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Research and Development (R&D) Expenses and the Market Capitalization

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A B S T R A C T

The present study has investigated the bank's area. A review of the research literature suggests that much research has been done in this area. The study subject is the examination of the relationship between capital structure and profitability of banks accepted in Tehran Stock Exchange. Assumptions were developed using research variables. The statistical population of the study is the banks accepted in Tehran Stock Exchange. Given the smallness of the study population and because the number of observations will become less than acceptable in quantitative research if sampling, the entire population is used as the sample . Library research method is used and in terms the goal it is an applied research. For analysis of the results, Pearson regression and correlation are used. Results indicate that the three leveraged variables influence on the return on Assets, but there is no statistically significant relation with the size of banks.

Keywords: Research and development (R&D) Expenses, Market value of Equity, Panel Data.

INTRODUCTION

Research and development (R&D) refers to any creative integrated activity to increase knowledge related to human, culture, society and to use it in modern applications(Chan, Lakonishok, & Sougiannis, 2001; Hsu, Tian, & Xu, 2014; Lev & Sougiannis, 1996). The basic role of R&D is to such an extent that it is considered as an important variable in economics(Berchicci, de Jong, & Freel, 2015). Research and development expenses can be effective in implementing competitive strategies, which improve operational performance and share price (Bozkurt, 2015; Link & Swann, 2016).

Research and development expenses are basically discussed when a company uses fundamental or applied researches to offer a new product or improve the present product in order to enhance its comparative position in the market and get any benefits from the activities in future(Tyagi, Choudhary, Cai, & Yang, 2015; Wirtz, Pistoia, Ullrich, & Göttel, 2016). Investing on research and development can improve profitability and operational performance in a company, while increasing sales, creating exclusive strength or increasing it as well as reducing risk(Zhu & Sarkis, 2004).

Addressing research and development activities has been one of the problems facing accountants in the past decades(Bebbington & Larrinaga, 2014; Dyckman & Zeff, 2015).

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Therefore, accounting for and disclosing costs in R&D activities are important for those who use financial statements(Merkley, 2013). The questions related to accounting for the costs often are how to know costs and depreciate them, assuming that it is expected that benefits from the costs will be gained in future periods(Drury, 2013; Vanderbeck, 2012). The market capitalization in a company reflects the specific value of its assets. When most assets are physical such as equipment and furniture, there is a fairly evident relationship between the asset value and the share price. However, in modern economies, the value of a company may primarily reflect its intangible assets(Christensen & Nikolaev, 2013; Goh, Li, Ng, & Yong, 2015). According to accounting standards of the most countries, some of the intangible assets are not reported in financial statements. Consequently, when a company has many intangible assets not reflected in financial statements, it is usually difficult to value the equity(Adibah Wan Ismail, Anuar Kamarudin, van Zijl, & Dunstan, 2013). Research and development activities are a kind of intangible assets (Andrews & De Serres, 2012; Arrighetti, Landini, & Lasagni, 2014; Hsu et al., 2014). Recently, they are of interest considerably, however, it is inferred that difficulty in evaluating the intangible assets such as R&D expenses may cause investors to underestimate the advantages of investing on research and development(Ali, Ciftci, & Cready, 2012). Therefore, companies welcome such investments rarely. Increased interest in advanced technologies proposes the question whether the market capitalization of a company reflect such intangible investments on research and development.

Nguyen, Nivoix, and Noma (2010) examined the valuation of R&D expenses in Japan stock market. The researchers thought that the low valuation of R&D expenses in the Japan market does not affect the stock return as in the American market while their findings showed the low valuation of R&D expenses leads to reduction in the stock return of listed companies in the Japan stock exchange.

It is unknown whether there is a significant relationship between R&D expenses and market capitalization or not. Therefore, the main aim of the study is to examine whether there is a significant relationship between R&D expenses and the market capitalization of the listed companies in Tehran Stock Exchange or not. As mentioned above, the main question of the study is as follows: What relationship is there between R&D expenses (R and D) and the market capitalization of the listed companies in Tehran Stock Exchange?

The research and development are so important that countries are divided into developed and undeveloped on the basis of research budget ratio to gross national income. Investing on research and development is one of the most important drives of the company growth, it also extends the market share of the company.

Recently, many researches have been performed on R and D expenses. Relationship between R and D expenses and profitability is one of the subjects attracting attention of the researchers significantly. In this regards, the researchers have achieved different findings (Bebbington & Larrinaga, 2014; Bozkurt, 2015; Xu & Zhang, 2004). Increasing R and D expenses, the companies with higher exclusive strength can achieve reduction in risk through creating innovation so that stock return is affected by R and D expenses and may increase, while exclusive strength preserved.

METHODOLOGY

The statistical population of the present study contains all companies listed in Tehran Stock Exchange. According to Tehran Stock Exchange, there were 520 companies listed in 37 industrial groups by the end of 2012. Therefore, the statistical population consists of all companies listed in Tehran Stock Exchange during a five-year period, from 2011 through 2015.

In the study, the criteria-filtering technique is used to choose the sample so that the sample represents the statistical population. Therefore, the following criteria are borne in mind. If a company meets all criteria, it will be chosen as a sample.

1 .A company has been listed in Tehran Stock exchange at most by 20th March 2011 and it has remained in it by 19th March 2016.

2 .Its shares have been traded actively in the stock exchange during the period.

3 .To increase the comparability between the companies, the fiscal period must end in 20th March and it has not been changed.

4 .It must not be among financial intermediaries (investing, holding, leasing, bank and insurance) because they have different operation.

5 .The necessary data is available.

The criteria have been applied in order. Therefore, if a company does not meet a criterion, it will not been considered in the next criterion.

101 companies out of 19 industries remained after the criteria have been applied. They are used to test the hypothesis. Therefore, the sample size is not equal to the total statistical population.

In the study, specialized articles and books in English and Persian and theses are used to study theoretical principles and examine the background by the library method. Since the data of the variables in the study includes many accounting items in audited financial statements of the companies, the data was extracted from financial statements available on the following websites and from compact disks of Securities and Exchange Organization manually.

Development Research Management and Islamic studies of Securities and Stock Exchange at www.rdis.ir

Comprehensive Data Base of All Listed Companies (Codal) at www.codal.ir

Financial Information Processing of Iran at www.fipiran.com

It seems that these are more reliable than other available resources. In addition, other necessary data of financial statements of the companies (such as market value per share of common at the end of the year needed to calculate Tobin's Q ration) are compiled from Securities and Stock Exchange Website and Rahavard Novin software, which is in Pdf and Excel. The data includes gains and losses, balance sheet, gain prediction etc.

The definitions of the variables and how to calculate them

The dependent variable

The market value of equity ($MVE_{i,t+1}$)

The study of Aman and Nguyen (2008) is followed to calculate the market value of equity; it is a natural logarithm of the market value of equity.

The independent variable

The research and development expenses of a company i at the year t.

The control variable

Systematic risk $BETA_{i,t}$

In the study, according to the study of Lev et al. [5] the following formula is used to calculate sensitivity ratio or adjusted beta.

$$E(R_i) = R_f + \lfloor E(R_m) - R_f \rfloor * \beta_i$$
$$\Rightarrow R_{it} = R_{ft} + (R_{mt} - R_{ft})\beta_i + e_{it}$$

R_{it} : The return rate of a company i during the period t.

R_{ft} : Risk free rate of return during the period t

β_i : The beta of a security (systematic risk) in a company i.

R_{mt} : The rate of return on portfolio during the period t.

e_{it} : Disturbance term

It is necessary to note that the data of return rate on security and on portfolio available in Securities and Stock Organization were used to measure systematic risk. The organization uses the following formula to measure the real return on security.

$$R_{i.t} = \frac{(p_t - p_{t-1}) + DPS_t + SO_t + SR_t}{P_{t-1}}$$

$R_{i.t}$: The return of a company i during the period t.

P_t : The price per share at the end of the period t.

P_{t-1} : The price per share at the end of the period t-1.

DPS_t : The divided gain per share during the period t.

SO_t : The value of option agreement for the purchase of shares during the period t.

SR_t : The value of preemptive right during the period t.

Accounting beta (systematic risk) is calculated as follows:

$$\beta_i = \frac{COV(R_{it}, R_{mt})}{VAR(R_{mt})}$$

R_{it} : The return rate of a company i during the period t.

R_{mt} : The rate of return on portfolio during the period t.

Accounting beta is obtained through covariance divided by variance. In the covariance changes in the two variances are compared and in the variance, the dispersion is considered, which is calculated as follows:

$$COV(R_{it}, R_{mt}) = \frac{\sum (R_i - \overline{R_i})(R_m - \overline{R_m})}{n}$$

$$= \mathrm{E}\left(R_i - \overline{R}_i\right)\left(R_m - \overline{R}_m\right)$$

Book value to market value of equity $BM_{i,t+1}$

According to the study of Ciftci et al. [6], the following formula is used to calculate book value to market value of equity:

$BM_{i,t+1}$ = book value/ market value of equity.

Company size

It is the natural logarithm of the book value of the total assets(Xu & Zhang, 2004).

In the study, SPSS 21, EViews 7, Minitab 16 and the multiple linear regressions are used to test the hypothesis. The statistical method used in the study is panel data.

RESULT

In the study, the measures of central tendency such as mean and median, and the measures of variability like standard deviation, skewness and Kurtosis are used to analyze the data. In this regard, the mean is the most main measure of tendency, it present the average of a data set. Standard deviation is a dispersion parameter that presents the dispersion of a data set. The skewness is also a parameter that determines deviation from symmetry; it indicates symmetry degree. In short, the descriptive statistics of the variables are presented in table 1, after outliers are deleted by using SPSS 20.

Table1. Descriptive statistics of the variables

Variable	N	mean	Std. Deviation	Minimum	Maximum	skewness	Kurtosis
Stock return	606	0.5780	1.3522	-1.8947	2.8658	-0.456	-1.358
Market value of equity	606	5.0779	2.0552	-6.6786	703234	-4.341	19.276
Book value to market value of equity	606	0.1504	17.1058	0.0634	0.2916	-24.531	603.177
Research and development expenses	606	0.0595	0.4856	0.0094	0.3495	0.249	-1.441
Systematic risk	606	0.0737	0.0737	-1.4392	1.3094	-0.551	0.832
Market value of equity	606	5.4060	0.6938	1.3295	7.3234	-0.438	3.883
Book value to market value of equity	606	0.2868	17.0552	0.0546	0.4634	24.551	603.795
Company size	606	0.7649	0.0442	0.6681	0.9025	0.499	0.145

Given the table 1, the mean, the market value of equity and the book value to the market value of equity for stock return are 0.5780, 0.0779 and 0.1504 respectively. The skewness and kurtosis of the variable, which must be 0 and 3 respectively so that it is normally distributed, show that it does not have a normal distribution. The mean of research and development expenses is positive and it equals 0.0595. In addition, the mean, the market value of equity, the book value to the market value of equity and company size for systematic risk are 0.0737, 5.4060, 0.2868 and 0.7649 respectively.

Testing normal distribution of the dependent variables

Considering that the significance level of the test K-S is less than 0.05 for market capitalization, therefore, H_0 based on the normal distribution of the variables is denied at the confidence level %95. It suggests that market capitalization is not normally distributed.

Table2. The results of testing normal distribution of the dependent variable

Variable	Number (N)	Test (K-S)	Significance level (Sig)
Market value of equity	606	8.430	0.000

The normal distribution of the dependent variable is requisite for regression models. Therefore, it is necessary to normalize the variables before testing the hypothesis. In the study, Johnson transformation is used to normalize data and it is analyzed by Minitab 16.

The results obtained by test K-S are as follows after the data was normalized.

Table 3. The results from testing normal distribution of the dependent variable after normalizing

Variable	Number (N)	Test (K-S)	Significance level (Sig)
Market value of equity	606	0.484	0.973

Given table 3, since the significance level of Kolmogorov–Smirnov test is more than 0.05 for market capitalization (0.973) after data is normalized, H_0 is confirmed at the confidence level %95. It suggests that market capitalization is normally distributed after normalization.

Correlation between the variables

In this part, the relationship between variables and the correlation existing between them are examined *using* Pearson *Correlation* Coefficient. The matrix of correlation coefficients between the variables is presented in table 4.

According to results from Pearson test, market value of equity is correlated with book value to market value of equity, systematic risk and market value of equity positively and significantly. Research and development expenses are also correlated with systematic risk positively and significantly. Market value of equity is also correlated with company size positively and significantly and it is correlated with the book value to the market value of equity negatively and significantly.

Table 4. The matrix of correlation coefficients between the variables

		1	2	3	4	5	6	7	8
1	Stock return	1							
2	Market value of equity (P-Value)	0.027 (0.507)	1						
3	Book value to market value of equity (P-Value)	-0.016 (0.700)	0.178 (0.001)	1					
4	Research and development expenses (P-Value)	0.012 (0.763)	0.067 (0.102)	0.031 (0.443)	1				
5	Systematic risk (P-Value)	-0.069 (0.088)	0.182 (0.001)	-0.004 (0.918)	0.080 (0.048)	1			
6	Market value of equity (P-Value)	0.002 (0.961)	0.342 (0.001)	0.046 (0.256)	-0.042 (0.297)	0.044 (0.280)	1		
7	Book value to market value of equity (P-Value)	0.018 (0.651)	-0.017 (0.671)	0.002 (0.956)	-0.028 (0.498)	0.061 (0.132)	-0.081 (0.045)	1	
8	Company size (P-Value)	-0.102 (0.012)	0.211 (0.001)	0.066 (0.105)	0.000 (0.994)	-0.062 (0.126)	0.651 (0.001)	-0.075 (0.066)	1

Collinearity between Variables

Collinearity means that there is a linear relation between independent or explanatory variables. A way to identify a collinear relation or non- collinearity is to examine correlation between independent variables. If there is not a severe correlation between independent variables, collinearity does not occur. Given that there is a single dependent variable in the study, therefore, collinearity will not occur.

The aim of testing hypothesis is to examine whether there is a significant relationship between research and development expenses and market capitalization of listed companies in Tehran Stock Exchange. The statistical hypothesis may be formulated as follows:

H_0: There is not any significant relationship between research and development expenses and market capitalization of listed companies in Tehran Stock Exchange.

H_1: There is a significant relationship between research and development expenses and market capitalization of listed companies in Tehran Stock Exchange.

The hypothesis is estimated by using (1) into panel data. If coefficient β_1 is significant at the confidence level %95, it will be confirmed.

$$MVE_{i,t+1} = \alpha_0 + \beta_1 RD_{i,t} + \beta_2 BETA_{i,t} + \beta_3 Size_{i,t} + \beta_4 BM_{i,t} + \varepsilon_{i,t}$$

$$\begin{cases} H_0 : \beta_1 = 0 \\ H_1 : \beta_1 \neq 0 \end{cases} \quad (1)$$

The results of Chow test (in order to determine whether panel data is used and Hausman test in order to determine whether the fixed effect model or the random effect model is used in panel data method) are presented in table 5.

Table 5. The results of Chow and Hausman tests for (1)

Test	Statistic	Statistic value	Degree of freedom	P-Value
Chow	F	3.6317	(100,500)	0.0001
Hausman	χ^2	0.6792	4	0.0002

Given that the results of Chow test and P-Value (0.0001) H_0 is rejected at the confidence level %95. It suggests that it is possible to use panel data method. In addition, considering the results of Hausman test and P-Value 0.0002 (less than 0.05), H_0 is rejected at the confidence level %95 and H_1 is confirmed. Therefore, it is necessary to estimate the model using fixed effect model. Examining the assumptions of classic regression, the results of Jarque-Bera test suggest that the remainders from estimating the model at the confidence level %95 are normally distributed so that probability value in the test is 0.6784 (more than 0.05).

Furthermore, considering significance level of Breusch-Pagan test 0.0000 (less than 0.05), the null hypothesis, that there is homoscedasticity, is rejected. It can be said that the model has heteroscedasticity. To remove the problem in the hypothesis, the method of generalized least squares (GLS) is used to estimate. In the autocorrelation test of remainders in the model performed using Durbin-Watson test (DW), Durbin-Watson test is 2.37. Since it is located between 1.5 and 2.5, it can be concluded that the remainders are independent. Furthermore, considering that significance level of Ramsey test is 0.9622 (more than 0.05), the null hypothesis, that the model in linear, is confirmed and it does not have specification error. The results of the test above are presented in table 6.

Table 6. The results of statistical assumption tests (1)

Ramsey test		Durbin-Watson test	Breusch-Pagan test		Jarque-Bera test	
$P-Value$	F	D	$P-Value$	F	$P-Value$	χ^2
0.9622	2.0384	2.37	0.0001	6.7017	0.6784	1.5485

Given the results from Chow and Hausman tests as well as the results from statistical assumptions of classical regression tests, (1) is estimated using the panel data method and fixed effect model. The results of the model estimated are presented in table 7.

Table 7. The results from testing the hypothesis using fixed effect model

Dependent variable: market value of equity The number of observations: 606 company-year				
variable	coefficient	Statistic t	P-Value	Relationship
Fixed	1.3753	2.2904	0.0224	Positive
Research and development expenses	0.0709	3.5989	0.0004	Positive
Systematic risk	0.0670	2.2253	0.0265	Positive
Company size	4.8355	6.1634	0.0001	Positive
Book value to market value of equity	0.0018	0.2963	0.7671	insignificant
Coefficient of determination				0.8093
Statistic F P-Value				20.4046 (0.0001)

The model estimated using EViews 7 is as follows:

$$MVE_{i,t+1} = 1.3753 + 0.0709RD_{i,t} + 0.0670BETA_{i,t} + 4.8355Size_{i,t} + 0.0018BM_{i,t} + \varepsilon_{i,t}$$

Examining the significance of total model, considering that probability value of statistic F is 0.0001 (less than 0.05) at the confidence level %95, its significance is confirmed. The coefficient of determination also suggests that 80.93 of market value of equity are determined by the variables of the model.

Examining the significance of coefficients, given the results in table 7, since the probability of statistic t for research and development expenses is 0.0004 (less than 0.05), it is confirmed that there is a significant relationship between research and development expenses and market value of equity at the confidence level 90 percent. Therefore, the hypothesis is confirmed and it can be confidently said that there is a significant relationship between research and development expenses and market value of equity. The positive coefficient of the variable (0.0709) suggests that there is a direct relationship between research and development expenses and market value of equity so that market value of equity increases 0.709, as research and development expenses increase 1 unit. Therefore, considering the analyses performed to confirm the hypothesis, we conclude that there is a significant direct relationship between R&D expenses and market value of equity of listed companies in Tehran Stock Exchange.

CONCLUSION

The results revealed that there is a significant direct relationship between R and D expenses and market capitalization of listed companies in Tehran Stock Exchange.

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