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AR-GE HARCAMALARININ SATIŞLAR VE KARLILIK ÜZERİNE ETKİSİ: BİST İMALAT SANAYİNDE BİR UYGULAMA[1]

THE EFFECT OF R&D EXPENDITURE ON SALES AND PROFITABILITY: AN APPLICATION IN BIST MANUFACTURING INDUSTRY

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Öz

Makro düzeyde nitelikli bir ekonominin göstergesi, nitelikli bir üretim sistemidir. Nitelikli bir üretim sistemi ise yürütülen Araştırma-Geliştirme (Ar-Ge) faaliyetleri sonucunda ortaya çıkan nitelikli teknolojik bilgi ve uygulamalar ile sağlanabilmektedir. Ar-Ge'nin ölçümünde yaygın olarak kullanılan Ar-Ge harcamaları, günümüzün teknolojik dünyasında işletmelerin sürekliliği ve rekabet edebilirliği için artık zorunludur. Ar-Ge'ye dayalı bir üretim sistemi, işletmelerde üretkenliği ve kaliteyi arttırmasının yanında maliyet avantajları da sağlamaktadır. Ar-Ge harcamalarının işletme satış ve karlılığı üzerine olan etkilerini araştırmak bu çalışmanın amacını oluşturmaktadır. Bu amaç doğrultusunda, BİST-100 endeksinde işlem gören imalat sanayisine ait 20 şirketin Ar-Ge harcamaları ile satışlar ve karlılık arasındaki ilişki, 2009-2021 dönemi yıllık verileriyle araştırılmıştır. Analizde, Hansen (1999) tarafından önerilen sabit etkilere sahip statik panel veri analizi kullanılmıştır. Sonuç olarak, iki dönem önceki Ar-Ge yatırımlarının satışlar ve karlık üzerinde rejim değişimine neden olduğu belirlenmiştir. Ayrıca, Ar-Ge yatırımlarının satışlar ve karlılığı arttırabilmesi için belirli bir düzeyde tutulması gerektiği sonucuna ulaşılmıştır.

Anahtar Kelimeler: Ar-Ge Harcamaları, Kârlılık, Satışlar, Panel Veri Analizi.

JEL Sınıflaması: M40, M41, C33, O30, O39.

Abstract

At the macro level, the indicator of a high-quality economy is a high-quality production system. Meanwhile, a qualified production system can be achieved through qualified technological knowledge and applications that emerge as a result of Research and Development (R&D) activities. In today's technological world, R&D expenditures, which are widely used in the assessment of R&D, are now essential for the continuity and competitiveness of business enterprises. A production system based on R&D not only increases productivity and quality but also provides significant advantages in terms of cost. The purpose of this study is to investigate the effects of R&D expenditures on the sales and profitability of business enterprises. In line with this purpose, the relationship between R&D expenditures, sales and profitability of 20 manufacturing companies that are included in the BIST-100 index is investigated using the annual data for the period 2009-2021. In this analysis, the static panel data analysis with fixed effects proposed by Hansen (1999) is used. In conclusion, it is determined that investments made in the field of R&D two periods ago led to a regime shift in sales and profitability. Moreover, it is concluded that R&D investments should be kept at a certain level in order to increase sales and profitability.

Keywords: R&D Expenditures, Profitability, Sales, Panel Data Analysis.

JEL Classification: M40, M41, C33, O30, O39.

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1. Introduction

Technology is of great importance in the manufacturing industry. Indeed, the key distinguishing feature of high-value-added products is their technological infrastructure. On the other hand, competitiveness and sustainability in the international market are achieved only through innovative products and production processes. This is achieved through technological developments that emerge as a result of R&D activities.

Research and Experimental Development (R&D) is defined as "creative and systematic work undertaken in order to increase the stock of knowledge – including knowledge of humankind, culture and society – and to devise new applications of available knowledge" in the Frascati Guidelines, which aim to define standards for research and experimental development indicators that countries take as a basis when formulating their science and technology policies (TÜBİTAK, 2002).

Economic growth, which is one of the most basic indicators in measuring social development and welfare, is generally achieved through technological development (Chamber of Mechanical Engineers [TMMOB - Turkish Chamber of Mechanical Engineers], 2018). While the technological knowledge that emerges as a result of R&D studies plays a significant role in the growth of business enterprises at the micro level, it provides economic growth by spreading to the global economy at the macro level (Erbay, 2021).

Nowadays, the economic development of nations increasingly depends on the production, accumulation, distribution, and utilization of knowledge. R&D efforts that generate new and improved knowledge can support a nation's innovation rate and industrial and economic growth. They also facilitate the emergence of new ideas, methods, and technologies, encourage innovations and improve the quality of human capital. There is a bidirectional causal relationship between economics and scientific findings. On the one hand, R&D activities drive economic growth; on the other hand, economic growth supports more research activities (Xie & Huang, 2022).

The core purpose of R&D activities is to help business enterprises grow and develop so that they can keep pace with their ever-changing environment and thus remain dynamic. In line with this purpose, they also serve the following purposes (Zerenler et al., 2007):

- To design new products and production processes,
- To develop different areas of use for already existing products and services,
- To keep pace with developments in the market in order to maintain competitiveness,
- To increase efficiency by reducing the costs of production,
- To improve the relations between the employer and the employees,
- To ensure the establishment of a management information system that can provide accurate, timely, and necessary information to the management.

Although the contribution of R&D investments to business enterprises is generally positive, R&D expenditures do not always increase the value of a business enterprise. In addition to the advantages they provide, R&D activities also impose significant costs on business enterprises. The possibility of R&D investments taking a long time and the uncertainty of their positive outcome are the main reasons why business enterprises avoid R&D (Güzen and Başar, 2019).

Although the increasing importance of R&D in today's global competitive environment is mirrored in R&D expenditures, the share of R&D expenditures in Turkey's Gross Domestic Product (GDP) is not at a significant level. This share, which was 0.5% in 1995, reached only 0.92% in 2015. This share (ratio) ranges between 2.5% and 3.52% in developed industrialized countries. The development of industrial sectors with high added value shall ensure that the production process, product structure and costs are optimum (TMMOB - Turkish Chamber of Mechanical Engineers, 2018). This is possible through technological developments that emerge as a result of R&D expenditures.

The improvement in the quality of products and production processes due to technological developments that emerge as a result of R&D expenditures, which is one of the basic indicators of the technological capacity of business enterprises, is reflected in the success of the business enterprises in the market and has a positive impact on sales revenues and profitability. Thus, the aim of the study is to investigate the effects of R&D expenditures on the sales and profitability of business enterprises. For this purpose, first, the literature is reviewed and then the relationship between R&D expenditures, sales and profitability of 20 manufacturing companies that are included in the BIST-100 index is investigated through annual data for the period 2009-2021. In this analysis, the static panel data analysis with fixed effects proposed by Hansen (1999) is used.

2. Literature Review

In the literature, there are many studies that have examined the impacts of R&D expenditures on the performance of business enterprises from the perspective of different sectors. Some of these studies are as follows.

At the end of the analysis on the data of top-level business enterprises operating in the manufacturing industry in the UK between the years 1979 and 1986; Geroski and Toker (1996) discovered a significant positive relationship between R&D investments, which include high advertising and innovation expenditures, and sales of business enterprises.

In a study on the relationship between product innovation and corporate growth in small business enterprises in Germany, Ireland, and the UK, Roper (1997) found that the production output of innovative small companies grew significantly faster than that of non-innovators.

In a study using cross-sectional data from 278 firms obtained from the Compustat II database, Hanel and St. Pierre (2002) investigated the relationship between the profitability of firms and R&D expenditures. The results of the study show that R&D has a direct positive impact on profitability.

By using the data of 500 business enterprises in Italy for the period between 1989 and 1997, Del Monte and Papagni (2003) analysed the relationship between R&D investments and growth. According to the results of the analysis, there is a positive relationship between R&D and corporate growth performance, and the sales velocity of R&D companies is higher than that of non-R&D companies.

By using the data of technology-intensive business enterprises operating in the US between the years 1963 and 1998, Coad and Rao (2008) investigated the impacts of innovation on corporate growth. According to the results of the study, innovation is very important for a small number of "superstar" fast-growing companies, while average companies are likely to experience modest growth. The reason for this is that innovative activities involve uncertainties and do not guarantee superior performance.

Johansson and Lööf (2008) investigated the impacts of R&D strategies on the productivity and profitability of companies. In the study, where 1767 business enterprises in the Swedish manufacturing sector were examined, the Least Squares Method and Quantile Regression Method were used. At the end of the analysis, it was found that companies that apply R&D continuously perform better than companies that rarely or never apply R&D.

By using financial statement data and panel data analysis for the period 2006-2010 for 39 computer software and hardware companies operating in the public sector in Europe, Pantagakis, Terzakis and Arvanitis (2012) analysed the relationship between R&D expenditures, market capitalization and corporate performance. According to the results of the analysis, there is a positive relationship between R&D expenditures and corporate performance.

Apergis and Sorros (2014) analysed the relationship between R&D expenditures and profitability for a group of companies operating in the energy sector in the USA by using the panel data analysis method. In the analysis covering the period 1990-2011, a total of 183 companies, 39 of which are fossil energy companies and 144 of which are renewable energy companies, were analysed. At the end of the analysis, a strong positive relationship was found between R&D expenditures and the profitability of business enterprises selling renewable energy.

Inekwe (2015) examined the role of R&D expenditures on the economic growth of developing economies between the years 2000 and 2009. For the purpose of determining the impacts of R&D expenditures on these economies, 66 different countries were analysed and these countries were categorized as upper-middle-income economies and lower-middle-income economies. According to the results of the study, R&D expenditures have a positive impact on growth in upper-middle-income economies, while they have no significant impacts on growth in lower-middle-income economies.

Freihat and Kanakriyah (2017) analysed the data for the period 2006-2015 of six pharmaceutical companies listed on the Amman Stock Exchange in order to determine the impacts of R&D expenditures on corporate performance. In the study, where simple regression analysis was applied, variables such as Return on Assets (ROA), Return on Equity (ROE) and Earnings per Share (EPS) were used. According to the results of the study, R&D expenditures have a positive impact on corporate performance as in developed countries. In the study, it is also emphasized that R&D expenditures have benefits such as a larger market share, higher share price and a better reputation for the business enterprise, hence the importance for business enterprises to shift their policies towards R&D investments.

By using the data belonging to the period between 2005 and 2010 of 29 business enterprises engaged in R&D activities in Gaziantep, Ünal and Seçilmiş (2014) analysed the impacts of R&D expenditures on the sales revenue of the companies and net profits of the period on R&D expenditures by using a dynamic panel data model. At the end of the analysis, a positive relationship was found between R&D expenditures and net sales revenues and between net profits for the period and R&D expenditures.

By using the 2009-2013 financial performance data of 16 business enterprises in the Borsa Istanbul Technology sector, Uzun Kocamış and Güngör (2014) analysed the effect of R&D expenditures, which play a significant role in the competitiveness of technology-intensive enterprises, on profitability. At the end of the analysis, a significant positive relationship was determined between R&D expenditures and profitability values (operating profit, pre-tax profit and net profit for the period).

Yücel and Ahmetoğulları (2015) examined the financial statement data for the period 2000-2014 of 135 business entities in the IT, software and technology sector, which are being traded on the BIST, by using the stepwise regression analysis method in the SPSS program. According to the results of the analysis, although the change in net profit with R&D expenditures increased positively in the said financial period, the effect of R&D expenditures on earnings per share became evident after three financial terms.

In a study analysing the effect of R&D expenditures on net sales revenue, pre-tax profit and profit for the period by using a regression model, Bayraktaroğlu (2016) analysed the 2011-2014 data of 70 business enterprises that are being traded in Borsa Istanbul Industrial Index. According to the results of the analysis, since there is a positive relationship between R&D expenditures and net sales revenue, pre-tax profit and profit for the period, it is observed that increased R&D budgets also increase sales revenue and profitability.

In a study investigating the impacts of R&D expenditures on profitability, Doğan and Yıldız (2016) used the data of 136 companies that are being traded on the BIST for the period 2008-2014. Return on Assets (ROA) and Return on Equity (ROE) are the dependent variables in the analysis. At the end of the analysis, it is found that increases in R&D expenditures increase the profitability of the companies.

By using panel data analysis in order to determine the impacts of R&D expenditures on financial performance, Dağlı and Ergün (2017) examined the impacts of R&D expenditures on Return on Assets (ROA) and Return on Equity (ROE) of business enterprises in the BIST technology and IT sectors. At the end of the analysis, it is determined that there is a unidirectional causality between R&D expenditures and ROA and ROE in the long run.

İşseveroğlu and Gücenme Gençoğlu (2018) analysed the impacts of R&D expenditures on operating results and market capitalization by using the panel data analysis method. According to the results of the analysis, where Eviews package program was used, it was revealed that R&D expenditures have significant impacts on the net profit for the period.

In order to determine the impacts of R&D expenditures on corporate profitability, Demir and Güleç (2019) conducted a panel data analysis on the data of 60 companies that were being traded in the BIST manufacturing sector between 2005 and 2016. Moreover, corporate size, capital structure, liquidity, and tangible fixed asset ratios are included in the analysis. According to the results of the analysis; a positive and significant relationship is found between R&D expenditures and profitability, and a positive and significant relationship is found between corporate size, liquidity and tangible fixed asset ratios and profitability. On the other hand, it is determined that the financial leverage ratio and financing ratio have a negative and statistically significant impact on profitability.

In a study investigating the impacts of marketing and R&D expenditures on stock value, Özer and Gülençer (2019) analysed the financial statement data of three selected companies that are traded on the BIST through panel regression analysis. At the end of the analysis, it is determined that R&D expenditures have a positive and significant relationship with stock value in parallel with the literature.

In a study investigating the impacts of R&D expenditures on corporate profitability, Güzen and Başar (2019) analysed the annual data of 62 business enterprises in the BIST Industrial Index for the period 2012-2018 through the panel data analysis method. The results of the analysis revealed that; although R&D expenditures decrease operating profit in the current period, they increase the operating profit after the second year.

In order to determine the impacts of R&D expenditures on financial performance, Kılıç (2020) used R&D and performance data of seven companies that were traded on BIST between 2012 and 2018. The impacts of R&D intensity and R&D activities on the Return on Asset Ratio, Return on Equity Ratio and Stock Earnings are analysed through the panel data analysis method. According to the results of the analysis, although there is a significant and positive relationship between the R&D intensity ratio and financial performance indicators, there is no significant relationship between R&D activities and performance indicators.

In order to determine the impacts of R&D expenditures on sales, net profit and gross profit, Oral and Polat (2021) analysed the 2009-2019 period data of 14 business enterprises traded in the BIST 30 index through the static panel data analysis method. At the end of the analysis, a significant positive relationship was observed between R&D expenditures, profitability, and sales.

Although the corporate performance was measured through different variables (profitability, sales, growth, productivity, stock return, etc.) during the literature review, the impacts of R&D investments on performance were generally found to be positive.

3. Data Set and Method

In this study, it is aimed to determine the effects of R&D investments on sales and profitability by using the annual frequency data for the years 2009-2021 of 20 business enterprises operating in the manufacturing industry. The data of the companies were obtained with the demo version of the Matriks software. The Fixed-Effect Panel Threshold Model proposed by Hansen (1999) is used as the methodology and the impacts of R&D investments on sales and profitability are investigated in the event that R&D investments are below or above a certain level. For this purpose, the models estimated in the study by using the Hansen (1999) approach are presented below:

$$Sales_{it} = \alpha_0 + \alpha_1 R\&D_{it} I(R\&D_{it} \leq \gamma) + \alpha_2 R\&D_{it} I(R\&D_{it} > \gamma) + \varepsilon_{it} \quad (1)$$

$$Pro fit/Loss_{it} = \alpha_0 + \alpha_1 R\&D_{it} I(R\&D_{it} \leq \gamma) + \alpha_2 R\&D_{it} I(R\&D_{it} > \gamma) + \varepsilon_{it} \quad (2)$$

In Equation 1 and Equation 2, the indicator function I(.) is[2]: the error term with γ threshold value feature and ε_{it} i.i.d. (0, σ^2) feature. The regime variable is R&D investments. (1) and (2) are single threshold (2-regime) models. The theoretical representation of the models with k thresholds (k+1 regimes) is presented in Equation 3 and Equation 4.

$$Sales_{it} = \alpha_0 + \alpha_1 R\&D_{it} I(R\&D_{it} \leq \gamma_1) + \alpha_2 R\&D_{it} I(\gamma_1 \leq R\&D_{it} < \gamma_2) + \ldots + \alpha_k R\&D_{it} I(R\&D_{it} > \gamma_k) + \varepsilon_{it} \quad (3)$$

$$Pro fit/Loss_{it} = \alpha_0 + \alpha_1 R\&D_{it} I(R\&D_{it} \leq \gamma_1) + \alpha_2 R\&D_{it} I(\gamma_1 \leq R\&D_{it} < \gamma_2) + \ldots + \alpha_k R\&D_{it} I(R\&D_{it} > \gamma_k) + \varepsilon_{it} \quad (4)$$

In equations 1 and 2, the fact that $H_0 : \alpha_1 = \alpha_2$ hypothesis cannot be rejected, shows that there is no threshold effect. The likelihood ratio test statistic of H0 if the sum of squared errors obtained from the fixed effects transformation of the non-threshold model is S0 and the sum of the residual squares of Equation 1 and/or 2 is

$$F = \frac{\left(S_0 - S_1(\hat{\gamma})\right)}{\hat{\sigma}^2} \sim \chi_k^2$$

In this equation $\hat{\sigma}^2$, it is the variance of the regression estimated from Equation 1 and/or 2. The test statistic has a χ^2 distribution with k degrees of freedom. If there are more than two threshold values, the number of thresholds (regime) is decided at the value where the F statistic is maximum and the null hypothesis is rejected.

4. Findings

Hansen (1999) argues whether there is a threshold value effect and the null hypothesis to be tested in order to decide on the number of regimes is H_0:α_1=α_2, and states that if the null hypothesis cannot be rejected, it is a linear model, otherwise it is a "regime switching model". He suggested the Likelihood Ratio (LR) test as a test statistic and stated that it should be decided whether the null hypothesis is rejected or not according to the probability values obtained by resampling (bootstrap) of the test statistic. At the point where the maximum LR statistic is reached for the multi-threshold model, the number of thresholds needs to be determined.

[2]The indicator function is a variable that is 1 when ($R\&D_{it} \leq \gamma$) and 0 otherwise; 1 when ($R\&D_{it} > \gamma$) and 0 otherwise.

Descriptive statistics of the variables are presented in Table No 1.

Table 1. Descriptive Statistics

Variables	Minimum	%25 Quantile	Median	%75 Quantile	Maximum	Average
Sales	17.656	20.333	21.274	22.789	25.740	21.517
Profit/ Loss	-21,608	16.983	18.748	20.273	23.500	15.126
R&D (Research and Development)	0	14.348	15.618	17.065	20.338	15.317

The unit root test aiming to determine the stability levels of the variables is determined according to the cross-sectional dependence of the variables. Cross-sectional dependence test results of the variables are presented in Table No 2. According to the results of Breusch & Pagan (1980), Pesaran LM (2004), deviation-corrected scaled LM (Baltagi et al., 2012) and Perasan CD (2004) cross-sectional dependence tests, all variables have cross-sectional dependence. Therefore, the stability levels of the variables were investigated by using Pesaran (2007) unit root test, which is one of the Second Generation unit root tests.

Table 2. The Results of the Cross-Sectional Dependence Test

Variable	Breusch-Pagan LM	Pesaran LM	Deviation-Corrected Scaled LM	Pesaran CD
Sales	2422.006 (0.000)*	107,935 (0.000)	107,060 (0.000)	49.159 (0.000)
R&D (Research and Development)	1376.835 (0.000)	56.936 (0.000)	56.061 (0.000)	29.237 (0.000)
Profit/ loss	693,008 (0.000)	23.568 (0.000)	22.693 (0.000)	18.855 (0.000)

* Values shown in parentheses are probability values.

Unit root test results are presented in Table No 3. According to the test results, when Profit/Loss variables are stable in terms of level, sales and R&D become stable when the first difference is calculated. Therefore, in the following chapters of the analyses, the first difference of sales (ΔSales) and the level values of the other variables were used.

Table 3. Unit Root Test Results

Variable	Level	First Difference	Critical Value
Sales	-2.004	2.926	%1 -2.34
Profit/ Loss	-2.675	-	%5 -2.17
R&D (Research and Development)	-2.105	-2.695	%10 -2.07

It is not very likely that R&D investments will have an impact on sales and profit/loss within time t. Therefore, the threshold value effect is investigated up to three lags and the test statistics are presented in Table No 4. According to these results, in the model where the dependent variable is $\Delta Sales_{it}$, it is decided that the single threshold (two-regime) model is appropriate when the regime change variable is $R\&D_{it-2}$ at 10% significance level; and, in the model, where the dependent variable is $Profit/Loss_{it}$, it is decided that the two-threshold (three-regime) model is appropriate when the regime change variable is $R\&D_{it-2}$. These results suggest that R&D investments two periods ago led to regime switching on sales and profitability.

Table 4. LR Test Results at Different Lags

Threshold Variable	LR Statistics		
	Single-Threshold	**Two-Threshold**	**Three-Threshold**
Dependent Variable: ΔSalesit			
R&Dit	3.74 (0.190)*	9.28 (0.380)	3.43 (0.956)
R&Dit-1	6.09 (0.210)	1.06 (0.976)	2.58 (0.823)
R&Dit-2	7.70 (0.080)	2.19 (0.800)	8.40 (0.310)
R&Dit-3	3.35 (0.436)	11.04 (0.126)	4.03 (0.920)
Dependent Variable: ΔProfit/Lossit			
R&Dit	2.34 (0.216)	5.90 (0.583)	5.17 (0.726)
R&Dit-1	4.07 (0.420)	5.59 (0.490)	17.30 (0.193)
R&Dit-2	3.11 (0.680)	24.52 (0.026)	10.85 (0.446)
R&Dit-3	4.04 (0.506)	3.66 (0.583)	2.82 (0.883)

* Values shown in parentheses are probability values.

Panel Threshold Regression Estimation Results according to the threshold number are presented in Table No 5. According to these results, the threshold value is calculated as 0.351 in the model where the dependent variable is sales. This value indicates the regime change of R&D investments on sales if R&D investments at time t-2 time are more than 35.1% compared to the previous period. If we analyse the coefficients separately, in the low regime ($\Delta R\&D_{it-2} \leq 0.351$), R&D investments do not have a statistically significant impact on sales. In the high regime ($\Delta R\&D_{it-2} > 0.351$), a 1 unit increase in R&D investments increases sales by 0.235%. In the model where the dependent variable is Profitability, the thresholds are calculated as 0.131 and 0.134. In cases where the increase in R&D investments at time t-2 compared to the previous period is less than 13.1%, between 13.1% and 13.4% and more than 13.4%, profitability has 3 different regimes. Although the threshold values are close to each other, in the low regime ($\Delta R\&D_{it-2} \leq 0.131$), a 1% unit increase in R&D investments decreases profitability by 0.768%.

In the mid-regime ($0.131 \leq \Delta R\&D_{it-2} < 0.131$), a 1% unit increase in R&D investments increases profitability by 227.6%. In the high regime ($\Delta R\&D_{it-2} > 0.134$), a one-unit increase in R&D investments decreases profitability by 4.236%. Therefore, R&D investments that are too low or too high reduce profitability.

Table 5. Panel Threshold Regression Estimation Results

Coefficient	**ΔSalesit**	**ΔProfit/Lossit**
α0	0.171 (0.000)*	1.391 (0.032)
α1	-0.002 (0.909)	-0.768 (0.502)
α2	0.235 (0.008)	277.608 (0.000)
α3	-	-4.236 (0.000)
Threshold Value	0.351	0.131-0.134

* Values shown in parentheses are probability values.

Table 6 shows the number of companies per regime in the analysis period of both models. In the model, where sales is the dependent variable, the number of companies in the low regime is higher than the number of companies in the high regime. In the model, where profitability is the dependent variable, it is observed that the number of companies in the low regime is considerably higher than the number of companies in the other regimes. When the results in Table No 5 are taken into account together with the results in Table No 6, only two companies are included in the middle regime throughout the analysis period. These companies are EREĞLİ DEMİR ÇELİK FABRİKALARI T.A.Ş. and TÜPRAŞ. Considering the sectors in which these two companies are active and their size, the obtained result is quite normal. Likewise, the coefficient estimation for the mid-regime is also quite high. In the same model, it is observed that the number of companies in the low R&D investment regime is considerably higher than the number of companies in other regimes. This means that R&D investments' being below a certain

threshold reduces the profitability of companies. Similarly, high levels of investment, in other words, high regimes, also reduce profitability. In short, R&D investments that are too low or too high reduce profitability.

Table 6. Distribution of Companies by Regimes between 2011 and 2020.

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Bağımlı Değişken: Satışlar											
$\Delta R\&D_{it-2} \leq 0.351$	0	15	12	12	15	18	18	15	13	14	13
$\Delta R\&D_{it-2} > 0.351$	0	5	8	8	5	2	2	5	7	6	7
Bağımlı Değişken: Karlılık											
$\Delta R\&D_{it-2} \leq 0.131$	0	13	12	11	12	17	14	15	12	11	13
$0.131 \leq \Delta R\&D_{it-2} < 0.131$	0	0	0	0	0	0	1	0	0	1	0
$\Delta_{it-2} > 0.134$	0	7	8	9	8	3	5	5	8	8	7

5. Conclusion and Recommendations

Due to their technological aspects, R&D investments are one of the key elements necessary for growth. Thanks to these investments, business enterprises are able to produce unique goods and services by using this knowledge as well as increasing their existing level of knowledge. The primary purpose of the establishment of business enterprises is to make profit. For this purpose, business enterprises must first realize the sale of goods and services related to their main field of activity. In the intensive competitive environment of today, in order for business enterprises to survive and continue their existence, it is very important for them to increase their sales revenues and profitability in parallel. At this point, investigating whether R&D investments have impacts on sales and profitability is the subject of this study.

In this study, the impacts of R&D investments on sales and profitability are investigated by using the data obtained from the financial statements of 20 companies traded on the BIST and belonging to the manufacturing industry. Since R&D investments have a long-run impact on sales and profitability, analyses are conducted by taking into account the impacts of past investments in the current period. The aim of the study is to reveal how sales and profitability are affected when R&D investments are above and/or below a certain level. According to the estimations made by using the panel threshold regression method proposed by Hansen (1999), it is concluded that R&D investments in the previous two periods cause regime switching on sales and profitability in the current period. It is revealed that R&D investments cause two regimes on sales, in the low regime, these investments do not have statistically significant impacts on sales, while in the high regime, they considerably increase sales. It is revealed that R&D investments cause three regimes on profitability. If R&D investments fall below a certain level, business profitability is negatively affected. Very high levels of R&D investments also have a negative impact on profitability. Therefore, it is recommended that business enterprises keep their R&D investments at a certain level. The obtained results are in line with the theoretical expectations. However, R&D investments may have a positive impact on profitability in longer periods due to the nature of the developed product.

In light of these findings, it is recommended that business enterprises should not go below a certain level and should not go above it in order to ensure an effective return on their R&D investments. However, results may vary due to differences in the analysis period, technological developments and used methods. For example, when dynamic panel data analysis is taken into account or when the R&D investments, sales and profitability of each business enterprise are analysed separately, the performance of large and small business enterprises may vary. Therefore, different analyses can be conducted in future studies by taking scale sizes into consideration.

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