, the study conducted by [5] possible benefits or risk from a firm's R&D investments in relation to share price was hypothesized and tested via the U.S. sample data during the sample period from 1979 to 1985. They tested to detect systematic financial factors to explain a change of stock price. The empirical study found that corporate announcement to increase R&D expenditure are overall positive news to increase firm's market capitalization. Moreover, no differences between positive or negative earnings were statistically identified in the increase of firm value in the long-term view. [6] tested hypotheses associated with corporate income that may be manipulated by management in the short run, if projected earnings are likely to deviate from the level of its target goal. As a positively significant relationship between the unexpected R&D and the unexpected income found to be existed for the 272 sample data with positive earnings, a positive relationship was also detected for the 319 sample observations with negative earnings. In the study of

[7], a regression model was applied to examine a relationship between corporate operating income and R&D expenditures as an explanatory variable. While the duration of benefits associated with R&D investment was overall estimated at 9 years for the chemical and pharmaceutical industries, as a longest period among the sample industries, while that of the scientific instruments industry was the shortest with 5 years. They found that profitability measured by return on equity (ROE) that is adjusted for capitalization, seemed to be higher than reported ROE for firms with a high growth rate of R&D expenditure. In the meantime, [8] market response in relation to both long-term stock rate of return and operating performance was tested after the announcement of corporate R&D activities. With respect to the results of the hypothesis test to examine a statistically significant abnormal rate of return for the sample groups, the alphas in the estimated models showed their importance as a measure for the abnormal return across models with differently defined sample groups. Interestingly, the alphas for high-tech firms were found to be larger than their counterparts in the low-tech industries across the equal- and value-weighted rates of returns. [9] tested an interesting issue on a firm's R&D investments, which was categorized by two type of firms such as high-tech vs. low-tech ones. It was hypothesized that investors in the U.S. domestic capital market may favorably respond to positive prospects of a high-tech firm's R&D investments in terms of stock returns before it announces a SEO (seasoned equity offerings) issue. In regard to the outcome, it was revealed that high-tech overinvestors outperformed low-tech overinvestors in terms of the CARs. Finally, given that most domestic Korean firms seems to gradually enlarge their R&D investments over the recent years, the study of [3] tested several hypotheses in relation to the optimal level of the corporate R&D spending and financial factors for firms listed on the KOSPI stock exchange in the post-global financial turmoil period. As for the results, the sample firms

were overall estimated not to maintain an optimal level of R&D expense at the intra-industry level, whereas statistically significant differences were detected at the inter-industry level. Meanwhile, the explanatory variables such as R&D expenses of the prior fiscal year, profitability and Tobin's q showed significant effects to explain the level of R&D outlay.

3. Empirical Estimation Procedures

3.1 Data Sampling and Variables Adopted

In the section, the criteria for sample data selection from both capital markets are described in <Table 1>, that are analogous to those in the previous literature with a different subject, as in [10].

Table 1. Data collection criteria for the U.S. and Korea

<U.S. Sample Firms>

1. The firms are included in the Annual Industrial Compustat data file in Wharton Research Database Service (WRDS).
2. They are listed on New York Stock Exchange (NYSE) at the end of the fiscal year, 2015.
3. All the data for each firm are available for at least 6-year (2010 -2015).
4. Financial and regulated industries are not included in the final sample observations.

<Korean Sample Firms>

1. The firms are included in the KISVALUE database provided by NICE in Korea.
2. The firms are a portfolio of Korea Composite Stock Price Index (KOSPI) listed on Korea Exchange at the end of the fiscal year, 2015.
3. All the data for each firm are available for at least 6 years (2010-2015).
4. Financial and regulated industries are not included in the final sample observations.

Based on the selection criteria above, total number of observations for the U.S. sample observations were 1,204 firms, each of which belonged to one of the 57 domestic industries, whereas Korean domestic firms consisting of total 613 firms were selected among the 25 industries in the domestic capital market. Moreover, as presented in [10], the reference period of the study (i.e., from 2010 to 2015) are selectively chosen to mitigate any spillover effect arising from the global

financial turmoil occurred in 2008. The followings are the description of the variables inclusive of the dependent and explanatory variables employed in the study, where a majority of them were also used in the previous literature including [4] and [11].

Table 2. Definition and symbol of each variable

Definition	Symbol	Measurement
R&D Intensity: [3], [5]	RD (Dependent Variable)	(R&D Expenses) / Sales
Interaction between High-growth Firm and R&D Intensity _{t-1} : [3], [5]	INTERRD	Indicator Variable for a High-growth Firm (as RANDDIND) × (R&D Expenses _{t-1} (as Lag_RD) / Sales _{t-1})
Market-value Based Leverage: [3], [9]	MLEVER	Book Value of Liabilities / (Book Value of Liabilities + Book Value of Preferred Equity + Market Value of Common Equity)
Firm Size: [3], [5]	SIZE	Natural Logarithm of Sales Amount
Profitability: [7]	PFT	Net income / Equity
Non-debt Tax Shield	NDTS	(Depreciation + Amortization) / Total Assets
Tobin Q: [9], [12]	GROWTH	(Market Value of Common Equity + Book Value of Preferred Equity + Book Value of Liabilities) / Total Assets
Change in Cash Liquidity	CASHHOLD	[(Cash & Cash Equivalents) _t - (Cash & Cash Equivalents) _{t-1}] / Total Assets _t
Accounting Treatment for R&D Outlay	ACCT	[(Earnings before Interest & Taxes (=EBIT) + R&D Expenses) / Total Assets
Business Risk	VOLATILITY	3.3 × (EBIT / Total Assets) + 1.0 × (Sales / Total Assets) + 1.4 × (Net Income / Total Assets) + 0.6 × (Market Value of Equity / Book Value of Equity)
Tangible Assets	TANASSET	Tangible Assets / Total Assets
Change in Net Investment	NETINVEST	(Tangible Assets _t - Tangible Assets _{t-1}) / Total Assets _{t-1}
Dummy Variable for Each Capital Market	CAPMARKET	CAPMARKET=1, if a firm belongs to the U.S. market; CAPMARKET=0, otherwise.

<Note> The number in [] of the column of “Definition” indicates a corresponding reference in the section of “References”, from which each variable is cited, besides [4] and [11], as described earlier.

Among the variables adopted, in which a majority of them are utilized to test for each relevant hypothesis below, a cross-product term, INTERACCT, between ACCT and CAPMARKET was employed to test for any statistically significant difference between the U.S. and Korea in terms of accounting treatment on R&D expenditures.

3.2 Hypothesis Postulations and Econometric Estimations

Three (alternative) hypotheses are formulated to detect any commonalities and disparities in financial characteristics of corporate R&D intensity as follows:

H1: *In the post-period of the global financial turmoil, (i.e., from 2010 to 2015), there may exist any significant financial factors to determine corporate R&D expenditure across the firms listed on the New York Stock Exchange (NYSE) or the KOSPI stock market in the statistical context.*

To test for the hypothesis across both groups of the sample firms on an absolute basis, various methodologies such as static panel data, Tobit and stepwise regression models were applied to obtain more rigorous empirical results. In particular, estimation by utilizing stepwise regression model as one of the conventional econometric methods, was also adopted for the hypothesis test to reduce the issues of heteroscedasticity and autocorrelation in a disturbance term described by [13]. Moreover, taking into account the mathematical characteristic of the dependent variable (i.e., R&D intensity) that is bounded from "0" in a positive direction, Tobit (censored) model was employed in the study, that is also presented in [14]:

H2: *During the sample period from 2010 to 2015, firms listed on the NYSE may possess any discriminating financial factor in comparison with their counterparts listed on the KOSPI stock market on a relative basis.*

In the second hypothesis, financial factors that may statistically discriminate between firms listed on the two separate bourses are investigated on a relative basis, which may be one of the untraversed subjects in the empirical finance to datae. For the statistical estimations, a wide spectrum of binary dependent variable models were applied as utilized in [4]. The ones (CLOGs) were also adopted to test the hypothesis assuming the extreme-value (or unbalance) distribution of a disturbance term, as presented in [15]. Moreover, a squared term of Lag_RD (i.e., SQLag_RD) was also employed in each model to test for an effect of a non-linearity of R&D intensity in the previous year, as in [11].

It may also be interesting to examine a causal effect of corporate R&D spending on its growth potential. Therefore, two separate analyses for firms in the two capital markets(i.e., U.S. and Korea) were implemented by using conditional quantile regression (CQR) model which had been also applied in the previous researches inclusive of [11] and [16]. In the present study, along with the other explanatory variables listed in <Table 2>, a lagged effect of R&D investments on corporate growth ratio (as a dependent variable) that is measured by Tobin's q, is analyzed.

H3: During the post-period of the financial turmoil, there exist any significant financial factors (inclusive of the lagged R&D outlay) to affect corporate growth portential for the NYSE-listed or the KOSPI-listed firms whose growth rates are categorized by employing conditional quantile regression (CQR) model.

4. Analysis and Discussion

4.1 Analyses of the Hypothesis Tests

The analyses on the results obtained from the three hypothesis tests are presented in each corresponding table below.

Table 3. Results of financial determinants to determine corporate R&D spending for firms in NYSE and KOSPI

IDV	Estimated coefficient from static panel data model (fixed effects)	Estimated coefficient from Tobit model	Estimated coefficient from stepwise regression model
Constant	0.02*	-0.005*	0.001*
Lag_RD	0.55*	1.06*	1.003*
MVLEV	-0.002**	-0.003*	-0.002*
PFT	-0.0001*	-0.0002*	-0.0001*
ACCT	-0.004	0.005	-0.002*
INTERACCT	-0.001	-0.006**	(N.A.)
SIZE	-0.0004	0.0003*	(N.A.)
NDTS	-0.02	-0.07*	(N.A.)
GROWTH	-0.0005*	-0.0004*	(N.A.)
TANASSET	0.001	-0.0004**	(N.A.)
VOLATILITY	7.774E-6	0.00001	(N.A.)
CASHHOLD	-0.01*	-0.01*	-0.001*
NETINVEST	-0.001*	-0.002*	(N.A.)

<Note1> * and ** indicate a statistical significance at the 5% and 10% levels, respectively.

<Note 2> (N.A.) denotes that the corresponding IDV is not statistically significant at the 5% entry and delete levels.

Since the null hypothesis was not accepted by all of the *a priori* tests at the 5% level such as Wald (F) test, Breusch-Pagan test and Hausman test with m-value of 1,970.95 (p-value < 0.0001), the 'best' appropriate model was selected as "fixed effect" model among fixed effect, random effect and pooled OLS models, as presented in [17]. Mean (standard deviation) of the dependent variable, RD, are 0.0187 (0.0494) for the U.S. sample and 0.0079 (0.0181) for the Korean sample during the sample period.

As reported in <Table 4>, several major factors showed their pronounced and consistent differences in the analysis as follows: SQLag_RD, RANDDIND, MVLEV, SIZE, NDTS, GROWTH, and ACCT. Meanwhile, the probability modeled is set to 1 for CAPMAEKET when applying the binary variable models that utilized SAS (9.4 version) package. Therefore, it is analyzed that the probability to be classified into a firm listed on NYSE gets larger, if non-debt tax shield (NDTS) increases with a positive sign of the coefficient.

Table 4. Results of limited dependent variable models to identify financial factors discriminating between the NYSE-listed and the KOSPI-listed firms in R&D costs

	Logit	Probit	Clog-log
Constant	-7.35*	-3.21*	-2.87*
Lag_RD	14.30	3.06	1.46
SQlag_RD	78.26*	57.52*	42.09*
RANDDIND	-0.23*	-0.30*	-0.47*
INTERRD	-19.76	-6.42	-2.64
MVLEV	-0.73*	-0.35*	-0.52*
PFT	0.03	0.02	0.02
SIZE	0.45*	0.28*	0.28*
NDTS	149.7*	69.07*	36.81*
GROWTH	0.29*	0.20*	0.16*
TANASSET	3.21*	0.14	0.07
VOLATILITY	-0.005	-0.002	-0.001
CASHHOLD	-1.18*	-0.54**	-0.37
NETINVEST	0.60*	0.33*	0.19*
ACCT	4.94*	2.86*	3.44*
Goodness of Fit	8657.44*	7744.10*	6373.50

<Note 1> * and **: Significant at the 5% and 10% levels with respect to the chi-square test.

<Note 2> Coefficients were estimated by the method of maximum likelihood (ML). The test for overall goodness of fit was performed by the likelihood ratio (LR) test, while the Wald test was used to test for the significance of each individual coefficient.

With respect to the third hypothesis postulated to test for corporate growth rate (Tobin's q) in relation to financial factors inclusive of the variable of Lag_RD, the conditional quantile regression (CQR) models were applied, which categorize the dependent variable into each quantile level for the sample firms. In the second column of <Table 5> for the U.S. sample firms, a majority of the variables were indicated that they are

not overall equal across the quantiles, except VOLATILITY and NETINVEST. For the multiple comparisons among all levels of quantiles, most of the proxy variables showed their consistency in terms of a direction (i.e., +, -) and statistical significance. In particular, MVLEV, PFT, SIZE and CASHHOLD seems to maintain persistency on corporate R&D intensity across the categories. It was interesting to detect that Lag_RD showed its importance as a financial determinant only in the lower levels of the quantiles (i.e., 20% and 40%), whereas INTERRD had its significance only in the extreme or polarized categories (i.e., 20% and 80%) with its different directions or signs.

The results of the CQR analysis for the KOSPI-listed firms are presented in <Table 6>. There are approximately a half of variables amongst total eleven ones, which did show statistically unequal coefficients across the quantiles, as indicated in (the second column of) the table. Meanwhile, Lag_RD, MVLEV, PFT, SIZE, VOLATILITY and CASHHOLD had overall and statistically significant effects on the R&D outlay across the entire quantiles. Moreover, existence of a significant interaction effect between high-growth firm and Lag_RD, (i.e., INTERRD) seems to be polarized in the extreme levels (i.e., 20% and 80%) of the entire quantiles, whose phenomenon is analogous to that in

Table 5. Results of the Estimated Coefficients for the Explanatory Variable on Corporate R&D Intensity for the NYSE-listed Firms by Applying Conditional Quantile Regression (CQR) Model

Variable	Test for Equal coefficients across quantiles	Quantile (20%)	Quantile (40%)	Quantile (60%)	Quantile (80%)
Constant	<N.A.>	1.41* (29.21)	1.71* (35.55)	1.98* (34.21)	2.39* (27.79)
Lag_RD	12.08*	5.37* (5.19)	3.39* (2.69)	1.95 (1.51)	0.27 (0.14)
RANDDIND	135.98*	0.08* (5.72)	0.05* (4.31)	-0.01 (-0.80)	-0.13* (-5.91)
INTERRD	56.34*	-5.06* (-4.88)	-1.93 (-1.51)	1.33 (0.99)	8.12* (4.05)
MVLEV	318.66*	-1.01* (-17.44)	-1.25* (-19.39)	-1.48* (-20.84)	-1.84* (-29.31)
PFT	100.81*	2.61* (10.14)	3.27* (11.61)	3.75* (11.12)	4.14* (14.17)
SIZE	74.37*	0.01* (3.38)	-0.0003 (-0.06)	-0.01* (-2.24)	-0.03* (-4.10)
NDTS	61.33*	-0.48* (-2.03)	-0.18 (-0.64)	0.80* (2.83)	2.97* (4.81)
TANASSET	20.61*	-0.11* (-3.71)	-0.08* (-3.20)	-0.03 (-0.86)	0.07 (1.29)
VOLATILITY	3.61	0.01* (1.99)	0.01 (1.49)	0.01 (0.83)	0.008 (1.10)
CASHHOLD	59.65*	0.22 (1.85)	0.41* (2.92)	0.49* (2.47)	1.43* (4.64)
NETINVEST	3.43	0.12 (0.67)	0.04 (1.19)	0.05 (1.12)	0.04 (0.4)

<Note> * indicates a statistically significant estimate at the 5% level and the number in parentheses denotes t-value.

the U.S. capital market.

4.2 Discussion

With respect to the results obtained from the first hypothesis test in <Table 3>, the intensity of corporate R&D expenditure is positively related to that in the previous fiscal year across firms listed on the NYSE and the KOSPI stock market. Coupled with the previous results obtained from [3] and [4], it was interesting to corroborate the positively significant relationship found in the present study, even after including firms with headquarters in the U.S. There was a negatively significant effect of MVLEV to determine the R&D intensity, which may be in supportive of the conventional theory in finance, theorizing that firm with a high debt ratio tends to reduce its R&D spending due to a large burden of borrowing costs. On the other hand, the negative linkage between corporate leverage and R&D intensity may also imply that shareholders of the firms in both capital markets appear to decrease or mitigate a possible "moral hazard" incurred by incumbent management by maintaining high market-valued debt ratio, as presented in [18]. Meanwhile, by utilizing a relationship between unexpected R&D costs and unexpected earnings, [6] hypothesized that corporate manager tends to adjust the costs to meet its planned

target in earnings. Therefore, the negative relationship between PFT (i.e., profitability measured by ROE) and the dependent variable of R&D intensity found in the study, may suggest that the level of corporate R&D spending may be controlled by the (unexpected) change in ROE that deviates from a original target. Finally, ACCT that adds the amount of R&D expenses to corporate EBIT, (then scaled by total assets), generally showed insignificant influence on the dependent variable in <Table 3>. It may, to a larger extent, attribute to a law of magnitude between the amounts of EBIT and R&D expenses. Furthermore, the interaction term, INTERACCT, between ACCT and a indicator variable which codes the U.S. capital market as "1", showed its insignificant influence on the R&D intensity at the 5% level. It may suggest that different accounting procedures on R&D expenditures between the two markets, did not reveal any significant effect on the dependent variable, which may arise from only a small fraction of corporate R&D amounts to be capitalized (i.e., not expensed) out of total R&D expenditures for the KOSPI-listed firms.

In the second hypothesis test, the positively significant *SQLag_RD* indicates that the probability to be classified into the NYSE-listed firms may become larger, as a level of corporate R&D intensity in the previous fiscal year (i.e., *Lag-RD*) increases. Second, the indicator variable for

Table 6. Results of the Estimated Coefficients for the Explanatory Variable on Corporate R&D Intensity for the KOSPI-listed Firms by Applying Conditional Quantile Regression (CQR) Model

Variable	Test for Equal coefficients across quantiles	Quantile (20%)	Quantile (40%)	Quantile (60%)	Quantile (80%)
Constant	<N.A.>	0.39* (11.35)	0.53* (14.26)	0.70* (20.13)	0.82* (12.75)
Lag_RD	6.46	8.12* (7.29)	6.34* (3.03)	7.43* (2.94)	20.49* (2.58)
RANDDIND	15.45*	0.03* (2.55)	0.002 (0.16)	-0.001 (-0.11)	-0.01 (-0.52)
INTERRD	5.19	-4.63* (-3.84)	-3.24 (-1.55)	-4.42 (-1.73)	-16.86* (-2.10)
MVLEV	104.92*	-0.14* (-3.58)	-0.31* (-7.50)	-0.45* (-13.36)	-0.50* (-8.25)
PFT	137.74*	-1.11* (-6.48)	-1.86* (-12.69)	-2.40* (-15.45)	-2.89* (-13.96)
SIZE	15.63*	0.02* (3.48)	0.02* (4.19)	0.01* (2.88)	0.002 (0.39)
NDTS	16.92*	1.07 (1.54)	0.56 (0.94)	0.19 (0.63)	-0.64 (-1.87)
TANASSET	4.61	0.003 (0.22)	0.03 (1.39)	0.02 (0.84)	0.007 (0.30)
VOLATILITY	117.80*	0.21* (14.68)	0.29* (18.55)	0.34* (25.14)	0.42* (14.85)
CASHHOLD	4.99	0.11 (1.00)	0.26* (1.99)	0.24* (2.07)	0.34* (2.97)
NETINVEST	0.05	0.02 (0.71)	0.01 (0.31)	0.02 (0.61)	0.01 (0.45)

<Note> * indicates a statistically significant estimate at the 5% level and the number in parentheses denotes t-value.

a high-growth firm such as RANDDIND showed its statistical results that there is a higher possibility to be included in the KOSPI-listed firms, if firm is classified into one of the high-growth industries. The phenomenon may arise from the characteristics of the Korean industrial structures with having a larger proportion of high-growth manufacturing industries than the service industries. Moreover, corporate non-debt tax shield (NDTS) showed that NYSE-listed firms may possess a higher level of NDTS than their counterparts on the KOSPI market.

Finally, in <Table 5> and <Table 6>, Lag_RD that was theoretically expected to have a positive association with a firm's growth potential, showed an expected sign at the 5% level for the Korean case, as also found in [4] and [11]. However, firms in the U.S. case overall had a statistically significant relationship between the two financial factors only in the lower quantile levels in Tobin's q (i.e., 20% and 40% quantiles). This may be, in part, associated with a phase of a capital market development, such that the trade-off relationship between benefits and risk of R&D investments seems to be more limited to the firms in advanced capital markets (including the U.S.), given the possible transition from growth stage to mature stage in their economic conditions. The phenomenon seems to be corroborated by the negative relationship between high-growth firms (RANDDIND) and Tobin's q in the upper quantiles (i.e., 60% and 80%) for the NYSE-listed firms. Interestingly, it is also noteworthy that R&D spending in the previous fiscal year (Lag_RD) by a high-growth firm (RANDDIND) may not support firm growth potential classified into the lowest quantile (i.e., 20%) in both capital markets. Therefore, it may be necessary for the firms in the quantile to effectively tunnel its R&D expenditures to ameliorate their growth rate in a virtuous cycle. Besides the aforementioned R&D related variables, the variable of SIZE to represent firm size (in sales) may suggest an intriguing finding for the U.S sample firms. That is, firms in the capital markets may, on average, approach their optimal levels of corporate growth rate,

as the sign of the significantly estimated coefficient of SIZE changed from a positive one in the 20% quantile of Tobin's q to a negative one in both 60% and 80% quantiles, along with the insignificant coefficient in the 40% quantile.

5. Conclusions and Future Research

The study investigated financial determinants to determine the R&D expenditures for the NYSE-listed and the KOSPI-listed firms, which is an extension of the preceding research such as [4] and [11]. While the pvariables such as Lag_RD, MVLEV, PFT and CASHHOLD showed their significant effects on the level of corporate R&D across the firms in the U.S. and Korean capital markets on an absolute basis, financial factors inclusive of SQLag_RD, RANDDIND, NDTS, GROWTH, and ACCT, had an importance to discriminate between the two groups on a relative basis. The study may suffer from weaknesses in implementing empirical procedures with different sampling criteria, in comparison with the previous literature. However, from the perspective of academics or practitioners, it may provide a new vision which may be applicable to firms across the two representative capital markets such as the U.S. market (as advanced one) and the Korean market (as emerging one) by identifying common or differentiated financial factors in relation to corporate R&D activities. Consequently, financial findings found in the study are expected to be usefully utilized as effective tools to gear up the increase of corporate value for a firm with headquarters in either market, which has overseas investment plans such as establishment of its foreign subsidiaries.

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<Research Interests>

Corporate Finance, M&A, Valuation, Int'l Finance