The Moderating Effect of Firm Value and Liquidity on the Relationship between Managerial Overconfidence and R&D

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ABSTRACT

Overconfident managers, who tend to overestimate their capabilities, underestimate the possibility and impact of side effects in projects. The purpose of this study is to review the influence of managerial overconfidence on research and development (R&D) expenditures and the moderating effect of firm value and liquidity on this relationship. To this end, 51 companies were chosen from oil, gas and petrochemical companies listed on the Tehran Stock Exchange over the period of 2012-2017. This research, within three basic hypotheses, is analyzed by Eviews software and shows that managerial overconfidence has a positive effect on research and development. Company liquidity has also a direct effect on relationship between managerial overconfidence and R&D, but the firm value does not meaningfully affect the relationship between managerial overconfidence and R&D.

1. Introduction

Nowadays, R&D is the key to compete with the rivals and access the world new technologies. Technology and advancement of technology can change the nature of production processes as well as product quality in different countries, can improve the competition power of goods, and can increase their export. The infrastructures required for producing a product can be divided into three types: hardware, software, and humanware; then, the expertise of different countries show that the determinants of international competitiveness are software and humanware factors (Badi and Baltagi, 2014). Competition is the main motivation for the growth and development of companies. Increasing competition and improving performance have led many organizations into concentrating their activities on core products and capabilities, which require investment in research and technological innovation. In organizations, researches are made with the aim of supporting innovation; R&D

activities for improving the performance and motivation for surviving must lead to developing new business opportunities, or organizational changes must occur to make a transition from the current state to some desired future state (Khanagha Barzegari et al., 2017).

Overconfidence is one of the most important concepts of modern behavioral finance used to explain some behaviors of managers and investors which are not in compliance with traditional finance theories and make human beings overestimate their knowledge and skills and underestimate the risks; they exaggerate the managers' abilities in controlling events and make them feel they have control over issues, but this may not be true (Ahmad, 2013). The overconfident managers systematically overestimate the future return of investment projects and make overestimation of input liquidity in their investment project, so they are confident about their abilities to achieve a proper performance. Therefore, regarding the competitive market, as well

as companies' high demands for development and presenting divers and new products, studying whether overconfident managers are optimistic about investing in research and development in terms of their behavioral characteristics is among the gaps and research needs.

The purpose of this paper is to study the effect of managerial overconfidence on R&D costs. The behavioral financial issues have robust presence in managers' decisions, and the effects of such decisions on the performance of companies are significant. Considering that oil, gas, and petrochemical companies are among the well-known industries in terms of their volume of activities and cash flows, R&D costs in such companies are important and necessary due to their effects on raising and developing the future income resources of oil and gas. Managers' precise attention to R&D costs, which prevents imposing unnecessary expenditures under this headline, has not been investigated so far. Therefore, the current work is innovative in its kind since we are addressing the question of "do the overconfident managers in Iran tend to invest in R&D which is somehow a long-term investment?". In addition, the moderating effect of firm value and liquidity on the relationship between managerial overconfidence and R&D is investigated.

2. Literature Review

Managers are strategic decision makers in big companies; therefore, the psychological impact of their "illogical" confidence will affect all the aspects of the company. These impacts are more likely to rely on judgments based on management prediction; one of these issues is investment in company's R&D. The psychological impacts of managerial overconfidence may assume three forms in R&D costs:

1. Self-motivation: innovative activities have a high profit, a high risk, and somehow a long cycle. In normal conditions, managers tend to avoid risks, but they have innovative investment activities; to avoid this narrow-minded behavior, an external motivation like managerial motives (monetary compensation and stock incentives) is needed. For example, the overconfident managers tend to overestimate the innovation advantages and underestimate their risks; this self-motivation makes them consider themselves successful.

2. Innovation motivation: innovation is constantly considered to be an important index of the company's competition and potentiality. The success of the innovation will bring not only high returns but good credit

to the company, and this is a symbol of power and view. Galasso et al. (2011) believed that executives show their abilities to control the market with innovation. Moreover, Hirshleifer et al. (2011) found that managers use false confidence to adopt innovation plans in technology as a way of showing their view and abilities; therefore, the overconfident managers have greater motivation for innovation because overconfidence enables them to control innovations with higher risks.

3. Representation costs: managers are not generally keen on innovative activities because this contradicts the stakeholders' long-run interests and increases the representation costs; however, overconfident managers' view is quite different. Fairchild (2005) found that overconfident managers are more diligent and help to represent problems. Therefore, overconfident managers protect the stakeholders' interests and are more loyal to them; they also follow the high return of R&D to improve the value of the company. Gervais et al (2011) stated that, from the viewpoint of the future cash flow, overconfident managers expect to achieve a higher future cash flow of investment projects and can make much riskier decisions; as a result, there will be no need to spend more resources, which justifies the motivation of most overconfident managers for R&D activities in comparison to logical managers (Gervais et al., 2011).

Regarding the robust presence of behavioral financial issues in the decisions of managers and decision makers in recent decades and the significant effects of such decisions on income and cost performances, research hypotheses are as follows:

1. Managerial overconfidence has a meaningful effect on R&D.

2. Firm value has a meaningful effect on the relation between managerial overconfidence and R&D.

3. Company liquidity has a meaningful effect on the relationship between managerial overconfidence and R&D.

Many researchers such as Wang et al. (2018) have studied the effect of political ties and managerial overconfidence on the intensity of R&D investment. They concluded that, unlike the previous researches, a high level of managerial interference increases the intensity of R&D. Chen (2017) investigated the impact of managerial incentives on R&D investments and cash flows and reported that risk-taking motivations may increase both risky investments and the financial limitations to R&D investment. Zavertiaeva et al. (2018) also studied the effect of managerial overconfidence on enterprise R&D and stated that those companies overcontrolled by managers invest more in R&D costs;

the countercontrol of R&D do not improve the effect of R&D financial determinants such as enterprise liquidity or profitability. However, determined managers do not invest effectively in R&D, and the costs may have a negative impact on the firm value. A great part of the literature shows that managerial overconfidence and optimism may affect R&D, but Zavertiaeva et al. (2018) found their negative impacts in companies in South Korea, France, Germany, Switzerland, Italy, Spain, and the Netherlands.

Wong et al. (2018) studied the effect of political ties and managerial overconfidence on investment in R&D. Upon examining 1293 Chinese companies with the panel data method, they concluded that powerful political ties decrease the intensity of investment in R&D, but the managerial overconfidence intensifies R&D activities. The result of the last hypotheses indicates that overconfidence has a positive effect on the relationship between political ties and R&D and changes the negative impact of political ties into a positive influence. Marina et al. (2018) also investigated the relationship between managerial overconfidence and R&D costs and confirmed that the R&D cost of the companies run by overconfident and optimist managers are higher. Managerial overconfidence enhances the influence of liquidity and firm value on R&D. However, overconfident managers do not make effective investment in R&D, and the costs can have a negative effect on the firm value. Garkaz et al. (2017) reported the impact of managerial overconfidence on abnormal return. Their research is of quasi-experimental and post-event type based on real information obtained from stock market and companies financial statements listed in stock exchange. The work is of applied type in terms of purpose, and, in terms of content, it is

of correlative type; regression analysis was used to test the hypotheses. Their results confirmed that there is a positive and meaningful relationship between managerial overconfidence and abnormal return. Keivani et al. (2017) also studied the relationship between operating profit and R&D investments and cash flows. Their findings show that there is no meaningful relation between operating profit and R&D investment, but operating profit and cash flows corelate meaningfully. Arjmand et al. (2017) considered the relation of political ties and managerial overconfidence with R&D investment. They stated that the relation between political ties and R&D investment is meaningful and that managerial overconfidence significantly influences the relation between political ties and R&D intensity.

3. Methodology

Since this is an applied research from the purpose point of view, managers of oil, gas, and petrochemical industries may use this paper and apply its findings to their decisions; in addition, it is a correlative and regression research from the viewpoint of method. Regarding the fact that the main data are achieved based on past performance and historical data, this is a post-event research (Hafeznaya, 2008). To analyze the information, descriptive inferential statistics and the panel multiple regression method are used.

3.1. The Model

Following Zavertiaeva et al. (2018), this research employs Equation 1 to test the hypotheses.

$$RD_{it} = \beta_0 + \beta_1 OverConf_{it} + \beta_2 + FV_{it} + \beta_3 Liq_{it} + \beta_4 OverConf \times FV_{it} + \beta_5 OverConf \times Liq_{it} + \beta_6 LEV_{it} + \beta_7 ROA_{it} + \beta_8 Size_{it} + \varepsilon_{it} \quad (1)$$

Table 1- Variables descriptive indices

Variable	R&D Investment	Managerial Overconfidence	Firm Value	Size	Return on Assets	Liquidity	Leverage
Symbol	RD	OVER	FV	SIZE	ROA	LIQ	LEV
Average	0.037	0.298	0.298	13.136	0.072	1.286	0.574
Mediator	0.026	0.000	0.212	13.031	0.084	1.153	0.580
Maximum	0.129	1.000	0.612	18.023	0.290	2.866	0.921
Minimum	0.004	0.000	0.112	10.025	-0.279	0.565	0.276
Deviation	0.032	0.458	0.351	1.547	0.132	0.541	0.153
Kurtosis	1.141	0.879	0.357	0.559	-0.975	1.342	-0.082
Skewness	0.322	0.773	1.855	3.279	4.051	4.687	2.514
Remarks	306	306	306	306	306	306	306

R&D is a dependent variable which is obtained from R&D costs divided by total assets. Managerial overconfidence is an independent variable used as a scale to measure a manager's overconfidence. Following Huwan et al. (2011), Lynn et al. (2005), and Park and Kim (2009), it can be calculated by subtracting the real profit from the annual projected earnings. If during a case, the number of management profit overestimations exceeds the number of underestimations, the manager is overconfident; in this case, the variable is equal to one, otherwise the variable is considered to be zero. Liquidity (total current assets to total current debts) and firm value (the logarithm of market value of the company's equity) variables were classified as a moderator, and their effects were measured because they directly affect the relationship between the independent and dependent variables of R&D costs. The three variables, including assets return (the ratio of after-tax profit to total assets), company size (logarithm of total assets at the end of fiscal year), and financial leverage (the ratio of the book value of debts to the book value of assets) were defined as control variables, and we assumed that their effects were constant since they might indirectly influence R&D costs.

3.2. Statistical population and sample

The statistical population of this research consists of all oil, gas, and petrochemical companies listed on the Tehran Stock Exchange during 2012-2017. The companies with incomplete data and companies with a fiscal year apart from March 19 were eliminated, and finally 51 companies were selected.

Table 2- Results of the normality test of errors of the research hypothesis model

Variable	Symbol	Jarque-Bera Test Statistics	Jarque-Bera Test Probability
Sentence errors	Resid	3.337	0.184

Table 3- Collinearity of the independent and control variables

Description	Symbol	Tolerance	Variance Inflation Factor
Managerial Over-confidence	OVER	5.528	1.066
Liquidity	LIQ	11.043	2.212
Firm Value	Firm value	44.729	1.007
Return on Assets	ROA	14.124	1.061
Company Size	SIZE	124.014	1.030
Financial Leverage	LEV	3.307	1.030

4. Empirical Results and Discussions
4.1. Descriptive Statistics of Research Variables

The average and mediator of R&D investment as a dependent variable are respectively about 0.037 and 0.026, which indicates that about half of the companies are above 0.26. The distribution of this variable has a positive skewness and kurtosis. Managerial overconfidence as an independent variable has an average of about 0.298, which indicates the average of managerial overconfidence of companies; the variable mediator also shows that half of the listed companies have overconfidence of about 0.000. The distribution of this variable has a positive skewness and kurtosis. Liquidity and firm value are variable moderators; the average of liquidity ratio is about 1.286. Moreover, the variable mediator indicates that about half of the listed companies have a liquidity ratio higher than 1.153. The distribution of this variable has a positive skewness and kurtosis. The average of FV is about 0.298, and the variable mediator indicates that about half of the listed companies have a value more than 0.212. The distribution of this variable has a positive skewness. Furthermore, the average of company size is about 13.136, and the variable mediator indicates that about half of the listed companies have a size larger than 13.031. The distribution of this variable has a positive skewness. The average of financial leverage is also about 0.574, and the variable mediator indicates that about half of the listed companies have leverage above 13.031. The distribution of this variable has a positive skewness but a negative kurtosis. The average of ROA is about 0.072, and the variable mediator indicates that about half of the listed companies have an ROA greater than 0.084. The distribution of this variable has a positive skewness but a negative kurtosis.

4.2. Inferential Statistics

In most parametric tests, there are lots of preliminary assumptions, and if these assumptions are not met, the results of the tests will be invalid. The most important and common assumption is having "normal data". A normal data distribution means that the histogram of the frequency of data is almost a normal curve. Before studying the normal data, it should be noted that, in most cases, the error distribution must be normal; in other words, instead of considering the normality of the data, the error distribution should be checked whether they are normal or not. In this research, Jarque-Bera test is utilized to determine whether the model errors are normal or not; thus, if the probability of Jarque-Bera test is

greater than the error level of 5%, it can be concluded that the errors of the research hypothesis model have a normal distribution, as shown in Table 2.

4.2.1. Normality Test of Sentence in Research Hypothesis Model

Sentence errors in the research hypothesis model have a normal distribution: H0

Sentence errors in the research hypothesis model does not have a normal distribution: H1

Since the amount of Jarque-Bera test probability is more than the level of 5% error, it can be found that the sentence error of the research hypothesis has a normal distribution.

4.2.2. Collinearity Test of Research Variables

Regarding the fact that the tolerance of all the variables is more than 0.2, and the variance inflation factor is less than 5, it can be noted that the independent and control variables are not colinear.

4.2.3. Pattern Selection Test

Regarding the current research literature and the nature of hypothesis, combined data are used in this research. To select a proper model (combined or panel with fixed or random effects) for the hypothesis test, Cha Wu-Hausman test is used.

Cha Wu Test

The results of test F on the regression model used in this research is tabulated in Table 4. The null and alternative hypothesis of Cha Wu test are as follows:

H0: combined data method
H1: panel data method

Regarding the meaningful results of Cha Wu test in Table 4 indicates that assumption H0 (the combined model) is not confirmed. In other words, there are individual or group effects, and the panel data method must be used to estimate the research regression model; Hausman test must be used to determine the type of the panel model (random or fixed effects) subsequently.

Hausman Test

Once it is clear that y-intercept is not the same at different years, the method of estimating the model (random or fixed effects) must be determined; Hausman test is therefore employed. The null hypothesis and alternative hypothesis of Hausman test are defined by:

H0: random effects method
H1: fixed effects method

Hausman test results are summarized in Table 5:

According to the Hausman test results in Table 5, Chi-2 statistics in Hausman test 95% is meaningful, which confirms H1 hypothesis; therefore, regarding the Hausman test, the constant

Table 4- Cha Wu test

Statistics	Probability	Test Result	
4.720	0.000	Null hypothesis rejected	Panel model

Table 5- Cha Wu test

Chi-2 statistics	Probability	Test Result	
15.989	0.023	Null hypothesis rejected	Panel with fixed effects

Table 6- Hausman test

Description		Coefficient	Statistic t	Level of Meaningfulness
Constant number		0.362	3.854	0.00
Managerial Overconfidence	OVER	0.091	14.633	0.00
Firm Value	FV	0.029	2.035	0.04
Managerial Overconfidence in Firm Value	FV*OVER	-0.061	-1.950	0.06
Liquidity	LIQ	0.032	4.343	0.00
Managerial Overconfidence in Liquidity	LIQ*OVER	0.427	3.526	0.00
Return on Assets	ROA	-0.197	-1.761	0.07
Firm Size	SIZE	0.019	2.863	0.00
Financial Leverage	LEV	-0.370	-0.079	0.93
Determination Coefficient		0.774	Statistic F	16.037
Moderated Determination Coefficient		0.726	Meaningfulness	0.000
			Durdin Watson Statistic	1.915

effects method using the panel data model matches the model of this study .

4.3. Empirical Analysis

After reviewing the classic hypotheses, we will examine the research hypotheses in the following., and the regression results and coefficients will briefly be analyzed.

As Table 6 shows, the level of meaningfulness of managerial overconfidence variable (0.00) is less than 5%. Therefore, the first main hypothesis of the research is approved at a confidence level of 95%, and the positive regression coefficient of managerial overconfidence (0.091) indicates a direct relation between the dependent and independent variables. The level of meaningfulness of managerial overconfidence variable in firm value (0.06) is more than the error level of 5%, so the second main hypothesis of the research is not confirmed at a confidence level of 95%. Firm value has no meaningful effect on the relation between managerial overconfidence and R&D. The meaningfulness coefficient of managerial overconfidence variable in liquidity (0.00) is also less than the error level of 5%, so the third main hypothesis of the research is confirmed at a confidence level of 95%. However, the positive regression coefficient of managerial overconfidence in liquidity (0.427) indicates that the company liquidity directly affects managerial overconfidence and R&D. Furthermore, size of the company has a meaningful effect on R&D costs because its meaningfulness level (0.00) is less than the error level of 5%. Based on the moderated determination coefficient of the model, about 73% of changes in R&D costs are explained by this model. Since the amount of Durbin-Watson statistic (1.915) is between 0-4 at an optimum interval, the hypothesis of self-correlation between the variables is rejected. Since the probability of F statistic test (0.000) is less than the error level of 5%, it is confirmed that the fitted regression is meaningful.

5. Conclusion

According to the first main hypothesis, managerial overconfidence has a meaningful effect on R&D costs, and, based on the test, the meaningfulness coefficient of managerial overconfidence variable (0.01) is less than the error level of 5%. Therefore, the first main hypothesis of the research is approved at a confidence level of 95%, and the positive regression coefficient of managerial overconfidence

variable (0.091) indicates a direct relation between the independent and dependent variables; as a result, managerial overconfidence has a positive effect on R&D, which means an increase in managerial overconfidence raises R&D costs and vice versa.

As per the second main hypothesis, firm value has a meaningful effect on the relation between managerial overconfidence and R&D costs, and based on the test, the meaningfulness level of managerial overconfidence variable in firm value (0.06) is more than the error level of 5%. Therefore, the second main hypothesis is not approved at a confidence level of 95%, so firm value does not meaningfully affect the relation between managerial overconfidence and R&D costs.

In accordance with the third main hypothesis, the company liquidity has a meaningful effect on the relation between managerial overconfidence and R&D costs, and based on the test, the meaningfulness level of managerial overconfidence variable in liquidity (0.00) is less than the error level of 5%. Therefore, the third main hypothesis is approved at a confidence level of 95%, but the positive regression coefficient of managerial overconfidence in liquidity (0.43) indicates the company liquidity directly impacts on the relation between managerial overconfidence and R&D. Overconfident managers in Iran Stock Exchange tend to invest on R&D, which expresses their optimism about improving future performance through investment in R&D, leading to developing and introducing new products to market, etc. In fact, these managers accept the risk and are optimistic about the future return of investment in R&D.

The result of this research is in agreement with the works of Zavertiaeva et al. (2018) and Marina et al. (2018). Zavertiaeva et al. (2018) showed that those companies managed by overconfident managers make greater investment in R&D costs, but such overconfidence has no impact on moderator variables such as the company liquidity and profitability. Marina et al. (2018) studied the relation between managerial overconfidence and R&D costs and reported that R&D costs are higher in companies controlled by confident and optimistic managers. However, our results contradict the results of Marina et al. (2018), concluding that managerial overconfidence strengthens the effect of firm value on R&D.

Based on the result of the first hypothesis, managerial overconfidence has a positive meaningful effect on R&D costs. It is recommended that other decision makers of

the company should evaluate the future function of the company after managerial overconfidence in investment in R&D to prevent unreasonable decision makings of managers and protect the stakeholders' interests. Regarding the result of the third hypothesis, the company liquidity has a meaningful effect on the relation between managerial overconfidence and R&D costs since the optimistic managers spend the company liquidity on R&D carelessly and irrationally, the outcome of which may increase the company risk. It is recommended that companies should pay special attention to personality traits and non-emotional behaviors when employing managers because a manager's emotional behavior may cause the stakeholders to lose their confidence; Finally, since the continued and increased investment (especially in stock companies with diverse investors) is the economy engine, its consequences may bring serious crisis in the long run.

6. Research Limitations

The research is carried out in oil, gas, and petrochemical companies; therefore, one must be cautious about popularizing the results in other societies.

Due to the high volume of the financial variables, it was not possible to consider all the effective variables.

The data of this research was extracted from Tehran Stock Exchange, and the inefficiency of this stock restricts the research results reliability.

We have a two-digit inflation rate in our country, and there is no standard to adjust the companies' historical financial statements. High inflation and its probable consequences on financial information may undermine the results of the research.

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