The impact of R&D expenditure volatility on stock return of the listed companies in Tehran stock exchange

Sogand Mozafari

M.A of Financial Management, Islamic Azad University, Ayatollah Amoli Branch, Amol, Iran.

Abstract: *The current research aims to examine the impact of R&D expenditure volatility on stock return of the listed companies in Tehran stock exchange. To determine the statistical population of the research during 2009 to 2013, 324 out of 405 listed companies in Tehran stock exchange were selected based on the systematic elimination method, and 86 firms were chosen through De Morgan table as the final sample. In this research, R&D expenditure volatility and stock return were regarded as the independent and dependent variables, respectively. EVIEW7 software is applied for data analysis in this investigation. The results showed that R&D expenditure volatility significantly impacts stock returns of the listed companies in Tehran stock exchange.*

Keywords: *R&D expenditure volatility; stock return.*

INTRODUCTION

R&D plays an essential role in competitive advantages, long-term growth and shareholders and value of partners. R&D expenditure should be retained for expanding stable competitive advantages, keeping firm performance and preventing from high costs (Limen et al., 2011). Firms always manage R&D expenditure in order to predict realized profits or income smoothing (Baba et al., 2013). As well, volatility in R&D expenditure can be regarded as managers' earnings management index or manipulation. This volatility plays serves as added value through supervising on management and over-investment (Tang & Zhang, 2014). The reaction of stock price depends on the firm's kind of industry. This reaction is importantly positive for industries with high technology. This case is significantly negative for firms with low technology (Chen et al., 2012). Li et al. (2005) found that abnormal return of R&D expenditure positively related to firm's investment opportunities. These expenditures add more values for firms with industries of high technology and cause creating more opportunities. Chambers et al. (2008) announced that risk can be effective on the relationship between R&D expenditure and stock return. The positive relationship between R&D expenditure and stock return occurs only in financially-distressed firms. These firms face with more risks, because they are unable to finance R&D projects. Any expenditure should be paid cautiously so that gain more return (Li et al., 2013). The main issue of the research is to examine what kind of relationship is between R&D expenditure volatility and stock return of the listed companies in Tehran stock exchange. If a relationship is existed among them, is it positive or negative? It seems answering to the above questions can be effective for investors, shareholders, managers and other stakeholders; groups for decision making process.

Research background

Pantagakis et al. (2012) investigate the relationship between R&D investment and firm performance. The obtained results suggested that there is a positive correlation between R&D investment and firm performance. There is also a non-linear relationship between R&D investment and firm's value market. Zhu & Huang (2012) examined the impact of R&D investment on financial performance of China's IT companies. Their findings indicated that investment motivation strategy in R&D results in significantly and importantly improvement and increase in firm performance of that firm on a given year. In their research, Hirshleifer et al. (2013) investigated the relationship between innovation efficiency and stock return. According to analyses, the results indicate that innovation efficiency and R&D expenditures are the strong predictors of stock return, regarding to controlling firm specifications and risk. Gharbi et al.

(2013) investigated the relationship between R&D investment and stock return volatility of firms with high technology. Their research aimed to examine R&D investment motivation as description of stock return volatility treatment in these industries. The obtained results showed that there is a positive and strong relationship between stock return volatility and R&D investment. Coleman et al. (2014) examined the impact of R&D expenditure volatility on stock return of the U.S firms. Their results showed that the relationship between R&D expenditure volatility and stock return is describable, not over-investment, regarding to earnings management. Bart (2014) investigated the impact of R&D investment on the performance of the listed companies in Holland stock exchange. In this investigation, firm performance has been measured in financial performance and market performance. As well, there has been more attention to the comparison between manufacturing companies and non-manufacturing companies. According to the analyses, the results show that firms' financial performance importantly and positively influenced by R&D investment. The result of significance for financial performance means return on assets is existed.

Research methodology
Research method
- R&D expenditure volatility significantly impacts stock market of the listed companies in Tehran stock exchange.

The research statistical population and sample
The statistical population of the current research is the listed companies in Tehran stock exchange during 2009 to 2013. The sample selection conditions are used with the systematic elimination method:
1. They should not have changes in their fiscal year during few years ago.
2. The necessary information of a firm should be available.
3. A firm should be a manufacturing one. It should not be a part of banks, financial institutions (investment, financial intermediary, holding, banks and leasing's firms).
4. Its fiscal year should end in march
5. Their stocks should be traded in stock exchange.
Regarding to the imposed restrictions, 86 out of 405 listed firms in Tehran stock exchange were selected as the final sample of the research.

How to measure variables
Stock return (dependent variable)
To calculate portfolio return, realized profit should be determined at first. The obtained interest from ownership may be paid in different ways to shareholders which capital maximization by reserve and by accounts receivable. Return rate calculation formula is as follow:

$$r_{it} = \frac{p_t(1+\alpha+\beta)-(p_{t-1}+c\alpha)+D}{p_{t-1}+c\alpha}$$

In which, p_t and p_{t-1} is the final stock price, t is the beginning of the period, a is capital maximization from accounts receivable, b is the percent of capital maximization, c is the price of underwriting contract of a new share, and D is the dividend during period t. Turnover rate has been calculated in the form of trading volume to the number of issued shares ratio as the following description:

$$T = \frac{V}{N}$$

Where, V is trading volume and N is the number of firm's shares. It can be said that calculating trading volume for preventing from bias due to major trading, the volume of block trades diminishes from total trading volume (Yahya Zadeh et al., 2010).

R&D expenditure volatility (Independent variable)
Following "Swift" (2008) R&D volatility using measured changes coefficient and as 3-year standard deviation turnover of R&D expenditure of a firm toward a 3-year R&D expenditure average as follow:

$$R\&D\ volatility = \frac{stddev_i}{mean_i}$$

Where, stddev$_i$ is 3-year standard deviation turnover of R&D expenditure of a firm and mean$_i$ is a 3-year R&D expenditure average (Kolen et al., 2014).

Firm size (Control variable)
Natural logarithm of book value of total assets (Yeganeh et al., 2008).

Firm age (Control variable)
The number of listing years in Tehran stock exchange (Yeganeh et al., 2008)

Firm type (Control variable)
Based on classification of Tehran stock exchange (yeganeh et al., 2008)

Research method
The current research is a kind of correlation one. The relationship between the variables are analyzed based on the goal of that study. The current study aims to examine the existence of a significant relationship between the independent variables and dependent variables. The used statistical methods are descriptive (non-experimental) and inferential. The applied indices related to the descriptive statistics involved mean, standard deviation and changes coefficient, and inferential statistics includes regression model.

Data analysis method
In this research, we use a suitable method like examining static variables. We use modified Wald test for evaluating group variance heterogeneity among the residuals of fixed effects regression model. The F and Hausman tests are used to determine one of two ways including fixed effect or random effect methods. The F and Hausman tests are used to determine one of two ways including fixed effect or random effect methods.

Research' results
Descriptive statistics

1-1- Data descriptive statistics

Indices	Business cycle (day)	Stock return (percent)	Firm size (percent)	Firm age (year)	R&D expenditure volatility (percent)
Min	37	-0.565	0.688	5	0.152
Max	255	0.716	9.265	14	0.869
Average	106	127	4.018	8.62	0.402
Standard deviation	0.326	0.492	3.299	4.17	0.621

Regarding the Table 1-1, the firm's mean business cycle is 106 days, mean stock return is 0.127, mean firm size is 4.018, mean firm age of the given firms is 8 years, and R&D expenditure volatility is 0.402.

Heterogeneity
The results of heterogeneity test of Arch-LM are as follow:

Table 2-1- ARCH LM test results for the heterogeneity

Description	Statistic value	Probability
F-statistic	0.914512	0.1147
Obs*R-squared	1.302884	0.1147

* 5% error level
According to Table 2-1, F-test statistic is not significant at the 5% level, so the hypothesis of variance homogeneity is confirmed and heterogeneity of variance is rejected for the disturbing terms.

Data normality test

Table 3-1- Jarque-Bra test

Variable	Statistics	Significance level
R&D expenditure volatility	1.511	0.122

Business cycle	1.623	0.127
Stock return	0.947	0.153
Firm size	0.847	0.137
Firm age	1.302	0.104
Type industry	0.814	0.296

Regarding the Table 3-1, due to significance level is not significant in 5% error level, it can be concluded that the research data are normal.

Hypothesis testing

Table 4-1- regression test and significance of model

Variable name	Estimated coefficient	Estimated diversion	T-statistic	Significance level
Fixed	0.845	0.247	3.241	*0.042
R&D expenditure volatility	-3.415	0.394	-8.667	*0.000
Firm size	9.036	0.816	11.073	*0.000
Firm age	0.745	0.198	3.762	0.068
Industry type	1.663	0.207	8.033	*0.000
Durbin-Watson	2.347			
F-statistic	102.369			
Significance level	0.000**			
Adjusted determination coefficient	0.492			

* 5% error level, ** 1% error level

According to Table 4.1, because the value of Durbin-Watson statistic is placed between 1.5 and 2.5; the correlation between the errors is rejected and the regression can be used. The R&D expenditure volatility and stock return have negative and adverse influence with respect to estimation coefficient (-3.415). If R&D expenditure volatility increases in a firm, the stock return would be decreased. This relationship is significant in significance level of t-statistics and 5% error level. Therefore, it can be said that R&D expenditure volatility significantly impacts stock returns of the listed companies in Tehran stock exchange. The independent and dependent variables can also describe about 49.2% of the dependent variable changes. And the significance level of F-statistics show that the research model is significant in 1% error level. The empirical model can be written as follow:

$$Stock\ Returns_{it} = 0.845 - 3.415 R\&D\ expenditure\ volatility_{it} + 9.036 Size_{it} + 0.745 Age_{it} + 1.663 Industry_{it} + \varepsilon_{it}$$

Conclusion

The results of the hypothesis showed that R&D expenditure volatility significantly impact stock return of the listed companies in Tehran stock exchange. Hence, Kolen et al. (2014) showed that there is a significant relationship between R&D expenditure volatility and stock return. The result of Bart (2014) indicated that firms' financial performance importantly and positively influenced by R&D investment. In return, the results of Gharbi et al. (2013) suggested that there is a positive and strong relationship between stock return volatility and R&D investment. Pantagakis et al. (2012) investigated the relationship between R&D investment and firm performance. The results showed that there is a positive correlation between R&D investment and firm performance. Khani et al. (2014) examined the impact of R&D expenditure on stock return of pharmacy firm in Tehran stock exchange. Their results showed that there is no significant relationship between R&D expenditure and stock return. It can be said, therefore, if firms minimize their R&D expenditure volatilities through imposing suitable policies, they can be expected to face with increased stock return.

Research suggestions

1. Investors and shareholders should examine the aimed R&D expenditure of the firm and evaluate the possible volatilities in those expenditure, that's because it can result in decreased stock return through increased expenditure in financial statements.

2. It can be recommended to Tehran stock exchange to rate firms based on their R&D expenditure in order to investors, shareholders and other stakeholders can use this information for their decision-making process.

3. It can be recommended to firms' managers to pay more attention to business cycle, because increased business cycle in firms due to decreased input and output resources, working capital is decreased and the firms have not enough resources for R&D and stock return is decreased which consequently causes increased investment risk.

References

Almeida, H., P. Hsu, and Li. (2013). Less is more: financial constraints and innovative efficiency. Working paper.

Bae , S& Kim, D.(2003). The effect of R&D investments on market value of firms: evidence from the U.S, Germany and Jaoan. Multinational business review, vol 11, pp 51-76

Bart, B. (2014). The effects of R&D investment on firm performance. Business administration. Organizational science.

Brown, J. R, & B. C. Peterson. (2011). Cash holdings and R&D smoothing. Journal of corporate finance, vol 3, pp 694-709

Cullen, G, Gasbarro, D, Ruan, W,& Xiang,E,(2014) .R&D expenditure volatility and stock return: earning management, adjusted costs or overinvestment ?

Gharbi, S, Sahut, J, & Teulon,F,(2013). R&D investments and high-tech firms' stock return volatility, Technological forecasting and social change

Hall, B. H., & J. Lerner. (2010). the financing of R&D and innovation. In hand book of the economics of innovation.

Hirshleifer, D., P. Hsu., & D, Li. (2012). Don't hide your light under a bushel: innovative diversity and stock returns. Working paper. Available at SSRN 2117516.

Hirshleifer, D., P. Hsu., & D, Li. (2013). Innovative efficiency and stock returns. Journal of financial economics, vol 107. No 3, pp 632-654

Jensen, M. C. (2005). Agency costs of overvalued equity. Financial management, vol 34, pp 5-19

Lamont, O., C. Polk & J. SA's-Requejo. (2001). Financial constrants and stock returns. Review of financial studies, vol 14, pp 529-554

Lev, B., B. Sarath, & T. Sougiannis. (2005). R & D reporting biases and their consequences. Contemporary accounting research, vol 22. No 4, pp 977-1026

Li, D.(2011). Financial constraints, R&D investment and stock returns, Review of financial studies 24: 2974-3007

Li, E& Liu, L. (2010). Intangible assets and cross-sectional stock returns: evidence from structural estimation. Working paper, university of Michigan.

Li, E, Livdan, D, & Zhang, L. (2009). Anomalies. Review of financial studies, vol 22, pp 4301-4334

Lin, X. (2007). Endogenous technological progress and the cross section of stock returns. Working paper, London school of economics.

McLean, R & Zhao, M. (2014). The business cycle, investor sentiment and costly external finance. Journal of finance, vol 3, pp 1377-1409

Pantagakis , E, Terzakis, D& Arvanitis, S. (2012). R&D investments and firm performance: an empirical investigation of the high technology sector (software and hardware) in E.U.available at www.ssrn.com

Swift, T. (2008). Creative destruction in R & D on the relationship between R&D expenditure volatility and firm performance. Doctoral dissertation, Temple university.

Swift,T.(2013). R&D expenditure volatility and firm performance: organizational and environmental context. International journal innovation techno management. No 10

Tong, Y & Zhang, F. (2014). Dose capital market punish managerial myopia? Working paper. Murdoch university.

Xu, C, & Yan, M. (2013). Historically erratic R&D spending and contemporaneous R&D management. Working paper, university of Michigan.

Zhu, Z& Huang, F.(2012). The effect of R&D investment on firms' financial performance: evidence from the Chinese listed IT firms. School of accounting , Zhejiang gongshang university, pp 915-919.