

Article

R&D Expenditures and Analysts' Earnings Forecasts

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Abstract: Previous research provides conflicting results regarding how R&D expenditures impact market value. Given that financial analysts are the primary intermediaries between companies and investors, our study focused on the impact of R&D-related uncertainty, growth, and information asymmetry associated on analysts' earnings forecasts. Based on 19,834 firm-year observations in the European market between 2005 and 2020, our results show that R&D activities lead to higher absolute forecast error and negative forecast error, indicating higher forecast inaccuracy with an optimistic bias. Additionally, these investments contribute to higher forecast dispersion, indicating disagreement among financial analysts. The comparison between 17 industries revealed that these effects are more pronounced in R&D-intensive industries than in non-R&D industries, uncovering the varied relationship between R&D investments and analyst forecasts across sectors.

Keywords: research and development (R&D); earnings; forecast inaccuracy; optimism; forecast dispersion



Citation: Elkemali, T. R&D Expenditures and Analysts' Earnings Forecasts. *Forecasting* **2024**, *6*, 533–549. <https://doi.org/10.3390/forecast6030029>

Academic Editors: Konstantinos Nikolopoulos and Dimitrios D. Thomakos

Received: 25 April 2024

Revised: 30 May 2024

Accepted: 5 July 2024

Published: 8 July 2024



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1. Introduction

In today's business environment, R&D expenditures represent catalysts for innovation and strategic growth. These investments present opportunities to explore new technologies, products, and markets, fundamentally reshaping competition and creating enduring value. Extensive research has delved into the intricate interplay between R&D expenditures and stock prices, uncovering that the inherent uncertainty and risk linked to R&D activities further complicate this relationship. R&D endeavors often involve exploring uncharted territories, experimenting with novel technologies, and pursuing innovative ideas, all of which inherently carry uncertain outcomes.

While some studies have suggested a positive relationship, indicating that higher R&D expenditures lead to increased market valuation due to the expectation of future growth and innovation [1–3], others have found no significant association or even negative effects [4]. Furthermore, other research distinguishes between capitalizing and expensing R&D, yielding varied results regarding their impact on share prices [5,6].

The contradictory nature of empirical findings regarding the influence of R&D on stock prices, coupled with the inherent uncertainty linked to R&D activities, serves as a primary motivation for studying analysts' forecasts. Financial analysts fulfill an essential function in interpreting and synthesizing complex information including R&D-related data to provide forecasts of companies' future performance. Their assessments inform investor decisions and contribute to market sentiment. Therefore, understanding how financial analysts integrate R&D information into their forecasts becomes paramount, particularly in light of the conflicting empirical evidence.

While prior research has largely examined the relationship between intangible assets as a whole and analysts' forecast accuracy and forecast dispersion [7–9], our study specifically focused on R&D expenditures due to their distinct characteristics compared to other

intangible assets. The existing literature on R&D expenditures and analysts' forecasts often narrows its scope to the impact of isolated characteristics of R&D such as uncertainty on forecast accuracy. However, R&D investments encapsulate a broader array of influences, including uncertainty, growth potential, and inherent information asymmetry.

Our research was motivated by the need to understand these combined effects of R&D-related factors on financial analysts' forecasts. By investigating these characteristics collectively, we aimed to provide a comprehensive analysis that captures not only how R&D impacts forecast accuracy but also its influence on forecast optimism and dispersion. This multifaceted approach allowed us to delve deeper into the complexities of how R&D expenditures shape analysts' predictions.

To study the impact of R&D combined characteristics rather than isolated characteristics on forecast properties, our first focus was on how the inherent uncertainty associated with R&D expenditures affects the accuracy of financial analysts' forecasts. Specifically, we aimed to understand whether this uncertainty leads to deviations between issued forecasts and announced earnings, resulting in lower forecast accuracy. Secondly, we investigated how financial analysts leverage the uncertainty of R&D expenditures to issue optimistic predictions, potentially aiming to preserve positive interactions with company leaders and overvaluing R&D as a source of growth opportunities. Lastly, we explored how R&D investments prompt analysts to expend additional effort in gathering private information about future prospects and how this increased information asymmetry contributes to higher forecast dispersion and increased forecast divergence among analysts. This comprehensive approach allowed us to examine the intricate effects of R&D investments on financial analysts' forecasts.

Based on 19,834 firm-year observations from European firms reporting R&D expenditures spanning from 2005 to 2020, our study offers empirical validation for our hypotheses. Firstly, we observed a positive association between R&D intensity and the absolute value of forecast errors, suggesting that heightened R&D activities correspond to lower forecast accuracy. Additionally, our analysis revealed a negative effect of R&D on forecast errors, indicating that analysts exhibit optimism towards R&D, resulting in exaggerated forecasts. Finally, our findings confirmed that an increase in R&D expenditure amplifies disagreement among financial analysts, as evidenced by a positive correlation between forecast dispersion and R&D activities.

Our study makes several significant contributions to the existing research on R&D expenditures and analysts' forecasts. First, it enhances our comprehension of the connection between innovation and financial outcomes within the European setting. Secondly, we extend prior research by examining how the combined specificities of R&D expenditures rather than isolated characteristics influence not only forecast errors but also forecast dispersion. By considering these dimensions, we provide a more comprehensive understanding of how R&D investments influence the accuracy and consensus among analysts' forecasts. This broader perspective enhances our ability to evaluate the ramifications of R&D expenditures on market expectations and investor perceptions. Thirdly, our findings highlight the importance of industry comparison when considering R&D-related factors in financial analysis and decision-making processes. By demonstrating the optimistic bias and increased forecast dispersion linked to R&D intensity, our study emphasizes the need for investors and analysts to critically evaluate the repercussions of R&D investments on market valuation.

The remainder of the paper is structured as follows: Section 2 outlines hypotheses development and research design. Section 3 presents our analysis sample. Section 4 provides empirical findings. In Section 5, we engage in discussions surrounding the implications of these results and draw conclusions.

2. Hypotheses Development and Research Design

Prior research has extensively focused on examining the impact of the uncertainty related to intangibles investments on analysts' expectations to understand market reac-

tions to these investments. Barron et al. [8] underlined that investments in intangibles result in placing more emphasis on private information, reflecting a decrease in consensus forecasts among financial analysts. Barth et al. [7] anticipated that due to the usual lack of recognition and undisclosed fair value estimates of intangible assets, intensive R&D firms would expect less informative pricing, particularly when analyst coverage is absent. Consistent with this expectation, their research revealed that analysts are more motivated to provide coverage for companies that possess substantial intangibles, leading to increased analyst attention on such firms compared to their industry peers. Amir et al. [9] examined if financial analysts consider intangibles when analyzing and evaluating firms' earnings. Their results confirm that intangible assets reduce forecast accuracy with negative forecast errors. Gu and Wang [10] proposed that the elevated information complexity associated with intangible assets poses challenges for analysts in processing information, thereby providing higher forecast bias for firms with a significant reliance on these investments. Their findings revealed a positive correlation between the forecast errors made by analysts and a company's degree of intangibles, which differs from the typical patterns observed in the industry. Higgins [11] demonstrated that financial analysts provide greater forecast errors when assessing intangible assets. Jeny et al. [12] indicated that there is a positive correlation between the extent of analyst forecast revisions and the level of disclosures concerning intangible assets. Additionally, this correlation extends to certain estimates within the purchase price allocation, especially the amounts assigned to goodwill. Ferrer et al. [13] concluded that intangibles intensity lowers forecast accuracy in the Spanish market.

Our study expands upon these prior research findings by centering on R&D investment, given its distinctive attributes that set it apart from other types of investments. We assume that R&D, as internally generated intangibles, is associated with uncertainty, growth, and information asymmetry and that these characteristics impact financial analysts' forecast.

The choice to focus on analyst forecast properties rather than stock market outcomes is rooted in the unique role analysts play in interpreting complex R&D information and synthesizing it into actionable forecasts for investors. Analysts' forecasts serve as a crucial intermediary between corporate R&D investments and market reactions, making them an essential focal point for our investigation. While prior studies have utilized market-based variables such as stock returns or volatility to infer the relationship between R&D and firm value, these measures capture the broader market's reaction to R&D expenditures, which may encompass a range of factors beyond analysts' interpretations. Market-based outcomes can be influenced by macroeconomic conditions, investor sentiment, and other externalities that are not directly related to R&D activities.

By contrast, focusing on analyst forecasts allows us to isolate and directly examine how R&D expenditures impact the expectations and consensus within the analyst community. This approach helps to clarify the pathways through which R&D investments affect market perceptions, specifically through the lens of those who are professionally tasked with evaluating and forecasting company performance.

2.1. The Impact of Uncertainty Associated with R&D on Forecast Accuracy

R&D initiatives are inherently fraught with uncertainty [10,14,15]. Investments in R&D introduce significant uncertainties into firms' operations, which can profoundly impact analysts' earnings forecasts. The unpredictable nature of innovation means that the outcomes of R&D frequently entail uncertainty and present challenges to expectations, leading to increased forecast error. Analysts may struggle to accurately assess the potential risks and returns associated with R&D investments, resulting in forecast errors that deviate from actual outcomes.

Furthermore, the uncertainty surrounding R&D expenditures escalates when, under International Accounting Standards IAS 38, they are expensed rather than capitalized. Unlike capitalized R&D, which is recognized as assets on financial statements, expensed

R&D appears as operating expenses, implying fluctuations in earnings as these expenses are incurred [16–18].

In the financial market, Xiang et al. [19] observed a negative correlation between the variability of R&D expenses and stock returns, indicating that investors react unfavorably to changes in R&D expenditures. Jeny and Maldovan [20] focused on the association between R&D as a specific category of internally developed intangible assets and financial market reaction. Their findings suggested that, due to its uncertainty, expensed R&D has lower value relevance compared to capitalized R&D. This treatment of R&D expenses can further exacerbate forecast error, as analysts may struggle to incorporate these expenses into their forecasts accurately.

Additionally, the substantial costs linked with R&D projects increase the financial risk for firms, especially if projects fail to yield the expected returns. Strategically, R&D investments carry the risk of technological obsolescence, where innovations become outdated or irrelevant before they can generate returns. This risk is compounded by the dynamic nature of technology and changing market conditions, making it challenging for firms to stay ahead of the curve.

Overall, the uncertainty and risk associated with R&D investments result in larger forecast errors, consequently increasing earnings forecast inaccuracies.

Hypothesis (H1): *R&D expenditures increase analysts' forecast inaccuracy.*

To test our initial hypothesis, we analyzed the relationship between R&D expenditures and the absolute forecast error for the following year $t + 1$. We analyzed how financial analysts integrate R&D expenses from year t into forecasting earnings for year $t + 1$. We expected a positive correlation, as R&D expenses increase the magnitude of the forecast error, thereby increasing forecast inaccuracy. We followed Gu and Wang [10] and regressed the following model:

$$AFER_{t+1} = \alpha + \beta_1 RD_t + \beta_2 SIZE_t + \beta_3 LOSS_t + \beta_4 SDROE_t + \beta_5 CVG_t + \zeta \quad (1)$$

where $AFER_{t+1}$ represents the absolute value of the forecast error for the subsequent year $t + 1$. The forecast error (FER) denotes the variance between actual earnings per share (EPS) for year $t + 1$ and the consensus forecast (F) for that year, adjusted by EPS_{t+1} . F is determined as the median of analysts' forecasts for year $t + 1$, compiled four months after the conclusion of fiscal year t . This four-month timeframe ensures the full accessibility of financial analysts to the annual statement from the previous year while formulating their forecasts for earnings $t + 1$ [21]. Penman [22] reported that 92 percent of companies publish their annual reports within the first quarter of the fiscal year $t + 1$. Additionally, O'Brien [23] stated that the typical duration from the forecast to its incorporation into the IBES records is approximately one month. RD expresses R&D expenditures, computing by dividing R&D expenses by total sales.

Previous studies have shown that other control variables also impact the forecast error [10,24]. We incorporated the business SIZE, determined as the natural logarithm of the company's market value of equity at the release of earnings for year t . Larger firms tend to exhibit lower bias and inaccuracy. LOSS is a dichotomic variable assigned a value 1 for firms with negative net income before extraordinary items in year t and 0 for those reporting positive net income. Analysts tend to demonstrate a higher level of bias in their forecasts for companies operating at a loss compared to those that are profitable, potentially resulting in larger forecast errors for loss-making firms.

To account for the impact of prior earnings volatility on forecast bias, we introduced SDROE, measured as the return on equity standard deviation over the previous five years. Higher earnings fluctuation is associated with increased forecast errors. CVG represents financial analyst coverage for the firm, expressed as the number of analysts contributing to consensus forecast. Previous studies have indicated that the rise in the number of analysts covering the company lowers forecast errors.

2.2. The Impact of Uncertainty and Growth Associated with R&D on Analysts' Optimism

Prior research has suggested that uncertainty often prompts financial analysts to issue optimistic forecasts. We posit that R&D activities, which are inherently uncertain, contribute to this optimism. Analysts' optimism, reflected in forecasts that exceed actual earnings, is influenced by both rational and behavioral factors. Rational optimism may stem from analysts' desire to cultivate strong connections with company executives and obtain access to confidential insights in situations of high uncertainty [25–27]. Given the complexity of R&D activity and its potential influence on future company performance, analysts may believe that issuing optimistic forecasts can enhance their ties with management and provide insights into the firm's innovation strategies. Furthermore, analysts could view favorable forecasts as a means to align themselves with leadership's positive outlook on R&D initiatives, thereby bolstering their credibility and information access. Additionally, analysts prefer covering firms expecting potential good prospects and may abstain when future performance appears pessimistic [28]. In this context, Cho and Kim [29] found that higher uncertainty leads to greater analysts' optimism and increased stock crash risk. Zhang and Wei [30] showed that analysts exhibit optimism particularly towards companies with low information transparency. Their findings revealed that optimistic analysts tend to possess more private information, supporting the idea that analysts use optimistic recommendations as a strategy to gain favor with management and thereby obtain more private information.

R&D is also a catalyst of growth opportunities [31,32]. Companies that invest in R&D are seen as forward-thinking and positioned for future expansion. Analysts interpret such investments as indicators of the firm's devotion to innovation and its capacity for enduring strategic expansion. This optimism stems from the belief that R&D initiatives will bring about new innovations, which can enhance the company's competitive advantage and increase its market share. As a result, analysts may project optimistic forecasts for companies with significant R&D expenditures, anticipating positive outcomes and growth opportunities in the future.

Conversely, analysts' optimism may be driven by behavioral factors, stemming from the effects of psychological biases. This optimism can manifest as analysts' underreaction and overreaction to earnings information [21,33]. Cognitive biases such as representativeness [34,35] are particularly pronounced in situations of high complexity and can lead analysts to perceive R&D as representative of future growth opportunities, resulting in an overestimation of future earnings. When analysts regard R&D initiatives as symbols of innovation and long-term growth potential, they may extrapolate positive outcomes from past R&D successes to current and future endeavors. This tendency to generalize from limited information can lead analysts to overestimate the potential benefits of R&D investments, especially if they have witnessed past successes. Anchoring bias can lead to underreaction to R&D failures and suboptimal performance. This bias arises when individuals excessively depend on initial information, known as "anchors", when making subsequent decisions or judgments [36]. Within the realm of R&D, analysts may anchor their expectations based on initial projections or past successes, leading them to underestimate the significance of R&D failures or setbacks. When R&D initiatives fail to meet expectations or encounter obstacles, analysts may downplay their importance or attribute them to temporary setbacks rather than recognizing the potential implications for the company's long-term prospects. As a result, analysts may not make adequate adjustments to their forecasts or recommendations in response to R&D failures, leading to an underreaction to negative information. This underreaction can result in delayed recognition of the impact of R&D failures on the corporate outcomes and may contribute to overly optimistic forecasts in the face of adversity [37,38].

Overall, both rational and behavioral tendencies contribute to the issuance of overly optimistic forecasts by financial analysts when evaluating companies with significant R&D activities. Consequently, we anticipate that the rise in R&D expenditures will be associated

with forecasts that exceed the actual earnings (negative forecast error), reflecting analysts' optimistic outlook on the company's future prospects.

Hypothesis (H2): *R&D expenditures boost analysts' optimism.*

To examine the second hypothesis regarding R&D effect on financial analysts' optimism, we employed the same model 1, utilizing the forecast error (without absolute value) as the dependent variable. In this equation, we leveraged the sign of the forecast error to discern its direction: a negative forecast error signifies optimistic behavior, whereas a positive forecast error implies pessimistic behavior. We anticipated observing a negative coefficient linking R&D expenses with forecast error.

$$FER_{t+1} = \alpha + \beta_1 RD_t + \beta_3 SIZE_t + \beta_4 LOSS_t + \beta_5 SDROE_t + \beta_6 CVG_t + \zeta \quad (2)$$

where FER_{t+1} denotes the forecast error for the subsequent year, as described in Section 2.1. If analysts are optimistic, they issue forecasts that surpass the actual earnings, resulting in optimism (negative forecast error). Conversely, if analysts are pessimistic, they provide forecasts that fall short of the actual earnings (positive forecast error). A negative value of β_1 would confirm that R&D expenditures enhance optimism [9].

2.3. The Impact of Information Asymmetry Associated with R&D on Forecast Dispersion

R&D activities often entail information asymmetry within financial markets, significantly impacting the availability of private information and forecast dispersion among financial analysts [14,39]. R&D initiatives inherently involve proprietary projects and strategic decisions that are not uniformly disclosed to the public. As a result, firms engaging in R&D often possess valuable private information that is selectively shared with certain analysts or kept confidential. This creates a disparity in access to information among analysts, with some having privileged insights into the potential outcomes of R&D investments, while others rely solely on publicly available data. Consequently, analysts with access to private information may form more informed forecasts, while those without such access may produce more conservative estimates. This discrepancy in information availability leads to forecast dispersion, as analysts' forecasts reflect their varying degrees of confidential information accessibility regarding the company's R&D endeavors [8,40].

Consequently, our third hypothesis assumes that R&D serves as a catalyst for asymmetry of information, shaping the availability of private information and contributing to forecast dispersion among financial analysts.

Hypothesis (H3): *R&D expenditures increase analysts' forecast dispersion.*

To investigate the third hypothesis, we investigated in model 3 the regression of the forecast dispersion on R&D expenses.

$$FD_{t+1} = \alpha + \beta_1 RD_t + \beta_3 SIZE_t + \beta_4 LOSS_t + \beta_5 SDROE_t + \beta_6 CVG_t + \zeta \quad (3)$$

The forecast dispersion, denoted as FD_{t+1} , is obtained from I/B/E/S and computed four months following the conclusion of fiscal year t (eight months prior to the conclusion of fiscal year $t + 1$). The calculation involves determining the standard deviation of analysts' forecasts, which is then divided by the absolute value of the analysts' median consensus forecast. This metric represents the forecast dispersion, indicating the magnitude of discrepancy amidst analysts' predictions regarding the company's future performance. A higher forecast dispersion indicates greater variance in analysts' forecasts, suggesting uncertainty or lack of consensus among analysts about the company's prospects. A positive coefficient for β_1 would confirm our third hypothesis, indicating that R&D expenditures increase forecast dispersion. Additionally, based on the prior literature, we anticipated that larger firms (SIZE) may have more stable financial performance, leading to lower forecast dispersion.

Conversely, higher financial analyst coverage (CVG) may lead to greater analysts' consensus, thereby suggesting a decreased dispersion of forecasts. The presence of LOSS may also contribute to higher forecast dispersion, as analysts may have difficulty forecasting the future performance of loss-making firms. Similarly, higher earnings volatility (SDROE) may lead to greater information asymmetry among analysts, resulting in higher forecast dispersion.

3. Sample Data

We gathered our data from two reputable databases: I/B/E/S, which provides information on analysts' forecasts, and Global Compustat for all other financial statement data, including R&D expenditures. Our dataset spans the European financial market from 2005 to 2020, consisting initially of 22,932 firm-year observations across 1874 firms, with financial consensus forecasts. The consensus forecast was computed as the median of analysts' forecasts. To ensure data quality, we implemented a filtering criterion by removing forecasts exceeding 200 percent of EPS. This step aimed to mitigate outliers and focus our analysis on forecasts within a reasonable range relative to earnings per share, resulting in a refined sample comprising 21,845 firm-year observations across 1653 companies.

To maintain focus on our research question regarding the influence of R&D activities on analysts' forecasts, we included in the sample all observations reporting R&D expenses.

To address the potential impact of missing R&D data and mitigate any selection bias, we replaced the missing values with the industry-average R&D expenditure. Koh and Reeb [41] recommended this approach, particularly when there are variations in R&D opportunities across industries, as it tends to yield well-fitting models.

Since our analysis examined the effect of year t data on year $t + 1$, we collected R&D expenditures data until 2019, while the consensus forecast and current EPS were collected until 2020, the last year of data availability. Additionally, to incorporate the control variable SDROE, we collected data since 2001, as this variable was computed as the standard deviation of return on equity for the last five years. Furthermore, to lessen the effect of outliers, all extreme observation values were adjusted to the 1st and 99th percentiles. This yielded a sample of 19,834 firm-year observations across 1603 firms, ensuring the robustness and reliability of our analysis. Table 1 displays the final sample description by country.

Table 2 highlights several key findings regarding forecast error (FER), absolute forecast error (AFER), forecast dispersion (FD), R&D expenditures (RD), and other variables. FER shows an optimistic trend, reflected in its mean of -0.019 and median of -0.012 , while AFER indicates forecast inaccuracy with a mean of 0.033 . The FD mean (0.101) being higher than the median (0.069) indicates disagreements among financial analysts and suggests a positive skewness in the distribution of forecast dispersion. Notably, RD exhibits a mean of 0.078 , surpassing its median of 0.047 and indicating significant concentration in a subset of firms' investments in R&D. This observation underscores the importance of controlling for industry effects when analyzing R&D expenditures (discussed in Section 4). Additionally, firm size (SIZE) demonstrates substantial variability, with a mean of 6.044 and a median of 3.612 . The dummy variable LOSS indicates that approximately 16.2 of firms report negative net income. Financial analyst coverage (CVG) displays variability across firms, with a mean of 3.223 , while the standard deviation of return on equity (SDROE) suggests potential volatility in firms' profitability over the prior five years, with a mean of 0.272 .

The correlation table (Table 3) elucidates several significant relationships among variables, with a specific focus on the associations involving R&D expenditures (RD). Notably, there is a substantial positive correlation between RD and the absolute forecast error (AFER) (0.326), underscoring the influence of R&D spending on increasing estimate inaccuracy, in line with our first hypothesis. Conversely, RD demonstrates a considerable negative correlation with the forecast error (FER) (-0.168), implying a strong relationship between R&D expenditures and forecast optimism, consistent with our second hypothesis. Furthermore, the correlation between RD and forecast dispersion (FD) (0.271) is positive, indicating a discernible association between R&D spending and analyst disagreement in

forecasts, supporting our third hypothesis. These correlations, all statistically significant at the 1% level, confirm our findings.

Table 1. Sample description by country.

Country	Number of Firms	%	Firm-Year Obs.	%
Belgium	58	3.62	644	3.25
Finland	73	4.55	927	4.67
France	238	14.85	2934	14.79
Italy	84	5.24	1068	5.38
Croatia	5	0.31	62	0.31
Czech Republic	6	0.37	68	0.34
Switzerland	86	5.36	1017	5.13
Germany	298	18.59	3691	18.61
Greece	35	2.18	436	2.20
Hungary	16	1.00	172	0.87
Ireland	19	1.19	221	1.11
The United Kingdom	229	14.29	2969	14.97
Luxembourg	2	0.12	21	0.11
The Netherlands	90	5.61	1039	5.24
Norway	67	4.18	844	4.26
Poland	19	1.19	238	1.20
Portugal	15	0.94	166	0.84
Romania	11	0.69	119	0.60
Russia	14	0.87	161	0.81
Slovakia	5	0.31	59	0.30
Slovenia	6	0.37	71	0.36
Spain	30	1.87	363	1.83
Sweden	137	8.55	1799	9.07
Turkey	60	3.74	745	3.76
Total	1603	100	19,834	100

The table reports, by country, the number of firms, firm-year observations, and the related percentages compared to the overall sample (%).

Table 2. Descriptive statistics for the total sample.

Variable	N.Obs	Mean	Median	Std	Q25%	Q75%
<i>AFER</i>	19,834	0.033	0.021	0.134	0.009	0.038
<i>FER</i>	19,834	−0.019	−0.012	0.058	−0.027	−0.004
<i>FD</i>	19,834	0.101	0.069	0.582	0.027	0.114
<i>RD</i>	19,834	0.078	0.047	0.144	0.016	0.138
<i>SIZE</i>	19,834	6.044	3.612	3.459	2.668	7.611
<i>LOSS</i>	19,834	0.162	0.000	0.337	0.000	0.000
<i>CVG</i>	19,834	3.223	2.000	3.563	1.000	4.000
<i>SDROE</i>	19,834	0.272	0.155	0.489	0.074	0.239

*AFER*_{*t* + 1} represents the absolute value of *FER* for the subsequent year *t* + 1. The forecast error *FER* denotes the variance between actual earnings per share (*EPS*) for year *t* + 1 and the consensus forecast (*F*) for that year, adjusted by *EPSt* + 1. *F* is determined as the median of analysts' forecasts for year *t* + 1, compiled four months after the conclusion of fiscal year *t*. *RD* expresses R&D expenditures, computing by dividing R&D expenses by total sales. *SIZE* is determined as the natural log of the company's market value of equity at the release of earnings for year *t*. *LOSS* is a dichotomic variable assigned a value 1 for firms with negative net income (before extraordinary items) in year *t* and 0 for those reporting positive net income. *SDROE* is measured as the return on equity standard deviation over the last five years. *CVG* represents financial analyst coverage for the firm, expressed as the number of analysts following the firm. *Std* and *Q25* and *Q75* indicate, respectively, the standard deviation and lower and upper quartiles.

Additionally, Table 3 presents significant associations between *SIZE*, *CVG*, *LOSS*, *SDROE*, and the variables *AFER*, *FER*, and *FD*. Larger firms exhibit lower absolute forecast errors, forecast errors, and forecast dispersion, suggesting potentially greater stability or transparency in their financial performance. Greater analyst coverage correlates with

reduced forecast errors and dispersion, indicative of heightened scrutiny and improved accuracy in predictions. Firms reporting losses demonstrate higher absolute forecast errors, while those with greater volatility in return on equity display increased absolute forecast errors and forecast optimism. These findings highlight the diverse influences of firm characteristics and financial metrics on the accuracy, optimism, and dispersion of financial analysts' forecasts.

Table 3. Pearson Correlation Analysis.

Variable	AFER	FER	FD	RD	SIZE	LOSS	CVG	SDROE
AFER	1							
FER	−0.399	1						
FD	0.276	−0.217	1					
RD	0.326	−0.168	0.271	1				
SIZE	−0.228	−0.082	−0.129	−0.043	1			
LOSS	0.321	−0.064	0.082	0.029	−0.053	1		
CVG	−0.262	−0.117	−0.313	−0.056	0.351	−0.121	1	
SDROE	0.364	−0.228	0.218	0.152	−0.233	0.269	−0.035	1

Significant Pearson correlations at 1% level are highlighted in boldface. Variables descriptions are detailed in Table 1.

4. Empirical Results

4.1. Regressions Results

This section presents the outcomes of our panel data regression analyses, which scrutinize the relationships delineated in our three models concerning the influence of R&D expenditures on analysts' forecast inaccuracy, optimism, and dispersion, as elucidated in Section 2. All our regressions were performed using the cross-section fixed-effect model. One advantage of this model is its capability to generate unbiased standard errors, especially when the firm effect is permanent [42]. Moreover, as R&D is endogenously determined, Breuer and DeHaan [43] illustrated that fixed-effects models substantially decrease the likelihood of omitted variable bias by addressing all time-invariant differences in both observable and unobservable variables.

The results from model 1 (Table 4) reveal a positive association between R&D expenditures and forecast inaccuracy. The significant positive coefficient (0.287, t-statistics 7.815) of R&D expenditures (RD) on the absolute forecast error (AFER) confirms that higher levels of R&D spending are indeed linked to reduced forecast accuracy. This outcome aligns with our expectation that greater R&D investments may introduce complexity and uncertainty into financial forecasts, leading to larger errors in analysts' predictions. The findings suggest that analysts may face challenges in accurately incorporating the effects of R&D spending into their forecasts, potentially due to the inherent uncertainty and risk surrounding the outcomes of R&D activities. Therefore, our first hypothesis, proposing a positive relationship between R&D expenditures and forecast inaccuracy, finds empirical support in the regression results of model 1. This result is aligned with those found by [9,10,40].

The estimates of model 1 also reveal a statistically significant intercept, suggesting that even when other variables are held constant, there is a systematic component of forecast error. The results regarding control variables confirm prior research findings. The firm size (SIZE) demonstrates a significant negative relationship with AFER, with a mean coefficient of -0.128 and a t-statistic of -7.365 , implying that larger firms tend to have greater forecast accuracy [44]. The variable LOSS, representing firms reporting negative net income, shows a significant positive association with AFER, suggesting that loss-making firms tend to decrease forecast accuracy [45]. The coefficient for analyst coverage (CVG) is negative but marginally significant, indicating that increased analyst coverage may lead to higher forecast accuracy [10], although this relationship warrants further investigation. Finally, the standard deviation of return on equity (SDROE) exhibits a significant positive relationship

with AFER, implying that greater earnings volatility over the prior five years is associated with higher forecast inaccuracy [24].

Table 4. Regressions of absolute forecast error, forecast error, and forecast dispersion on R&D expenditures.

Variables	Model1: AFER		Model2: FER		Model3: FD	
	Coefficient	t-Statistics	Coefficient	t-Statistics	Coefficient	t-Statistics
Intercept	0.023	6.591 ***	−0.031	−6.139 ***	0.056	7.005 ***
RD	0.287	7.815 ***	−0.219	−7.525 ***	0.338	8.364 ***
SIZE	−0.128	−7.365 ***	−0.068	−3.701 ***	−0.301	−6.542 ***
LOSS	0.112	5.585 ***	−0.049	−1.444	0.214	5.261 ***
CVG	−0.033	−1.712 *	−0.015	−1.775 *	−0.229	−5.148 ***
SDROE	0.051	3.109 ***	−0.071	−2.011 **	0.242	6.150 ***
N.Obs	19,834		19,834		19,834	
Adj. R ²	0.201		0.182		0.312	

The table provides regressions results of absolute forecast error (AFER), forecast error (FER), and forecast dispersion (FD) regressions on R&D expenditures (RD). Variables descriptions are detailed in Table 1. Panel data regressions were performed, starting with a homogeneity test using Fisher statistics, which revealed the presence of specific effects. Following this, the Hausman test indicated that fixed-effects models were appropriate. The Schwarz criterion was used to determine the optimal model, identifying the cross-section effect as the best fit due to its lower value compared to the year fixed effect. To address heteroscedasticity, cluster-robust standard errors at the firm level were utilized. ***, **, and *, represent significance at 1, 5, and 10, respectively.

In model 2 (Table 4), which focuses on the forecast error (FER), the results reveal significant associations with the independent variables. The intercept displays a statistically significant negative mean coefficient of −0.031, with a t-statistic of −6.139, indicating that, on average, financial analysts tend to exhibit a degree of optimism in their forecasts. This observation aligns with expectations that analysts may lean towards optimism in their predictions [21,25,33]. Furthermore, R&D expenditures (RD) demonstrate a substantial negative association with FER, with a mean coefficient of −0.219 and a t-statistic of −7.525. This suggests that higher levels of R&D spending are linked to negative forecast errors, supporting our second hypothesis that R&D investments contribute to analysts' optimism regarding future firm performance. Additionally, all other control variables exhibit significant negative associations with FER. For instance, the firm size (SIZE) shows a negative relationship, implying that larger firms tend to have more optimistic forecasts. Loss-making firms (LOSS) display a negative association with FER, indicating that analysts may adopt a more cautious stance when forecasting for companies reporting negative net income. Analyst coverage (CVG) and the standard deviation of return on equity (SDROE) also exhibit negative associations with FER, albeit marginally significant, suggesting that higher analyst coverage and greater earnings volatility tend to lead to optimistic forecasts. Overall, the findings from model 2 offer insights into the factors influencing financial analysts' optimism in their forecasts and provide support for our second hypothesis regarding the impact of R&D expenditures on forecast optimism.

Findings from model 3, which examines forecast dispersion (FD), indicate significant explanatory power of the independent variables. The intercept exhibits a statistically significant positive mean coefficient of 0.056, with a t-statistic of 7.005, suggesting that, on average, financial analysts' forecasts tend to display a degree of disagreement. This finding aligns with the expectation that analysts may differ in their predictions, leading to variability in forecast dispersion [46]. Additionally, R&D expenditures (RD) demonstrate a substantial positive association with FD, with a mean coefficient of 0.338 and a t-statistic of 8.364. This indicates that higher levels of R&D spending are linked to increased forecast dispersion, supporting our third hypothesis that R&D investments contribute to greater analyst disagreement in forecasts. Moreover, other control variables exhibit significant associations with FD. The firm size (SIZE) displays a negative relationship, implying that larger firms tend to have lower forecast dispersion. Loss-making firms (LOSS) exhibit a positive association with FD, suggesting that analysts may face greater uncertainty when

forecasting for companies reporting negative net income. Analyst coverage (CVG) and the standard deviation of return on equity (SDROE) also demonstrate significant associations with FD, indicating their influence on forecast dispersion. The adjusted R-squared of 0.312 indicates that approximately 31.2% of the variance in the dependent variable (FD) is explained by the independent variables included in model 3. Comparing the adjusted R-squared values across the three models, we can see that model 3 (FD) has the highest adjusted R-squared value, suggesting that it provides the best fit to the data among the three models. Overall, the results from model 3 provide evidence into the factors explaining analysts' forecast dispersion and lend support to our third hypothesis regarding the impact of R&D expenditures on forecast dispersion.

4.2. Robustness Test: Industry Comparison

Following the methodology outlined by Amir et al. [9], we extended our analysis by regressing our three models for each of the 17 industries identified by their two-digit Standard Industrial Classification (SIC) codes for our 19,834 firm-year observations. This approach allowed us to investigate how the relationship between R&D expenditures and financial analysts' forecasts varies across different sectors. By examining industry-specific effects, we gained deeper insights into the nuanced impact of R&D investments on forecast accuracy, optimism, and dispersion within distinct economic contexts.

Panel A of Table 5 elucidates a noteworthy trend: Industries characterized by higher median R&D expenditures are associated with increased levels of absolute forecast errors, negative forecast error, and higher forecast dispersion. This suggests that as R&D spending within an industry increases, there is a corresponding rise in the discrepancy between forecasted and actual values as well as a tendency for forecasts to skew negatively. Moreover, greater R&D expenditures seem to contribute to heightened variability and divergence in analysts' forecasts within these industries.

These results are corroborated by the coefficients of the regressions, demonstrating that an increase in R&D expenditure positively impacts the absolute forecast error in panel A. Moreover, this impact is notably more pronounced for industries with higher R&D intensity (highlighted in boldface), such as chemicals, electrical, industrial, commercial, machinery, and computer equipment. Additionally, panel B reveals a negative association between R&D expenditure and the forecast error, indicating that higher R&D spending tends to lead to more optimistic forecasts for R&D, particularly in R&D-intensive industries. Conversely, in panel C, industries highly involved in R&D exhibit larger positive coefficient for R&D expenditures in relation to forecast dispersion, suggesting that these expenditures boosts disparity and variability in analysts' forecasts in these sectors. These findings collectively are consistent with our hypotheses even after controlling for industry effects, underscoring the complex and multifaceted influence of R&D expenditure on analysts' forecasting accuracy, optimism, and dispersion across different industry sectors.

The control variables consistently exhibit the expected trends across nearly all industries. Notably, variables such as SIZE and CVG demonstrate a negative correlation with both the absolute forecast error and forecast dispersion. This suggests that larger firms and those with greater analyst coverage tend to yield more accurate and less-dispersed forecasts. Conversely, variables like LOSS and SDROE show a positive impact on AFER and FD, indicating that firms reporting losses and experiencing higher earnings volatility tend to be associated with increased forecast inaccuracy and analysts' disagreement. Intriguingly, these same variables have a negative effect on FER, suggesting that financial analysts may underreact to losses and that earnings volatility leads to optimistic forecasts.

It is noteworthy that for the three models, the adjusted R-squared for R&D-intensive firms is relatively high compared to non-R&D firms. This suggests a relatively strong relationship between the variables included in the model for these firms. Conversely, for non-R&D firms, the adjusted R-squared may be lower, indicating that the explanatory power of the model is comparatively weaker.

Table 5. Regressions of absolute forecast error, forecast error, and forecast dispersion on R&D expenditures: industry comparison.

Panel A	SIC Code	Medians				Model 1: AFER						
		AFER	FER	FD	R&D	Int	RD	SIZE	LOSS	CVG	SDROE	Adj-R ²
Oil and G. Extraction	13	0.021	−0.015	0.418	0.011	0.177 7.603 ***	0.132 2.645 ***	−0.065 −3.912 ***	0.044 5.752 ***	−0.063 −4.617 ***	0.056 5.928 ***	0.091
Food, Kindred	20	0.010	−0.009	0.219	0.014	0.021 3.854 ***	0.017 1.496	−0.011 −4.815 ***	0.012 6.209 ***	−0.029 −3.823 ***	0.017 5.448 ***	0.048
Textile Mill.	22	0.012	−0.010	0.172	0.008	0.005 2.043 **	0.013 1.584 *	−0.011 −2.287 **	0.015 5.714 ***	−0.014 −3.869 ***	0.018 4.101 ***	0.043
Printing and Pub.	27	0.014	−0.006	0.088	0.007	0.009 1.708 *	0.008 1.158	−0.011 −4.174 ***	0.010 4.227 ***	−0.013 −4.107 ***	0.020 5.742 ***	0.036
Chem. and Allied	28	0.037	−0.028	0.644	0.181	0.228 5.449 ***	0.218 7.928 ***	−0.041 −9.599 ***	0.021 5.462 ***	−0.038 −3.717 ***	0.061 7.487 ***	0.198
Primary Metal	33	0.011	−0.008	0.118	0.017	0.008 1.781 *	0.016 2.241 **	−0.010 −3.424 ***	0.012 5.009 ***	−0.015 −4.420 ***	0.018 3.925 ***	0.030
Fabricated Metal	34	0.015	−0.013	0.101	0.035	0.016 3.485 ***	0.013 1.401	−0.018 −5.102 ***	0.012 4.883 ***	−0.014 −4.472 ***	0.021 5.452 ***	0.048
Ind. Com. Mch. Computer	35	0.033	−0.029	0.602	0.158	0.223 5.621 ***	0.219 8.901 ***	−0.024 −6.784 ***	0.017 5.428 ***	−0.042 −4.117 ***	0.039 7.102 ***	0.221
Elec and Other Elec. Equip.	36	0.036	−0.025	0.631	0.162	0.188 6.414 ***	0.241 9.128 ***	−0.042 −7.498 ***	0.028 6.680 ***	−0.065 −5.824 ***	0.072 7.347 ***	0.252
Transp. Equip.	37	0.011	−0.019	0.424	0.091	0.094 5.828 ***	0.112 7.740 ***	−0.026 −4.002 ***	0.011 2.287 **	−0.019 −2.847 ***	0.031 4.61 ***	0.129
Measuring Instru.	38	0.027	−0.029	0.589	0.124	0.178 8.748 ***	0.191 8.827 ***	−0.029 7.634 ***	0.017 5.023 ***	−0.049 −5.812 ***	0.051 6.921 ***	0.156
Misc. Manuf.	39	0.011	−0.005	0.113	0.007	0.006 1.685 *	0.013 1.466	−0.009 −3.789 ***	0.004 3.804 ***	−0.013 −3.504 ***	0.015 4.228 ***	0.043
Communications	48	0.026	−0.013	0.092	0.121	0.178 6.607 ***	0.192 8.767 ***	−0.034 −7.622 ***	0.017 5.064 ***	−0.031 −3.389 ***	0.033 6.111 ***	0.131
Elec. Gas. Sanit. Serv.	49	0.007	−0.004	0.091	0.001	0.013 1.560 *	0.011 1.302	−0.017 −4.671 ***	0.015 3.144 ***	−0.013 −1.791 *	0.018 3.303 ***	0.064
Durable Gds., Wholesale	50	0.010	−0.007	0.111	0.004	0.011 1.703*	0.005 0.911	−0.014 −3.558 ***	0.012 4.737 ***	−0.011 −3.556 ***	0.015 4.921 ***	0.037
Home Furn. and Equip. Store	57	0.029	−0.021	0.332	0.074	0.228 7.484 ***	0.233 9.741 ***	−0.034 −7.378 ***	0.014 5.831 ***	−0.039 −4.034 ***	0.049 6.742 ***	0.193
Bus Services	73	0.029	−0.016	0.374	0.075	0.149 6.177 ***	0.173 6.107 ***	−0.047 −5.811 ***	0.011 3.115 ***	−0.029 −3.088 ***	0.057 5.412 ***	0.148

Table 5. Cont.

Panel B		Model 2: FER					
Industry	Int	RD	SIZE	LOSS	CVG	SDROE	Adj-R ²
Oil and G. Extraction	−0.066 −5.137 ***	−0.111 −4.703 ***	−0.019 −2.322 **	−0.013 −1.482	−0.031 −3.386 ***	−0.021 −3.022 ***	0.056
Food, Kindred	−0.038 −2.115 **	−0.011 −1.367	−0.008 −2.272 **	−0.017 −1.801 *	−0.022 −3.121 ***	−0.014 −3.539 ***	0.031
Textile Mill.	−0.042 −1.744 *	0.009 1.573 *	0.006 1.386	−0.008 −0.844	−0.017 −1.998 **	−0.012 −1.577 *	0.032
Printing and Pub.	−0.024 −3.805 ***	−0.008 −1.711 *	−0.004 −1.621 *	−0.011 −2.345 **	−0.018 −2.902 ***	−0.012 −2.603 ***	0.040
Chem. and Allied	−0.081 −6.687 ***	−0.346 −8.817 ***	−0.038 −5.414 ***	−0.026 −4.377 ***	−0.051 −4.728 ***	−0.025 −4.615 ***	0.233
Primary Metal	−0.024 −3.717 ***	−0.163 −3.122 ***	−0.019 −3.006 ***	−0.014 −4.124 ***	−0.019 −3.746 ***	−0.009 −3.012 ***	0.173
Fabricated Metal	−0.012 −1.811 *	−0.013 −2.224 **	−0.013 −2.323 **	−0.011 −3.723 ***	−0.025 −4.175 ***	−0.014 −3.601 ***	0.117
Ind. Com. Mch. Computer	−0.069 −7.045 ***	−0.412 −8.892 ***	−0.071 −7.562 ***	−0.036 −3.143 ***	−0.051 −5.617 ***	−0.022 −4.462 ***	0.267
Elec and Other Elec. Equip.	−0.092 −7.668 ***	−0.557 −8.328 ***	−0.058 −6.172 ***	−0.053 −5.488 ***	−0.068 −7.117 ***	−0.033 −4.902 ***	0.316
Transp. Equip.	−0.025 −2.902 ***	−0.112 −1.704 *	−0.017 −2.249 **	−0.011 −1.302	−0.024 −3.569 ***	−0.012 −3.009 ***	0.021
Measuring Instru.	−0.058 −5.013 ***	−0.224 −3.442 ***	−0.033 −2.121 **	−0.016 −3.345 ***	−0.007 −1.288	−0.016 −3.269 ***	0.197
Misc. Manuf.	−0.032 −1.381	0.008 0.922	0.007 1.267	−0.012 −0.878	0.019 1.737*	−0.012 −0.927	0.013
Communications	−0.058 −4.012 ***	−0.187 −3.103 ***	−0.015 −1.472	−0.015 −3.002 ***	−0.011 −1.668*	−0.010 −2.141**	0.161
Elec. Gas. Sanit. Serv.	−0.042 −2.014 **	−0.007 −1.162	0.005 1.362	−0.011 −1.211	−0.014 −1.799 *	−0.009 −1.002	0.012
Durable Gds., Wholesale	−0.038 −2.609 ***	−0.005 −0.678	0.004 0.804	−0.011 −1.253	0.012 1.819*	−0.011 −1.571*	0.012
Home Furn. and Equip. Store	−0.022 −3.805 ***	−0.189 −4.637 ***	−0.031 −3.489 ***	−0.017 −2.912 ***	−0.018 −4.517 ***	−0.015 −3.345 ***	0.193
Bus Services	−0.081 −7.215 ***	−0.369 −5.873 ***	−0.048 −4.628 ***	−0.017 −3.639 ***	−0.041 −4.144 ***	−0.018 −3.907 ***	0.271

Table 5. Cont.

Panel C		Model 3: FD					
Industry	Int	RD	SIZE	LOSS	CVG	SDROE	Adj-R ²
Oil and G. Extraction	0.039 6.117 ***	0.290 5.112 ***	−0.136 −4.008 ***	0.191 3.869 ***	−0.191 −5.004 ***	0.204 5.268 ***	0.145
Food, Kindred	0.021 3.680 ***	0.107 2.811 ***	−0.066 −1.906 *	0.095 1.558 *	−0.094 −2.40 1**	0.092 2.778 ***	0.099
Textile Mill.	0.010 2.247 **	0.051 1.443 *	−0.031 −0.924	−0.044 −0.731	−0.044 −1.152	0.047 1.583 *	0.072
Printing and Pub.	0.012 3.793 ***	0.060 2.056 **	−0.037 −2.958 ***	0.052 1.989 **	−0.053 −1.369	0.056 1.423	0.069
Chem. and Allied	0.052 8.237 ***	0.572 8.591 ***	−0.150 −4.448 ***	0.211 4.294 ***	−0.212 −5.555 ***	0.226 7.294 ***	0.271
Primary Metal	0.037 3.636 ***	0.156 3.999 ***	−0.119 −1.927*	0.145 3.636 ***	−0.176 −2.784 ***	0.191 4.118 ***	0.201
Fabricated Metal	0.014 2.748 ***	0.107 2.380 **	−0.051 −1.483	0.071 1.431	−0.071 −1.852 *	0.076 2.060 **	0.145
Ind. Com. Mch. Computer	0.108 9.713 ***	0.638 8.782 ***	−0.171 −5.114 ***	0.241 4.928 ***	−0.244 −6.187 ***	0.272 7.566 ***	0.321
Elec and Other Elec. Equip.	0.051 6.172 ***	0.662 7.072 ***	−0.178 −4.242 ***	0.249 5.109 ***	−0.253 −4.721 ***	0.270 8.480 ***	0.372
Transp. Equip.	0.022 1.394	0.022 1.901 *	−0.066 −1.727 *	0.093 1.890 *	−0.093 −2.444 **	0.099 1.081	0.014
Measuring Instru.	0.033 5.348 ***	0.407 9.552 ***	−0.107 −4.078 ***	0.150 3.049 ***	−0.151 −4.904 ***	0.160 4.065 ***	0.287
Misc. Manuf.	0.015 2.016 **	0.018 1.826 *	−0.045 −1.117	0.066 1.292	−0.068 −1.783 *	0.065 1.842 *	0.092
Communications	0.025 3.684 ***	0.323 5.631 ***	−0.075 −2.895 ***	0.104 1.709 *	−0.107 −3.098 ***	0.113 4.003 ***	0.204
Elec. Gas. Sanit. Serv.	0.010 1.121	0.014 1.885 *	−0.043 −2.049 **	0.061 1.712 *	−0.060 −1.753 *	0.066 2.707 ***	0.062
Durable Gds., Wholesale	0.011 2.989 ***	0.014 2.687 ***	−0.040 −1.883 *	0.057 1.662 *	−0.056 −1.643 *	0.061 2.367 **	0.054
Home Furn. and Equip. Store	0.035 6.013 ***	0.313 4.971 ***	−0.109 −3.246 ***	0.154 3.131 ***	−0.155 −4.058 ***	0.143 5.337 ***	0.252
Bus Services	0.064 6.721 ***	0.341 8.653 ***	−0.075 −4.311 ***	0.114 2.392 **	−0.102 −2.261 **	0.117 6.272 ***	0.267

Variables descriptions and regressions methods are detailed in Table 4. The table presents industry comparison based on the two-digit SIC codes. R&D-intensive industries are highlighted in bold. ***, **, and *, represent significance at 1, 5, and 10, respectively.

Our industry comparison is intriguing, as it brings to light the varying levels of R&D expenditures across different sectors, allowing for a potential decomposition between R&D-intensive industries and non-R&D firms. This continuity with prior research [9,47] underscores the importance of understanding the role of R&D investments in shaping financial analysts' forecasts. Moreover, it reveals that the influence of R&D expenditures on financial analysts' forecasts varies significantly across industries, suggesting that the impact is not uniform and may be contingent upon sector-specific factors.

5. Discussion and Conclusions

Our study argues that R&D investment has its own characteristics that influence analysts' earnings forecasts. Because R&D expenditures are associated with uncertainty and growth, we expect that financial analysts may struggle when providing forecasts, leading to higher forecast inaccuracy. Additionally, this uncertainty and growth gives rise to rational incentives to maintain good relationships with managers to benefit from more private information, may overweight future incomes, and may amplify cognitive biases, leading to optimistic forecasts. Furthermore, R&D expenditures boost information asymmetry, resulting in higher disagreement among financial analysts and therefore higher forecast dispersion.

Based on 19,834 firm-year observations between 2005 and 2020, our empirical analyses in the European market corroborate our hypotheses. R&D expenditures positively affect the absolute forecast error and forecast dispersion while negatively impacting the forecast error. This indicates that financial analysts exhibit higher forecast inaccuracy, optimism, and forecast dispersion when incorporating R&D investments in their forecasting process. Moreover, the robustness test on 17 industries validated the generalizability of our findings and revealed that our findings are more pronounced for R&D-intensive industries compared to non-R&D industries.

Our study contributes to the existing body of literature by establishing a theoretical framework for understanding R&D-related uncertainty, growth, and information asymmetry. By delving into the factors influencing analysts' forecasts and the role of R&D characteristics in shaping these forecasts, we deepen our understanding of the complexities surrounding R&D expenditures in the financial realm. Expanding upon previous research, our study not only delves into forecast accuracy but also incorporates analyses of optimism and forecast dispersion. The industry comparison aspect of our study enhances the robustness of our findings and contributes to the literature by providing potential insights into the decomposition between R&D-intensive industries and non-R&D industries.

Our study has implications for investors. By highlighting the impact of R&D expenditures on analysts' earnings forecasts, investors gain insights into the potential risks and opportunities associated with companies' innovation strategies. Investors can use these findings to tailor their investment strategies, allocate resources more effectively, and manage risk more prudently in industries characterized by high levels of R&D activity.

The lack of data after 2020 affects the temporal scope of our analysis, potentially reducing its relevance to present market conditions. The absence of post-2020 data limits our ability to assess how recent events, such as the COVID-19 pandemic or shifts in regulatory environments, may have influenced this relationship. Future research could address this limitation and focus on the impact of R&D accounting treatments, in terms of assets and expenses, on analysts' forecasts accuracy, optimism, and dispersion. Such studies would provide valuable insights into the nuances of R&D reporting practices and their implications for financial market perceptions.

Funding: This research was funded by the Deanship of Scientific Research, Vice Presidency for Graduate Studies and Scientific Research, King Faisal University, Saudi Arabia, under Project Grant A101.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available from the author upon reasonable request.

Conflicts of Interest: The author declares no conflicts of interest.

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