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The Moderator Role of Managerial Overconfidence in the Relationship between R&D Volatility and Firm Value: An Application in Borsa Istanbul

Ar-Ge Volatilitesi ve Firma Değeri İlişkisinde Yönetimsel Aşırı Güvenin Moderatör Rolü: Borsa İstanbul'da Bir Uygulama

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Abstract

Purpose: The study aims to reveal the moderating role of managerial overconfidence in the link between R&D volatility and firm value in firms operating in the Metal Goods Sector of Borsa Istanbul during the period 2010-2020.

Design/Methodology: The moderating role of managerial overconfidence in the linkage between R&D volatility and firm value is investigated with panel data analysis.

Findings: The short-run estimates reveal positive linkage determined between R&D volatility and firm value. We also reveal that managerial overconfidence positively moderates the link between R&D volatility and firm value. In this direction, the effect of R&D volatility on firm value is higher and positive in firms where managers have excessive self-confidence.

Limitations: The limitation of the study is that the analysis period is determined as 2010-2020 and the sample consists of 20 firms operating in the Borsa Istanbul Metal Good Sector.

Originality/Value: The number of studies in the literature on the relevant period and sample is limited. Therefore, the study contributes to the literature and is original.

Keywords: R&D Volatility, Firm Value, Managerial Overconfidence, BIST

Öz

Amaç: Çalışmada, 2010-2020 döneminde Borsa İstanbul Metal Eşya Sektöründe faaliyet gösteren firmalarda Ar-Ge volatilitesi ile firma değeri ilişkisinde yönetimsel aşırı güvenin moderatör rolünün araştırılması amaçlanmıştır.

Tasarım/Yöntem: Ar-Ge volatilitesi ile firma değeri arasındaki ilişkide yönetimsel aşırı güvenin moderatör rolü panel veri analizi ile araştırılmıştır.

Bulgular: Gerçekleştirilen analizler sonucunda Ar-Ge volatilitesi ile firma değeri arasında pozitif ilişki ortaya çıkarılmıştır. Ayrıca yönetimsel aşırı güvenin Ar-Ge volatilitesi ile firma değeri ilişkisini olumlu yönde yumuşattığı bulgulanmıştır. Dolayısıyla yöneticilerin kendine aşırı güvendiği firmalarda Ar-Ge volatilitesinin firma değeri üzerindeki etkisinin daha fazla ve pozitif yönde olacağı söylenebilmektedir.

Sınırlılıklar: Çalışmanın sınırlığı analiz döneminin 2010-2020 olarak belirlenmesi ve örneklemin Borsa İstanbul Metal Eşya Sektöründe faaliyet gösteren 20 firmadan oluşmasıdır.

Özgünlük/Değer: Literatürde ilgili dönem ve örneklemde çalışma sayısı sınırlıdır. Dolayısıyla çalışma literatüre katkı sağlamakta ve özgünlük sunmaktadır.

Anahtar Kelimeler: Ar-Ge Volatilitesi, Firma Değeri, Yönetimsel Aşırı Güven, BİST

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1. INTRODUCTION

Research and Development (R&D) investments refer to investments in intangible assets that contribute to the long-term growth of the firm. Therefore, the market value of a firm reflects the present value of tangible assets as well as intangible assets. Rational investment in R&D results in an innovative product or service that permits a firm to diversify itself from other firms (Ho et al., 2005). R&D investments are associated with high uncertainty as returns are not immediate. These investments are seen to create opportunities in the future that can be both profitable and provide the company with a distinct competitive advantage. As a result of increasing competition, companies are looking for growth opportunities in the market and want to enter the market before their competitors. This means that they need to innovate at a remarkable step, growing and developing new products and services and generating ideas that are obviously designed to become commercially effective and profitable business ventures. Therefore, studies show that R&D investment creates worth for the firm as it provides competitive benefits thanks to the diversify strategies that produce new and better products and services and increases its value in financial terms (Ehie and Olibe, 2010).

R&D expenditures include both exploratory innovations and exploitative innovations. Exploitation innovations aim to achieve remediation, production, efficiency and execution, which are objectives that are best reached in steady and predictable environments. Investigative improvements focus on risk-taking, experimentation, research, exploration and rooted innovation actions associated with rapid change. Maintaining the appropriate balance between exploratory and exploitative innovations is critical to an organization's success and even survival, as relying on only one process can lead to suboptimal results (Mudambi and Swift, 2014). When the main focus in the innovation strategy alter from exploitative changing to explorative innovation, there is a significant increase in the required resources. Conversely, when the focus shifts from exploratory innovation to exploitative innovation, there is a significant decrease in the required resources. The firm's transition between exploratory and exploitative innovations can be expressed as R&D volatility. Exploratory innovation causes positive volatility because it requires high expenditures, while exploitative innovation causes negative volatility because it requires low expenditures. The volatility in R&D expenditures should serve the firm to compensate its short-term income goals (Hai et al., 2020). Therefore, firms that can achieve a balance between exploratory and exploitative innovation will be able to gain competitive advantage and firm values will be positively affected.

According to the literature, R&D intensity is a major factor of firm profitability and high investment in R&D is often argued to be a high risk-high return strategy. Focusing on R&D can increase a firm's ability to innovate, which in turn increases the firm's capability to reach the better performance in the market. This is attractive for shareholders who expect better financial performance (Ehie and Olibe, 2010). According to the punctuated equilibrium theory, firms may remain explorative changing and exploitative innovation in several periods. Managers play an important role in the transitions between these innovations. Overconfident managers are more likely to increase R&D spending by performing explorative innovation projects than rational managers. Overconfident managers are also more confident in translating exploitative innovation projects into action, improving product characteristics through the periodic results of exploratory innovation, increasing the efficiency of present processes, consolidating competitive advantages, and eventually generating higher economic returns (Hai et al., 2020). Therefore, it can be said that overconfidence has a role in the link between R&D and firm value.

In this context, the study aims to analyze the moderating role of managerial overconfidence in the link between R&D volatility and firm value in firms operating in the Metal Goods Sector of Borsa Istanbul during the period 2010-2020. The findings of the study are important for firms' R&D management and strategies. The number of studies in the literature on the relevant period and sample is limited. Therefore, the study contributes to the literature and is original.

2. LITERATURE REVIEW

There are studies in the literature that analyze the link between R&D expenditures and firm value. In addition, there are studies that analyze the link between volatility in R&D expenditures and firm value. When some of the studies investigating the relationship between R&D expenditures and

firm value are examined, Hall (1987), Geroski and Machin (1992) reveal that positive linkage between R&D and growth, Johnson and Pazderka (1993) reveal that positive linkage between R&D and market value, Pindado et al. (2010) reveal that R&D expenditure efficiency depends on firm characteristics, Ehie and Olibe (2010) reveal that positive linkage between R&D and growth. Kim et al. (2018) reveal that as R&D investments increase, firm value increases up to a certain point and then decreases. When the studies on R&D volatility are analyzed, Mudambi and Swift (2011) stated in their study that R&D volatility includes both exploratory and exploitative innovations of the firm and is positively related to firm growth. Swift (2013) argues that high organizational freedom increases the positive relationship between R&D volatility and firm performance. He reveals that firms with superior access to freely held discretionary funds use these resources to finance nascent R&D projects and reduce uncertainty, thereby encouraging more commercially valuable innovations. Patel et al. (2018) have investigated the role of corporate governance in returns from R&D volatility. They have found that corporate governance complements R&D volatility in increasing a firm's performance. Duppati et al. (2017) have reveal that R&D volatility has a positive effect on the increase and decrease in firm performance for Spanish firms. Hao et al. (2020) have examined the impact of R&D volatility on market capitalization and the moderating role of managerial overconfidence on this effect. They have reveal that both positive and negative R&D volatilities have a strong and significant positive effect on market capitalization and that managerial overconfidence positively affects the linkage between R&D volatilities and market capitalization. Xiang et al. (2020) reveal a negative linkage between R&D volatility and firm return in their study. They have argued that the linkage between the volatility of R&D expenditures and stock returns may be affected by disruptive adjustment costs, arise from earnings management, or reflect the actions of managers.

3. METHODOLOGY

3.1. Data Set, Methodology and Variables

The study aims to analyze the moderating role of managerial overconfidence in the linkage between R&D volatility and firm value in firms operating in the Metal Goods Sector of Borsa Istanbul during the period 2010-2020. The moderating role of managerial overconfidence in the linkage between R&D volatility and firm value is investigated with panel data analysis. In this context, for panel data analysis, multicollinearity and endogeneity, horizontal cross-section dependence and homogeneity, stationarity, estimation model selection, autocorrelation and variance assumptions are tested and model estimation is performed. The study period has been determined as the period for which firms' data are available. Since proportional change is taken in the calculation of the R&D volatility variable, data for 2020 could not be included in the analysis and data for the period 2010-2019 are included in the analysis. The data used in the analysis has been retrieved from the Finnet database. The firms included in the analysis in the study are determined as 20 firms operating in the Metal Goods Sector of Borsa Istanbul and whose data can be accessed in the relevant period are shown in Table 1.

Table 1: Firms Included in the Analysis

S. N.	BIST CODE	S. N.	BIST CODE
1	ALCAR	**11**	SAYAS
2	ASUZU	**12**	OTKAR
3	ARCLK	**13**	SILVR
4	EGEEN	**14**	TOASO
5	EMKEL	**15**	TMSN
6	FROTO	**16**	PRKAB
7	IHEVA	**17**	TTRAK
8	JANTS	**18**	ULUSE
9	KARSN	**19**	VESTL
10	KLMSN	**20**	VESBE

3.1.1. Measurement of firm value and R&D volatility variables

In this study, the firm value (FV) variable is calculated using the market capitalization to book value ratio. There are different approaches in the literature to measure the volatility of R&D expenditures. Since the time dimension of the study is narrow, R&D volatility (RDVOL) is measured by taking the certain value of the proportional change in R&D expenditure based on the study of Xiang et al. (2020). The way it is calculated is shown in the formula below.

$$\text{RDVOL}= \left|\frac{R\&D_t - R\&D_{t-1}}{R\&D_{t-1}}\right| \quad (1)$$

3.1.2. Measurement of managerial overconfidence variable

In the measurement of the managerial overconfidence variable, the process in Gao and Han (2022)'s study has been followed. Gao and Han (2022) have measured overconfidence tendency with five proxy variables in their study. Due to insufficient data, three proxy variables have been used in the study. The calculation of the variables is as follows.

Variable 1: Under the assumption that overconfident managers prefer debt financing, the Debt/Equity ratio is created as 1 if it is greater than the sector median; and otherwise, it is created as a dummy variable that takes the value of 0.

Variable 2: For each firm, the regression residuals of total asset growth on sales growth are taken. If the residual is greater than zero, it is assumed that the manager has an overconfidence tendency, and it is created as 1; and otherwise, it is created as a dummy variable that takes the value of 0.

Variable 3: Under the assumption that overconfident managers will reduce dividend distribution, it is created as 1 if firms do not distribute dividends and otherwise it is created as a dummy variable that takes the value of 0.

Then, following the method in Gao and Han (2022), the total score of the above 3 variables have been calculated. If this score is equal or greater than 2, it is considered that the manager has a tendency to show overconfidence and thus, a managerial overconfidence (MO) variable with a value of 1 has been created. If this score is not equal or greater than 2, it is considered that the manager does not tend to show overconfidence, and a managerial overconfidence (MO) variable with a value of 0 has been created.

3.1.3. Moderator variable

In order to investigate whether managerial overconfidence has a moderating role in the link between R&D volatility and firm value, a moderator variable has been created as R&D Volatility x Managerial Overconfidence (RDVOLxMO).

3.2. Research Design and Related Hypotheses

The study aims to analyze the moderating role of managerial overconfidence in the link between R&D volatility and firm value in firms operating in the Metal Goods Sector of Borsa Istanbul during the period 2010-2019. In this context, 2 regression models are created. The models and hypotheses are shown in Table 2.

Table 2: Models and Hypotheses

R&D Volatility-Managerial Overconfidence-Firm Value Relationship (Panel A)
$FV_{it} = \alpha i + \beta_1 RDVOL_{it} + \beta_2 MO_{it} + \varepsilon_{it}$
Hypothesis 1-H_1: There is a linkage between R&D volatility and firm value.
Hypothesis 2-H_2: There is a linkage between managerial overconfidence and firm value.
The Moderator Role of Managerial Overconfidence in the Relationship between R&D Volatility and Firm Value (Panel B)
$FV_{it} = \alpha i + \beta_1 RDVOL_{it} + \beta_2 MO_{it} + \beta_3 RDVOLxMO_{it}\ \varepsilon_{it}$
Hypothesis 3-H_1: Financial leverage has a moderating role in the impact of asymmetric information on firm value.

R&D volatility includes both exploratory innovation and exploitative innovation of firms (Mudambi and Swift, 2014). An explorative innovation strategy serves firms to include new market occasions by introducing new technologies, exploring new processes and growing new distribution channels when the firms are faced with rapid changes in technologies, differences in customer preferences and fluctuations in product demand or material supply. Thus, since exploratory innovation requires high R&D expenditures, it leads to positive volatility in R&D expenditures. When exploratory innovation provides new forms of competitive advantage leading to a reduction in R&D expenditure, in the routine course of events, most firms revert to exploitative innovation. Exploitative innovation is designed to compensate the needs of present customers or markets and contains developing present methods or materials used to increase their performance in competitive environments. Therefore, it causes negative volatility in R&D expenditures. In this framework, R&D volatility is expected to have a positive impact on firm value (Hai et al., 2020). Overconfidence is the tendency to overestimate expected returns under uncertainty. Overconfident managers make more aggressive financing and other managerial decisions. Overconfident managers are more likely to increase R&D expenditures by implementing explorative projects than rational ones. Moreover, overconfident managers are more willing to reduce costs, optimize internal management, and improve performance through exploitative innovation. In this framework, managerial overconfidence is expected to play a positive moderating role in the link between R&D volatility and firm value (Hai et al., 2020).

3.3. Findings

The descriptive statistics of the analyses conducted to analyze the moderating role of managerial overconfidence in the link between R&D volatility and firm value are presented in Table 3.

Table 3: Descriptive Statistics

	FV	**RDVOL**	**MO**
Mean	2.167134	1.097927	0.385000
Median	1.704454	0.226215	0.000000
Maxima	13.17759	153.2193	1.000000
Minima	0.000000	0.000000	0.000000
SD	1.818365	10.81752	0.487816
Skewness	2.310807	14.00902	0.472672
Kurtosis	11.65364	197.5031	1.223419
Jarque-Bera	802.0406	321803.8	33.74930
J-B Probability	0.000000	0.000000	0.000000
Observation	200	200	200

The mean values of the variables are 2.167 for firm value, 1.097 for R&D volatility and 0.385 for managerial overconfidence. The mean value for firm value suggests that firms' shares have been overpriced in the relevant period, while the mean value for managerial overconfidence suggests that there has been managerial overconfidence in less than half of the analysis period. When the JD probability values of the variables are analyzed, it is observed that the probability value realized in all variables is less than the critical value of 0.05. Therefore, it has been determined that the variables did not exhibit a normal distribution. Since the series are not normally distributed, the problem of multicollinearity is examined with the Spearman Correlation test. The test results reported in Table 4.

Table 4: Spearman Correlation Test Results (Independent Variables)

Correlation	FV	RDVOL	MO
FV	1.000000		
RDVOL	0.062077	1.000000	
MO	-0.224717	0.050724	1.000000
t-Statistic	FV	RDVOL	MO
FV	-----		
RDVOL	0.875195	-----	
MO	-3.245039	0.714669	-----
Probability	FV	RDVOL	MO
FV	-----		
RDVOL	0.3825	-----	
MO	0.0014	0.4757	-----

When the Spearman Correlation test results are analyzed, it is determined that there is no high-level (0.75 and above) relationship between the independent variables. Therefore, there is no multicollinearity problem between the variables (Topaloğlu, 2019). One of the assumptions in model building with the moderator variable is that there should not be a high degree of correlation between the independent, moderator and dependent variables. For this reason, the correlation relationship between the dependent, independent and moderator variables has also been examined and it has been determined that there is no high-level relationship. Then, it is investigated whether there is an endogeneity problem in the models or not. For this purpose, the error terms of each model have been obtained and the relationship between them and the independent variables has been analyzed by Spearman Correlation test. The results are reported in Table 5.

Table 5: Spearman Correlation Test Results (Panel A, Panel B Error Term and Independent Variables)

PANEL A				**PANEL B**				
Correlation	Error T.	RDVOL	MO	**Correlation**	Error T.	RDVOL	MO	RDVOLXMO
Error T.	1.000			Error T.	1.000			
RDVOL	0.064	1.000		RDVOL	0.052	1.000		
MO	-0.000	0.0507	1.000	MO	0.003	0.050	1.000	
				RDVOLXMO	0.004	0.228	0.953	1.000
t-Statistic	Error T.	RDVOL	MO	**t-Statistic**	Error T.	RDVOL	MO	RDVOLXMO
Error T.	-----			Error T.	-----			
RDVOL	0.912	-----		RDVOL	0.733	-----		
MO	-0.003	0.714	-----	MO	0.048	0.714	-----	
				RDVOLXMO	0.065	3.306	44.347	-----
Probability	Error T.	RDVOL	MO	**Probability**	Error T.	RDVOL	MO	RDVOLXMO
Error T.	-----			Error T.	-----			
RDVOL	0.362	-----		RDVOL	0.463	-----		
MO	0.997	0.475	-----	MO	0.961	0.475	-----	
				RDVOLXMO	0.947	0.001	0.000	-----

According to the Spearman correlation test results in Table 5, there is no high degree of correlation between the error term of the model and the independent variables in both models. Therefore, it seems that there is no endogeneity problem in the models. Before the stationarity test, cross-section dependence and homogeneity have been tested to determine which unit root test to use. Cross-section dependence is investigated with the CD test (Peseran, 2004), which is used when N(number of firms)>T(time period) dimension is high. Cross-section dependence (CSD) and slope heterogeneity test results on a variable basis are shown in Table 6.

Table 6: CSD and Slope Heterogeneity Test Results

CSD Test Results			
Variable	**Test**	**Statistic**	**Probability**
FV	CD (Peseran, 2004)	-1.082	0.140
RDVOL	CD (Peseran, 2004)	-0.614	0.269
H_0: no cross-section dependence.			
Slope Heterogeneity Test Results			
Variable	$\tilde{\Delta}$ **Probability**		$\tilde{\Delta}_{adj}$ **Probability**
FV	3.753	0.000	4.486	0.000
RDVOL	-0.949	0.829	-1.135	0.872
H_0: homogeneity.				

When the cross-section dependence test results are analyzed, it is observed that the probability value is greater than the critical value of 0.05 in both variables and the null hypothesis of no horizontal cross-section dependence cannot be rejected. It is revealed that there is no cross-section dependence problem in both variables. When the delta test results for the variables are analyzed, it is revealed that the probability value for the FV variable is less than the critical value of 0.05, while the probability value for the RDVOL variable is greater than the critical value of 0.05. Therefore, the slope coefficient of the FV variable is heterogeneous, while the slope coefficient of the RDVOL variable is homogeneous. Then, the stationarity of the RDVOL variable is analyzed with the LLC test, which is used for homogeneous series with no horizontal cross-sectional dependence, and the stationarity of the FV variable is analyzed with the IPS test, which is used for heterogeneous series with no horizontal cross-sectional dependence. The stationarity results reported in Table 7.

Table 7: Stationarity Results

RDVOL			
	Test	**t-stat.**	**Probability**
Constant	LLC	-11.7082	0.0000
Constant and Trend	LLC	-11.4711	0.0000
FV			
	Test	**t-stat.**	**Probability**
Constant	IPS	-2.65685	0.0039
Constant and Trend	IPS	-0.17315	0.4313
H_0: has a unit root.			
CONSTANT/TREND SELECTION			
FV	**Coeff.**	**Std. Error**	**t-stat.**	**Probability**
C	1.443706	0.159861	9.031000	0.0000
@TREND	0.077962	0.032107	2.428174	0.0381

When the LLC test results for the RDVOL variable are analyzed, it is observed that the test probability value is less than the critical value of 0.05 for both constant and constant-trend and the null hypothesis of unit root is rejected. Therefore, the series is found to be stationary at level. When the IPS test results for the FV variable are analyzed, it is observed that the test probability value for the constant is less than the critical value of 0.05, while the test probability value for the constant trend is greater than the critical value of 0.05. Since the results are contradictory, the model estimation has been performed with ECM by adding constant and trend terms to the FV variable series in order to reveal which unit root test is appropriate for the structure of the variable: constant term or constant and trend term. According to the model results, the constant term is found to be more significant. Therefore, the unit root result for the constant is taken into account. The FV variable has also been found to be stationary at level. Then, F test, Breusch-Pagan LM (1980) and Honda (1985) tests are used to analyze which of the fixed, random or pooled models will be used for estimation. The results reported in Table 8.

Table 8: Model Selection Results

	PANEL A		PANEL B	
Test	**Stat.**	**p-value**	**Stat.**	**p-value**
F-group_fixed	18.76182	0.000000	18.76092	0.000000
F-time_ fixed	6.353953	0.000000	6.295763	0.000000
F-two_ fixed	14.75957	0.000000	14.74066	0.000000
LM-group_random	286.8751	0.000000	287.8531	0.000000
LM-time_ random	4.683599	0.030452	4.411153	0.035705
LM- two_ random	291.5587	0.000000	292.2643	0.000000
Honda- group_random	16.93739	0.000000	16.96624	0.000000
Honda- time_ random	2.164162	0.015226	2.100275	0.017852
Honda- two_ random	13.50684	0.000000	13.48206	0.000000

According to the F test results, both group and time effects are present in both models and that using the two-way fixed effects model will yield efficient results. According to the LM and Honda test results, random effects model is valid instead of the pooled model and both group and time effects are present in both models. Since the data used in the study belongs to a specific period and group, estimation is made with the fixed effects model (Baltagi, 2005: 12). The results of the variance and autocorrelation tests for the fixed effects model are reported in Table 9.

Table 9: Heteroscedasticity and Autocorrelation Test Results

PANEL A		
Heteroscedasticity		
Breusch-Pagan-Godfrey LM	335.3027	0.000000
H_0: no heteroscedasticity		
Autocorrelation		
Baltagi ve Li (1991) LM	45.16064	0.000000
Born ve Bretuing (2016) LM	69.81265	0.000000
H_0: no autocorrelation		
PANEL B		
Heteroscedasticity		
Breusch-Pagan-Godfrey LM	340.0261	0.000000
Autocorrelation		
Baltagi ve Li (1991) LM	44.58971	0.000000
Born ve Bretuing (2016) LM	69.08989	0.000000

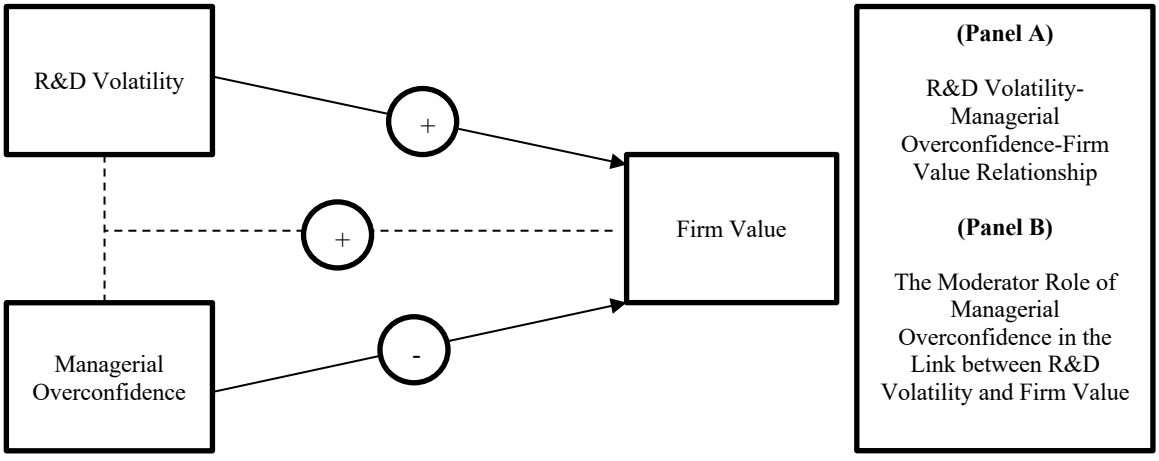
When the autocorrelation and heteroscedasticity test results for Panel A and Panel B are analyzed, the probability value is less than the critical value of 0.05 in all tests. Therefore, it is determined that both models have heteroscedasticity and autocorrelation problems. In this context, estimation has been performed with the White diagonal method, which takes these problems into account and solves them. The estimation results are shown in Table 10.

Table 10: Estimation of factors for models

Dependent Variable: FV **Method: White (Dioganal)** **Sample: 2010-2019**				
PANEL A				
Variable	**Coefficient**	**Standart E.**	**t-Statistic**	**Prob.**
RDVOL	0.005689	0.002585	2.201006	0.0290
MO	-0.160641	0.092674	-1.733385	0.0848
C	2.222734	0.056167	39.57375	0.0000
R^2			0.629006	
Adjusted. R^2			0.585237	
S.E. of Reg.			1.176241	
F-statistics			14.37103	
Prob (F- statistics)			0.000000	
Dependent Variable: FV **Method: White (Dioganal)** **Sample: 2010-2019**				
PANEL B				
Variable	**Coefficient**	**Standart E.**	**t-Statistic**	**Prob.**
RDVOL	0.005596	0.002694	2.077185	0.0392
MO	-0.309371	0.115677	-2.674426	0.0082
RDVOLXMO	0.455744	0.270517	1.684716	0.0938
C	2.219623	0.055563	39.94799	0.0000
R^2			0.631803	
Adjusted. R^2			0.586039	
S.E. of Reg.			1.173920	
F-statistics			13.80550	
Prob (F- statistics)			0.000000	

In order to reveal the moderating role of managerial overconfidence in the linkage between R&D volatility and firm value, Panel A, which investigates the link between the independent and moderating variables with the dependent variable, and Panel B, which investigates the effect of independent, moderating and interaction variables on the dependent variable together, are constructed. When the estimation results of Panel A are analyzed, the model as a whole is significant according to the F statistic probability value and the explanatory power of the independent variables on the dependent variable is approximately 63%. There is a negative link between managerial overconfidence and firm value, and a positive linkage between R&D volatility and firm value. When the estimation results of Panel B are analyzed, the model as a whole is significant according to the F statistic probability value and the explanatory power of the independent variables on the dependent variable is approximately 63%. There is a statistically significant and positive link between the interaction variable and firm value. In this context, Hypothesis 1, Hypothesis 2 and Hypothesis 3 are accepted. The findings of the study support the findings of the study conducted by Hai et al. (2020). (see Figure 1).

Figure 1. Graphical Summary of Results



4. CONCLUSION

R&D volatility refers to the transition from exploratory to exploitative innovations and from exploitative to exploratory innovations. Maintaining the appropriate balance between exploratory and exploitative innovations is critical to an organization's success and even survival. Managers play an important role in the transitions between these innovations. It is known that overconfident managers are more likely to increase R&D expenditures than rational ones (Mudambi and Swift, 2014; Hao et al. 2020). In this context, this study aims to reveal the moderating role of managerial overconfidence in the link between R&D volatility and firm value in firms operating in Borsa Istanbul Metal Goods Sector in the period 2010-2019. In this context, 2 regression models have been constructed. The first model examines the effect of managerial overconfidence and R&D volatility on firm value, while the second model examines the moderating role of managerial overconfidence in the link between R&D volatility and firm value. As a result of the analysis, a statistically significant and negative linkage reveal between managerial overconfidence and firm value, and a statistically significant and positive linkage reveal between R&D volatility and firm value. A statistically significant and positive linkage reveal between the interaction variable and firm value. Overall, the results suggest that R&D volatility creates a competitive advantage that affects firm value and managerial overconfidence positively moderates the link between R&D volatility and firm value. Therefore, the impact of R&D volatility on firm value will be higher and positive in firms where managers are overconfident. The findings of the study are important in terms of firms' R&D strategies and management, managers' R&D decisions, shareholders' expectations and investors' investment strategies based on these decisions.

Ethics Statement: *In this study, no method requiring the permission of the "Ethics Committee" was used.*
Author Contributions Statement: *1st author's contribution rate is 40%, 2nd author's contribution rate is 30%, 3rd author's contribution rate is 30%.*
Conflict of Interest**:** *There is no conflict of interest among the authors.*

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