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THE IMPACT OF R&D INTENSITY AND FINANCIAL SLACK ON COMPANY PERFORMANCE: AN ANALYSIS OF COMPANIES WITH THE HIGHEST R&D EXPENDITURE IN TÜRKİYE

Ar-Ge Yoğunluğu ve Finansal Gevşekliğin Firma Performansına Etkisi: Türkiye'de En Yüksek Ar-Ge Harcaması Yapan Firmaların Analizi

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JEL Codes:
C23, C33, C53, G17.

Abstract

Financial slack refers to the existence of excess resources, such as unused borrowing capacity, liquid assets, and equity, that companies hold to respond to unexpected opportunities and use during times of crisis. This study conducts an exploratory analysis of the comparative effects of financial slack and the intensity of research and development activities on the profitability of companies operating in Turkey. As stated in Turkish Time (2023), this study uses panel data obtained from 26 companies with the highest research and development expenditures between 2004 and 2023. Panel FGLS analysis shows that the effect of R&D intensity on profitability remains significantly negative. This result can be explained by the long-term focus on returns and the high costs involved. Conversely, financial slack positively affects the company's profitability, and financial slack is seen to mean the slack and capacity to respond to unexpected market demands. However, the additional Panel FGLS analysis, a non-linear inverse U-shaped relationship was found between financial slack and market value (P/B ratio). While these resources increase market value up to an optimal threshold, when accumulated excessively, they can signal inefficiency in resource allocation and negatively impact firm value. Therefore, the strategic management of financial slack is of critical importance.

Anahtar Kelimeler:
Ar-Ge Yatırımları, Finansal Gevşeklik, Ar-Ge Yoğunluğu.

JEL Kodları:
C23, C33, C53, G17.

Öz

Finansal gevşeklik, şirketlerin beklenmedik fırsatlara yanıt vermek ve kriz zamanlarında kullanmak üzere elinde tuttuğu, kullanılmayan borçlanma kapasitesi, likit varlıklar ve öz sermaye gibi fazla kaynakların varlığını ifade eder. Bu çalışma, finansal gevşekliğin ve araştırma ve geliştirme çalışmalarının yoğunluğunun Türkiye'de faaliyet gösteren şirketlerin karlılığı üzerindeki karşılaştırmalı etkilerinin keşfedici bir analizini yürütmektedir. Bu çalışma, Turkish Time (2023) yayınında belirtildiği gibi 2004-2023 yılları arasında en yüksek araştırma ve geliştirme harcamalarına sahip 26 şirketten elde edilen panel verilerini kullanmaktadır. Panel FGLS analizi, Ar-Ge yoğunluğunun karlılık üzerindeki etkisinin önemli ölçüde negatif kaldığını göstermektedir. Bu sonuç, getirilerin uzun vadeye odaklı olması ve önemli maliyetler içermesiyle açıklanabilmektedir. Aksine, finansal gevşeklik şirketin karlılığını olumlu yönde etkilemektedir ve finansal gevşekliğin, beklenmedik piyasa taleplerine tepki verme esnekliği ve kapasitesi anlamına geldiği görülmektedir. Bununla birlikte, yapılan ek Panel FGLS analizinde finansal gevşeklik ile piyasa değeri (P/B oranı) arasında ters U şeklinde doğrusal olmayan bir ilişki tespit edilmiştir. Optimal bir eşiğe kadar piyasa değerini artıran bu kaynaklar, aşırı biriktiğinde kaynak tahsisinde verimsizlik sinyali vererek firma değerini olumsuz etkileyebilmektedir. Bu nedenle, finansal gevşekliğin stratejik yönetimi kritik önem taşımaktadır.

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1. Introduction

In today's hypercompetitive environment, the integration of technology is indispensable for firms. To sustain and elevate their market positions on a global scale, substantial investments in research and development are essential. A high level of R&D intensity serves as a clear indicator of a firm's commitment to and openness toward innovation. It has been observed that firms that attach importance to R&D intensity show higher performance by utilizing innovation and innovation and that R&D intensity significantly enhances firm performance (Gui-long et al., 2017: 41-42).

Technological developments compel firms to innovate more. Firms that cannot keep up with innovation lag behind the times. Firms that cannot catch up with the era are forced to settle for less profitability or face the danger of being erased from the market. R&D investments are investments based on technological infrastructure. R&D investments increase labor productivity, sustainability, and competitiveness of firms by keeping innovation in their hands. This allows firms to earn high returns (Rađenović et al., 2022: 34-36).

R&D investments are long-term investments and are considered risky investments by nature. R&D investments show how much a firm can grow in the future by using innovative opportunities. Firms' use of innovative opportunities will provide cost advantages to the firm. In this way, the firm is expected to reduce its costs. It is thought that the financial performance and market value of the firm will increase (Erdogan and Yamaltdinova, 2019: 541-544)

R&D investments are expressed as critical intangible resources for the firm. Although high R&D intensity plays a driving role for firms to achieve their technological goals, high R&D intensity alone does not mean anything for the firm. Firms also need to have financial capabilities, such as sales, marketing, etc. R&D investments blended with financial capacities are expected to contribute positively to firm performance (Yeh et al., 2010: 394).

Despite the prevalent view that R&D expenditures contribute positively to long-run firm value, empirical evidence often reveals a non-monotonic, inverted U-shaped association. This curvilinear relationship indicates that while R&D investment is beneficial up to a certain point, there exists a threshold beyond which its marginal benefits decline, implying an optimal level of investment; exceeding this level may lead to diminishing returns and can even adversely affect performance. Therefore, to enhance financial profitability, it is advisable for firms to maintain their R&D investments within this optimal range rather than exceeding it (Lehenchuk et al., 2022: 131-133).

R&D investments are portrayed as the driving force that ensures the survival of firms. It has been observed that R&D investments have gained importance in all large firms that have been in existence for many years. However, the impact of R&D investments on financial performance is not always positive. The items and resources allocated to R&D investments become more important. Even if the firm has made intensive R&D investments, if the resource allocation is not appropriate to the firm's structure, R&D investments may negatively affect the firm's performance. Here, the concept of financial slack comes to the fore. Since financial slack refers to the excess resources of firms, the issue of which investments these excess resources will be used for gains importance for the firm's performance (Lee et al., 2014: 582-585).

Financial slack is a reserve of liquid assets that a company can use flexibly for new projects or to handle unexpected challenges. It plays a critical role in strategic flexibility and innovation.

According to Bourgeois and Singh (1983), financial slack is an insurance against environmental uncertainties under which companies can leverage emergent opportunities or respond to emergent threats at the cost of operational stability. Companies with moderate levels of financial slack will be able to make investments in exploratory projects and R&D to foster long-term competitiveness. Financial slack that is excessive, however, may lead to agency problems because managers will prioritize personal goals over value creation for shareholders. Therefore, writers like Voss et al. (2008) assert that financial slack maximization entails balancing resource availability and controlled governance such that strategic flexibility is kept in equilibrium with fiscal prudence. Consequently, scholars like Voss et al. (2008) assert that optimizing financial slack requires balancing resource availability with disciplined governance to ensure alignment between strategic agility and fiscal responsibility.

As a second definition, financial slack also means the additional resources that firms have left after paying their debts. Financial slack creates the ability for firms to act flexibly. Firms that can allocate more resources to R&D investments strengthen their position in the sector by using innovative technologies. In this way, firms can offer new products and services to users more easily. Since the competitive advantage of a firm that strengthens its position in the sector will increase, financial slack is expected to positively affect firm performance. It is well-established in the literature that R&D intensity and financial slack strengthen firm performance. (Guo et al., 2020: 1-9).

Financial slack essentially means the excess resources that a firm has beyond what is absolutely necessary to continue its ongoing operations. This includes not only its current liquid assets but also its potential to obtain additional financing through borrowing. The most commonly used classification level for financial slack in the literature depends on the level of existence. Financial slack classified by the level of existence defines three different types of financial slack (Bourgeois, 1983: 43):

1. Available Slack: This consists of unused and held-in-reserve resources, such as idle cash, that are immediately available for use. This type of excess provides management with the greatest discretion and enables the organization to respond promptly to urgent opportunities or crises.

2. Recoverable Slack: Slack of this nature consists of resources that have already been absorbed into the operational setup of the company, say, inflated administrative expenses, but can be released or re-allocated in difficult times. These resources serve as an internal buffer internalized in the company's day-to-day activities.

3. Potential Slack: This is the company's ability to raise new capital from external sources, such as additional debt or equity offerings, beyond its internal pool. It is a latent financing capacity that is dependent on the credit standing of the firm and the terms that prevail in the capital markets.

Two contrasting theoretical perspectives are evident in the literature on the impact of financial slack on firm performance. The Resource-Based View, aligning with the positive school of thought, perceives financial slack as an abstract internal resource that creates innovation and competitive advantage (Barney, 1991). The Resource Dependency Theory argues that financial slack is a strategic tool that firms utilize in order to manage their dependence on the external world and reduce uncertainty (Pfeffer and Salancik, 1978). On the other hand, the Agency Theory, which is advancing a negative position, believes that managers will waste looseness at their own expense (Jensen and Meckling, 2019), and the X-Efficiency Theory believes that economic looseness leads to operational efficiency and organizational apathy by reducing pressure from competition (Leibenstein, 1966). Therefore, the net effect of laxity depends on the outcome of the balance between these positive strategic benefits and the risks of negative managerial action.

Since financial slack refers to actual and potential resources for the firm, it allows the firm to take risks and experiment with innovations. Greater financial slack allows firms to allocate more resources to investments. It is expected that the relevant excess resources will be more easily directed to R&D investments. R&D investments are inherently risky investments. While directing the excess resources held by the firm to R&D investments, the firm's risk is expected to decrease. In reducing this risk, financial slack is thought to act as a buffer (Ashwin et al., 2016: 8-10).

R&D investments create added value for its business line, thereby helping to establish a competitive edge by sustaining its activities at the international level. The need for R&D investments is more prominent in markets such as technology, health, software, etc., that require high R&D investments. R&D investments are expected to be used effectively in internal processes and to benefit the firm in the long run, thereby increasing firm profitability. Therefore, especially in developing countries, the utilization of R&D investments gains more importance. Therefore, this study will investigate the firms with the highest R&D investments in Türkiye.

Earlier works mostly concentrated on examining the isolated relationship between R&D expenditure and firm performance. However, the literature is still lacking the essential analysis of how R&D intensity and financial slack work collectively to influence firm performance. The gap is especially evident in developing nations such as Türkiye, in which there is no empirical study that connects these two variables within one analytical framework. Furthermore, while earlier research has been based largely on balance sheet-derived metrics (e.g., ROA, ROE), it has uniformly neglected market-based valuation metrics. In particular, this study is expected to contribute to the literature by including the Price-Book Value (P/B) ratio, a market-oriented performance measure, in the analysis. —a market-driven performance measure—into the analysis, marking its first application in the Turkish R&D context. Additionally, earlier research in Türkiye has been confined to sector-specific analyses, hence not incorporating the largest R&D spenders in companies by industry. In an attempt to make up for this deficiency, the current study employs a new sample selection strategy, utilizing the Turkish Time (2023) report to catch top R&D spenders. However, due to data availability constraints, many of the firms in the report are unlisted or listed on non-domestic exchanges; the final sample has 26 BIST-listed companies. The study has a 2004–2023 longitudinal dataset, whose beginning is determined based on the available earliest financial history for smaller firms in the sample, along with bigger constituents of BIST30.

2. Literature

In the literature so far, it has been uniformly accepted that R&D expenditure is positively related to firm performance. However, studies conducted in different industries, countries and time periods revealed that the relationship is not consistent under every circumstance but rather varies with the environment. It is discovered that the link between R&D investment and company growth is more confined, especially in high-technology industries, and that growth is highly complemented by R&D in these sectors. However, there are some studies that have failed to create a statistically significant relationship between R&D investment and company growth; in others, it does not exist or is even negative.

A review of the literature suggests that a large number of studies have addressed the impact of R&D intensity on firm performance. Nevertheless, there is a real research gap in investigating the interactive effects of R&D intensity and financial slack in explaining performance results. To comprehensively bridge this gap in a systematic manner, the literature can be categorized into two broad streams: (1) studies that emphasize singling out the pure influence of R&D intensity on performance metrics and (2) emerging issues that investigate how financial slack influences or mediates such an effect. While the first stream dominates the literature, the second is not well addressed, particularly in environments of resource shortages or economic unrest. In order to facilitate the analysis of a more precise nature, the literature in place has been split into two distinct streams: one that studies the effect of R&D intensity alone on firm performance, and the other with the dual effect of R&D intensity and financial slack. The following is an overview of these two areas of research.

2.1. Studies Examining the Effect of R&D Intensity on Firm Performance

Sharma (2012) applied the GMM estimator to examine data for 89 Indian pharma companies from 1994-2006. The study revealed that increased R&D intensity significantly increases the total factor productivity (TFP), thereby increasing the gross value added to the firm's output.

Gui-long et al. (2017) studied the 100 largest indigenous electronics manufacturing companies in China during the period 2003–2007. Using both OLS and pooled quantile regression estimations, they found that R&D intensity is positively correlated with enhanced firm performance, reflecting the positive impact of high R&D spending on business performance.

Erdogan and Yamaltdinova (2019) used a panel dataset of 620 firms in manufacturing, chemical, metal, and technology sectors listed on the BIST across the years 2008–2017. Their findings indicate that R&D intensity increases profitability initially before finally decreasing it, revealing an inverted U-shape relationship between R&D expenditure and profitability. They also established a significant association between size and return on assets.

Chen et al. (2019) analyzed financial performance and R&D intensity in 96 Taiwan semiconductor companies from the 2015-2016 period. Drawing from their results, they concluded that R&D intensity in the recent period negatively affects performance in the same period. They further reported that the association between R&D intensity and profitability is initially a declining trend that, over time, becomes an even more solid trend, and that an increasing debt ratio is associated with poorer performance.

Eldawayaty (2020) used regression analysis on data of 13 Egyptian pharmaceutical companies over the period 2000–2019. The research identified a negative relationship between R&D intensity and multiple measures of financial performance. But since R&D investments take time to affect, it is expected that this effect will become positive in later years.

Lehenchuk et al. (2022) sampled 26 Slovak medical device companies that were active between the years 2015-2019. They discovered, employing panel regression, the existence of an inverted U-shaped relationship between R&D intensity and profitability in which both R&D intensity and its squared term significantly positively affect return on assets when the level of R&D is at its optimum point.

Rađenović et al. (2023) examined a sample of 24 innovative firms—cross-sections representative of the top 50 R&D spenders across various industries and countries from 2001 to 2021. Their cluster and regression analyses confirmed that an increase in R&D intensity has a strongly positive effect on ROA.

Regression was done by Akyol and Özkan (2023) on 171 largest industrial companies from 2012 to 2020. In their research, they found that while extreme R&D can negatively affect short-run performance, it ultimately generates long-run benefits, employing an inverted U-shaped form of a firm's overall performance.

Aslan (2024) used panel data methods to examine 92 companies from a diverse range of industries listed on the BIST over the period 2014-2023. The results indicated that an increase in R&D intensity has a negative effect on firm performance.

Irmak (2024), in examining the listed firms in the BIST 100, concluded that financial slack enhances firm performance. Existing, potential, and recoverable types of financial slack were found by the study to enhance market performance measures such as Tobin's Q, P/E, and P/B. It was also concluded that ownership and board structure moderate the relationship, but foreign ownership does not consistently show an effect.

2.2. Studies Examining the Effects of R&D Intensity and Financial Slack on Firm Performance Together

Lee et al. (2014) analyze a panel data sample of 311 firms over the period 1999-2003 and find that such R&D-intensive firms are less likely to experiment in new opportunities due to dependence on existing resources. Surplus financial slack, in contrast, is found to promote experimental activities by steering firms away from existing asset-based initiatives.

Ashwin et al. (2016) investigated 172 Indian drug firms between the years 2003-2009 in India. Using a Tobit regression model, their research discovered that financial slack had a high positive correlation with R&D intensity. Furthermore, research highlighted that higher R&D expenditures were linked to a statistically significant rise in the number of independent board directors.

Guo et al. (2020), in their panel data of 543 Chinese small and medium-sized enterprises (SMEs), found that financial slack enhances firm performance in a positive way, and R&D intensity acts as the mediator in this process. In addition to this, it is also driven by outside elements such as government aid and support from market organizations. These findings add to a multi-disciplinary perspective on the crossroads of financial resource flexibility with innovation and corporate governance structures.

Şahin and Irmak (2024) employed panel data of 80 manufacturing firms listed on the Istanbul Stock Exchange (2018-2023) and tested the effect of R&D intensity on financial slack. The findings identified that there existed a positive linear relationship between R&D intensity and actual and potential financial slack. Yet, a significant inverse U-shaped relationship was found for recoverable slack, and this gives support to behavioral theory. These findings suggest that the impact of financial slack on innovation is complex and, to a significant extent, dependent on the type of financial slack in question.

Although each of R&D intensity and financial slack has been individually examined in international literature regarding their impact on corporate performance, there has been limited scholarly work that examines the interaction between these two variables. This is especially true in emerging economies, such as Turkey, which are known to be subject to constant economic fluctuation, where the topic has not been properly addressed by academic studies. A review of the local literature offers a wide lacuna, with no or few analyses offering a linear and complete assessment of financial slacks on the performance of companies. Such a lacuna as identified is one of the foremost driving forces in the current research. Hence, this study aims to close this significant gap in the overall international, particularly the Turkish finance literature, by investigating the complementary role of financial looseness and R&D intensity on firm performance in BIST-listed firms.

3. Methodology and Analysis

Panel data is characterized by its two-dimensionality that allows us to observe changes over time in cross-sectional units such as individuals, firms, or countries, and includes both cross-sectional (i) and time series (t) dimensions. These rich data sets, which go beyond the use of a single cross-section or a single time series, offer the possibility of both more observations and more in-depth analysis. With the increasing ease of access to data, these advantages have driven the growing popularity of panel data analysis across various fields, from economics to the social sciences, in recent years (Hsiao, 2007: 1-2).

Panel data, therefore, combines the best characteristics of time series and cross-sectional data and presents it to the researcher. The issue of multicollinearity, common in time series data, is greatly diminished in panel data models. This is due to the additional variation in the horizontal cross-section units (countries, individuals, firms), which diminishes it. The additional information and heterogeneity enable the model to present more efficient estimates as well as reduce high linear correlation between the variables (Baltagi, 2008: 5-6).

Panel data analysis integrates cross-sectional observations with time-series data, enabling the examination of changes in variables over specific periods. This approach enhances regression analysis by incorporating both temporal and different units. The different units, such as countries or firms, represent the spatial aspect, while the temporal aspect refers to the specific time periods during which the data were collected. Through this approach, the analysis is carried out by providing a comparative view of the trends followed by firms in certain periods. The general formulation of a panel data model is given by (Yaffee, 2003: 1-3).

$$Y_{it} = \text{ß}_0 + \text{ß}_1 RDI_{it} + \text{ß}_2 FS_{it} + \varepsilon_{it} + a \quad (1)$$

In equation (1), the dependent variables dependent variable is represented as Y_{it} and include the indicators of financial performance and the indicators of market performance, namely ROA, ROE, NPM, and P/B. The independent variables in the model include the RDI and FS. Talking about the parameters in the model, the fixed effects parameter denoted by (α) refers to the characteristics of the unit that are company-specific but fixed over time. The (ε_{it}) in the equation refers to the error term and the part of the dependent variable that is unexplained by the model parameters. The subscripts (i and t) refer to the company and the year, respectively.

Common issues in financial data analysis, such as heteroskedasticity and autocorrelation, can lead to biased and inefficient standard OLS estimates. The Breusch-Pagan and Wooldridge tests conducted in this study indicate that both issues are statistically significant in our model. Therefore, the Feasible Generalized Least Squares (FGLS) method, which addresses these issues and provides consistent and efficient estimates, has been preferred in the analysis. FGLS helps produce more reliable results by correcting both cross-sectional heteroskedasticity and time series autocorrelation (Wooldridge, 2010: 376-381).

The FGLS method will be used in the analysis. The package program used in the analysis is the Stata 14 package program. The financial ratio data used in the study came from the Finnet (2024) database, while the R&D expenditures came from the corresponding report in the publication by Turkish Time (2023). The independent variables, dependent variables, control variables, and formulation information of the relevant variables in the analysis are shown in Table 1.

Table 1. Variables Included in the Analysis and Their Explanations

Variables	Abbreviations	Formulation Information
Independent Variables		
R&D Intensity	RDI	$(\text{R\&D Expenditures/Total Sales})^2$
Financial Slack	FS	Current Assets/Short Term Liabilities
Dependent Variables:		
Return on Assets	ROA	Net Profit/Total Assets
Return on Equity	ROE	Net Profit /Total Equity
Net Profit Margin	NPM	Net Profit / Total Sales
P/B Ratio	P/B	(Market Value/Book Value)
Control Variables:		
Company Size	S	Total Sales (Log)
Financial Leverage Ratio	L	(Short Term Liabilities + Long Term Liabilities) / Total Assets

The choice of dependent and independent variables in Table 1 is informed by the studies of Lehenchuk et al. (2022) and Ashwin et al. (2016). Furthermore, this analysis incorporates the P/B ratio as an additional variable. The R&D intensity (RDI) values of companies in Turkey are exceptionally low compared to international peers, clustering around zero. This indicates that companies' R&D expenditures are still far below the theoretical critical threshold required to generate positive returns. The fact that the curve starts at this near-zero point makes the linear effect of the relationship too weak to be statistically detectable. In contrast, the quadratic term (RDI^2) captures the acceleration effect of even small increases in expenditures much more effectively. For these reasons, instead of the linear term (RDI), the square of R&D intensity (RDI^2), which better represents the initial dynamics of the relationship, has been used as the independent variable in the model. For these reasons, the square of R&D intensity (RDI^2) has been retained in the final model as it better represents the initial dynamics of the relationship, while the statistically insignificant linear term (RDI) has been removed from the model. The empirical investigation is based on data from 26 firms listed on BIST over the period 2004–2023.

Table 2. Cross-sectional Dependence Test Result

Test Statistic	Probability Value
2.57	0.01**

Based on Pesaran’s (2004) test for cross-sectional dependence shown in Table 2, the p-value of 1% indicates that cross-sectional dependence exists within the model. Consequently, due to this dependence, we will employ Pesaran's CIPS (2007), a second-generation unit root test, rather than using first-generation tests.

Table 3. CIPS Unit Root Test Result

Variables		Test Statistic-Constant	Test Statistic-Constant and Trend
ROA		-2.50***	-2.91***
P/B		-2.21**	-2.59*
ROE		-2.91***	-2.86***
NPM		-2.66***	-3.16***
FS		-2.90***	-3.28***
RDI		-2.16**	-3.44***
S		-2.34***	-2.52
L		-2.45***	-2.89***
CADF Critical Values	%10	-2.07	-2.58
	%5	-2.15	-2.67
	%1	-2.32	-2.83

According to the results of the Pesaran (2007) CIPS panel unit root test presented in Table 3, all of the variables are stationary at strong significance levels of 1% or 5%. This result supports the null hypothesis of a unit root for each variable, affirming that the series are integrated of order zero.

Table 4. The Breusch-Pagan (1979) and Cook Weisberg (1983) Test Results

Test Statistic	Probability Value
19.47	0.00***

The Breusch-Pagan (1979) and Cook-Weisberg (1983) test results in Table 4 indicate a p-value of 0.00%. Since this value is below the 5% significance level, it confirms the presence of heteroskedasticity, meaning that the variance is not constant.

Table 5. Autocorrelation Test Result

Test Statistic	Probability Value
37.38	0.00***

As a result of the Wooldridge (2010) test, the probability value is realized as 0.00%. Since the probability value is below 5%, there is autocorrelation.

Table 6. Model Selection

Tests	Test Statistic	Probability Value
Breusch and Pagan Test	12.76	0.00***
Hausman Test	11.77	0.06**

In table 6, the appropriate econometric model was determined through the application of the Breusch–Pagan (1979) and Hausman (1978) specification tests. The Breusch–Pagan Lagrangian multiplier test produced a statistically significant value (p = 0.00), leading to the null hypothesis. This confirms the application of a random effects model against a pooled ordinary least squares (OLS) approach. The following Hausman test produced a p-value of 0.06, which exceeds the conventional 5% significance level. Thus, the null hypothesis for this test was not rejected, confirming the equivalence of the random effects estimator. This led to the final selection of the random effects model for the analysis.

Table 7. Panel FGLS Regression Analysis Results

Independent Variables	**Dependent Variables**			
	ROA	**ROE**	**NPM**	**P/B**
FS	1.59*** (p=0.00)	0.87*** (p=0.00)	1.86*** (p=0.00)	0.30*** (p=0.00)
RDI	-18.67** (p=0.00)	-30.07*** (p=0.00)	-66.04*** (p=0.00)	3.24 (p=0.17)
S (Control Variable)	1.41*** (p=0.00)	4.14*** (p=0.00)	1.19*** (p=0.00)	-0.04*** (p=0.10)
L (Control Variable)	-0.19*** (p=0.00)	-0.43*** (p=0.00)	-0.23*** (p=0.00)	0.07*** (p=0.00)
Wald chi2	993.94	480.41	5682.77	597.27

Panel FGLS regression procedure was used to deal with the inter-section dependence, autocorrelation, and heteroscedasticity problems of the model. The analysis results show that all of the estimated models are significant at large (Wald chi2 p-values < 0.01). If the detailed outcomes are examined closely, it is observed that the FS variable has a statistically significant and positive coefficient on all of the performance proxies (ROA, ROE, NPM, and P/B). A one-unit increase in FS results in a 1.59-unit increase in ROA, a 0.87-unit increase in ROE, a 1.86-unit increase in NPM, and a 0.30-unit increase in the P/B.

Conversely, the R&D intensity variable is found with a strongly significant negative impact on profitability in terms of ROA, ROE, and net profit margin. Contrarily, its impact was statistically insignificant (p=0.17) upon the P/B.

Among control variables, S positively affects profitability indicators (ROA, ROE, NPM) and negatively affects the P/B ratio. The variable L negatively affects profitability indicators but positively affects the P/B ratio. Generally, the findings of the analysis confirm that financial slack reinforces firm performance, while R&D intensity has a negative effect.

The statistically significant and positive contribution of financial slack to firm performance squarely contradicts the fundamental assumptions of Agency Theory and X-Efficiency Theory that argue this resource generates wastage and organisational lag. Rather, the empirical evidence thus obtained substantiates the Resource-Based View that sees financial slack as a key source of competitive advantage, and the Resource Dependency Theory that views it as a strategic tool for managing environmental uncertainties.

The fact that the R&D intensity of Turkish firms is usually below 1% means that such expenditures constitute cost pressures within the short-term horizon, as opposed to allowing profitability to be enabled. It emerges from this study that R&D intensity is negatively correlated with dependent variables in a statistically significant manner. This can be blamed on aspects such as long-term horizon, as well as the risky nature of R&D expenditures, persistence of inflation, as well as exchange rate volatilities within the economy, lack of appropriate technological infrastructure as well and poor patent protection regimes. This finding reflects on the critical role played by free resources in enabling firms to maintain flexibility within operations as well as manage innovation risks while quickly responding to strategic opportunities lying under circumstances of uncertainty.

The study highlights the essential role of bringing about structural reforms as well as devising adaptive institutional structures to overcome short-term capital constraints linked with investments in research and development in emerging markets. It is of paramount importance that policies are focused on methods that facilitate approaches leading to commercialization to gain maximal long-term advantage through innovation. The identified positive correlation of performance with as well as financial slack on performance supports the centrality that organizations view R&D as more than a mere operational expenditure but as a strategic asset that can cater to changing marketplace demand. In addition to that, linking R&D with sustainability-oriented innovation brings double dividends: reducing damage to the environment while achieving a sustainability-based transition that strengthens competitive advantage.

In addition to enriching the model's validity as well as evaluating its congruence with prior literature, the research also included an examination of the possibility of a non-linear relationship between firm performance as well as financial slack within the context of base Panel FGLS estimation. In aiming to attain this aim, the quadratic form (FS^2) of financial slack is used in estimating the model to test for the presence of any inverse U-shaped impact.

Table 8. Results of Panel FGLS Regression Analysis Including Curved Effects of Financial Slack

Independent Variables	**Dependent Variables**			
	ROA	**ROE**	**NPM**	**P/B**
FS	0.50* (p=0.08)	1.23** (p=0.04)	1.38*** (p=0.00)	0.51*** (p=0.00)
FS^2	0.13*** (p=0.00)	-0.38 (p=0.47)	0.06*** (p=0.00)	-0.02*** (p=0.05)
RDI	-24.41*** (p=0.00)	-28.35*** (p=0.00)	-66.92*** (p=0.00)	4.09** (p=0.04)
S (Control Variable)	1.38*** (p=0.00)	4.15*** (p=0.00)	1.19*** (p=0.00)	-0.01*** (p=0.00)
L (Control Variable)	-0.20*** (p=0.00)	-0.42*** (p=0.00)	-0.23*** (p=0.00)	0.07*** (p=0.00)
Wald chi2	862.72	481.42	9481.36	780.93

The FGLS regression analysis revealed a statistically significant inverse U-shaped relationship ($p=0.05$) between Financial Slack (FS^2) and the firm's P/B ratio; this means that an increase in FS initially raises P/B, but after a certain optimal point, further increases significantly reduce the positive contribution to valuation. In contrast, FS's positive effect on ROA ($p=0.00$) and NPM ($p=0.00$) shows statistically significant increasing returns, while its effect on ROE is only linear and positive ($p=0.04$). On the other hand, despite the statistically highly significant and strong negative effects of R&D intensity (RDI) on traditional profitability indicators (ROA, ROE, NPM; all $p=0.00$), its positive effect on P/B is significant ($p=0.04$). The control variables (S) and (L) have statistically significant (all $p=0.00$) but opposite effects on both profitability and market value. In conclusion, the effect of financial slack on performance depends on the measure used, and excess can lead to inefficiency, especially when market value is considered.

4. Conclusion and Recommendations

R&D expenditures are essential for companies that aim to create a competitive advantage. Focusing on R&D can enable companies to be ahead of the curve in terms of technological advancement with a long-term sustainability orientation. In that sense, companies that develop such an advantage would sustain their position as leaders through the establishment of new products. Companies would be able to assist in formulating a niche market through product innovation. Companies that are attentive to expenditure on R&D build brand value through demand fulfillment from customers. Companies with new patents as well as intellectual rights would develop a competitive advantage over other companies in the future. Aside from that, product innovation through R&D-led environmentally friendly technologies would result in sustainability as well as produce social value for companies.

This research investigates observations extracted from 26 companies that are highlighted for significant R&D investment on the BIST during 2004-2023. Panel FGLS regression method is used with independent variables as financial slack and R&D intensity. Meanwhile, performance measures like ROA, ROE, NPM, and P/B Ratio are taken as dependent variables while firm size and financial leverage are introduced as control variables.

The study finds that R&D intensity negatively impacts firm performance. In most instances, Turkish firms register an R&D intensity of 1% or lower, which means that low investment in R&D is inadequate to translate expenditure into profitability. As investments in R&D are long-term in nature and risky as well, their payoffs are usually yielded over a long horizon rather than upfront. Further, Türkiye's economic woes, such as prevalent crises, marketplace uncertainties, as well as high exchange rates, add to cost pressures that translate into lower-quality R&D efforts that cannot meaningfully increase profitability levels. This might lead firms to perceive R&D efforts as an additional expense, particularly in economies subject to economic as well as political variations. This can be due to numerous factors, such as inadequate availability of finances, lack of proper technological base, weak institutional support, weak patent protection policies, as well as inadequate risk sophistication.

Conversely, financial slack appears to improve performance. Essentially, financial slack represents excess resources that act as a buffer against uncertainty, enabling companies to continue their innovative investments with greater confidence and allocate additional funds to R&D initiatives. Accordingly, these companies are in a strong position to meet their short-term payments by maintaining their financial slack capacity. This will contribute to the sustainability of the company's operations. Financial slack, which is particularly needed during crisis periods, will help the company adapt to the changing environment. This will contribute to the company's cash flow. The company will be more willing to take risks when making new investments. A company that is more daring in its investment decisions will have more opportunities to invest. This encourages innovation and enables the company to maintain its competitive position. Especially in this innovation-intensive sector, financial slack is expected to benefit companies.

However, a second analysis examining the relationship between financial slack and firm performance in greater detail revealed that this positive effect on the P/B ratio is not linear and exhibits a statistically significant inverse U-shaped relationship. This finding points to a non-linear relationship where the positive effect of financial slack on the P/B ratio increases up to a certain optimal point, but beyond this point, the contribution of additional financial resources to valuation begins to decline.

The finding that R&D intensity negatively affects performance is consistent with the works of Chen et al. (2019), Eldawayaty (2020), Aslan (2024), but contrary to the positive effects identified by Lehenchuk et al. (2022) and Rađenović et al. (2023) and Şahin & Irmak (2024). Similarly, the facilitative function of financial slack in improving firm performance is consistent with the works of Lee et al. (2014), Guo (2020), and Irmak (2024).

In line with the empirical results, this study further argues that the negative impact of R&D intensity on profitability may result from high upfront costs and long payback periods inherent in innovation activity, particularly for Turkish firms in a developing economy. The adverse effect would further be intensified by low absorptive capacity and market uncertainty in such settings, hindering the timely realization of R&D investment into monetary gains. Alternatively, the role of financial slack also illustrates how it serves as an essential buffer, allowing firms to sustain R&D activities in downtimes without compromising short-term profitability. This audit implies a necessity for even resource allocation, where Turkish firms may concentrate on financial planning strategically, along with R&D spending in an attempt to mitigate risks and achieve optimal long-term performance.

In order to resolve this situation, government-supported incentives should be increased, laws and regulations should be made to transform innovation into economic value, and patent protection systems should be established. R&D-oriented funds should be established, and funds should be provided to companies in need. In addition, more shares should be allocated from the public budget for R&D investments. Special support packages should be created for R&D intensive companies. In particular, the government should create more support programs for small and medium-sized enterprises. A vocational training program should be established to improve R&D investments.

The findings of this study call for the integration of policy-oriented solutions and institutional strategies to manage the negative effects of R&D intensity on short-term performance in emerging economies such as Turkey. In particular, in order to accelerate the conversion of R&D projects into economic value, it is critical to expand technoparks and university-industry collaborations to strengthen R&D infrastructure, as well as publicly supported incentives (tax advantages, grant programs). Moreover, modular financing models (e.g., risk-sharing loans) and patent commercialization mechanisms should be developed to boost SMEs' R&D capacity. On the other hand, the fact that financial slack positively supports performance suggests that firms should align their liquidity management with their innovation strategies. In this context, the adoption of integrated reporting systems that measure the impact of R&D on sustainability can contribute both to achieving environmental-economic balance and increasing stakeholder confidence.

Future research could extend the analysis over a longer time horizon to capture the prolonged effects of R&D expenditures. Moreover, exploring how firms integrate R&D spending into their marketing strategies may offer further insights. Comparative studies examining the impact of varying R&D investment levels on performance in both advanced and emerging economies could provide a more comprehensive understanding of these dynamics. By conducting policy-oriented studies, comprehensive research can be conducted on which instruments are more effective by including grants, tax cuts, and low-interest loans received by countries in the analysis. In addition, the influence of R&D investments on firm performance can be addressed from the perspective of sustainability. In this way, it will be possible to see the environmental and social benefits of R&D investments.

Declaration of Research and Publication Ethics
This study which does not require ethics committee approval and/or legal/specific permission complies with the research and publication ethics.

Researcher's Contribution Rate Statement
I am a single author of this paper. My contribution is 100%.

Declaration of Researcher's Conflict of Interest
There is no potential conflicts of interest in this study.

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