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R & D Intensity and Dividend Policy: Evidence from South Korea's Biotech Firms

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Abstract: In this paper, we examine the relation between a firm's research and development (R & D) intensity and dividend payout policy with a focus on biotech firms in a sample of 18,253 firm-year observations in South Korea. We find that biotech firms' R & D intensity is negatively related to dividend payout. Furthermore, for biotech firms, increased internal cash holding accomplished via a lower dividend policy is positively associated with long-term corporate value. In particular, this study reports that the relation between biotech firms' cash holding and corporate firm value is significantly positive in firms with high stock dividends. Moreover, it shows that non-biotech firms in the maturity stage of the corporate lifecycle tend to distribute cash dividends, a practice that is relatively uncommon among biotech firms in an R & D steady state.

Keywords: R & D intensity; South Korea's biotech firms; cash holding; dividend policy; firm value

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1. Introduction

"Today's business environment, perhaps more than at any other time in modern history, demands a continuous search for new sources of competitive advantage for sustainable growth" [1]. As competition grows, it becomes ever more vital for companies to discover new advantages. One path of discovery is through innovation, which is driven by investment in research and development (R & D). The quality of R & D, e.g., its efficiency and expertise, is essential to the sustainable success of the firm, because a shortening time-to-market timeline has accelerated the need to produce new products [2]. Therefore, management must adeptly assess the financial situation within a firm and determine the appropriate amount of resources to invest in R & D.

One decision management must make is whether to fund short-term projects for the purpose of making immediate profits or focus on longer-term projects that may generate a more sustainable success. Management must decide which strategy to employ when investing resources, as the decision partially determines the company's short-term and long-term value, which has an effect on dividend payments and stock prices [3].

The dividend policy of a firm is a complex financial decision and one of the most highly debated issues in corporate finance literature in both developed and emerging markets. When deciding on a policy, management must consider the amount of earnings that will be reserved and distributed as well as the ways in which the supply shortages that may occur during dividend distribution will be supplemented. Before the financial crisis, the most commonly practiced dividend policy was to distribute low dividends regardless of earnings. However, through the improvement of corporate governance, management transparency and shareholder rights were enhanced. This increased the effect of a firm's dividend policy on firm value by considering both current earnings and future profitability [4].

Social interest in dividend policy has increased due to the recent phenomenon of low growth and interest rates. According to Korea Stock Exchange, 755 corporations announced cash dividends from December 2015 to February 2016, 52 more than in the previous year. Total dividends also increased by 3.9 trillion won to a total of 18.0 trillion won. Likewise, there is a continuous increase in the number of cases of domestic firms returning shareholder profits with cash dividends. However, among pharmaceutical and biotech industries, this tendency is reversed. Recently, in the years following a boom in R & D investment in new drugs, these firms seem to be focusing on securing R & D funds for future sustainable growth rather than focusing on dividends.

In a 2018 study, the 20 highest R & D-investing firms of all listed pharmaceutical or biotech firms in 2016 were analyzed to find the correlation between cash dividends and R & D investment [5]. Many of those firms either reduced cash dividends or did not distribute them at all. The highest investing firm, Celltrion, invested 39% of its sales, or 264 billion won. Celltrion distributed cash dividends for three years, from 2010 to 2012, but has not distributed them since. Following Celltrion, Hanmi Pharmaceutical, which is second in R & D investment (162.6 billion won), only issued cash dividends once during the 2010s. That was in 2015, when Hanmi Pharmaceutical reached an all-time high in the amount of technology exports. This led experts to determine that domestic pharmaceutical or biotech firms that focus on domestic demands such as developing generics are now inclined to invest stockpiled cash in R & D rather than on dividends. In other words, as top firms are spurring R & D for entrance to the global market, they are expanding R & D investment rather than returning cash to shareholders.

Management plays an important role in corporate decision making for the benefits of shareholders [6,7]. Its foremost goal is to maximize the value of the firm and increase the market value of its stock [8,9]. In general, managers appear to firmly believe that the market values companies with a stable dividend policy [10]. However, there is evidence that firms that have positive investment opportunities either offer no payout or pay out very little compared to other firms, and that trend is spreading to all firms regardless of investment opportunities [11]. These findings suggest that the ideal dividend policy for firms with positive growth prospects is one in which cash is channeled to corporate insiders by lowering or eliminating the dividend.

The biotechnology industry is characterized by particularly high-risk, long-term development and lengthy commercialization periods, in part because it is a rapidly-evolving, high-tech industry that depends on entrepreneurialism and innovation [12]. The innovation of these firms, which is generally believed to be excellent, is measured by the intensity of R & D. That innovation is driven by investment in R & D, which increases both profitability and future growth opportunities of the firm [13]. Due to the increasingly global biotech market, firms must substantially invest in R & D [14]. With this in mind, a biotech company in a small country such as Korea requires a consistent, low-cost source of large amounts of capital in order to be sustainably successful.

Relatively little research has been conducted on the unique relationship between intensity of R & D and dividend policy among biotech firms. Regarding this, the study conducted its empirical analysis by using 18,253 firm-year observations (which included 1667 biotech firms for the period from 2000 to 2017 in South Korea) and discovered the following outcomes. First, we found there to be a negative correlation between R & D intensity and dividend payout among biotech firms. Second, internal cash holding is positively correlated to the long-term value of the firm. Furthermore, stock dividends are the only effective tool to satisfy investor demand for dividends while retaining internal funds. This study also found that, while firms outside of the biotech industry often distribute cash dividends when they reach the maturity stage of the corporate lifecycle, that is not the case for biotech firms in an R & D steady state. Due to delayed profitability resulting from large-scale, consistent R & D investment and the long-term lifecycle within the industry, the relatively weak connection between biotech firms with high R & D intensity and dividend payouts are observed at every level of maturity. Finally, we found that firms with high R & D intensity increase firm value through internal funds and a policy of low dividend payout. Several additional tests were conducted to determine that the findings of this study were still valid by the robust regressions in estimating specifications.

This study makes the following contributions. First, our study is one of the first to examine the consequences on the dividends of the biotech firms with high R & D intensity. Prior studies report that R & D drives innovation and has a persistent, positive long-term effect on firm value [15], and they focus primarily on the effect of R & D on firm value. To achieve this, continuously funded R & D investment is crucial. However, the literature does not provide much evidence on the financing sources for aiding R & D activity. By reporting R & D intensity is negatively correlated to dividend payout even if the firms have excess cash holdings, this study contributes to the literature that attempts to link biotech companies with high R & D to financing sources through dividends policy. Second, this study offers an in-depth analysis by considering various types of dividends and industries. Most studies have concentrated only on the cash dividends and general dividend tendency of the firms, implying that firms with high profitability are likely to distribute the earnings in the form of dividends to satisfy shareholders, but the opposite is true for biotech firms. The dividend policies of biotech firms with high growth opportunities and R & D intensity differ in that, since external financing through the capital market can reveal sensitive information about the firm to the competitors, many R & D-intensive biotech firms choose to finance internally via reducing dividends.

This paper is structured as follows. In Section 2, we review previous literature—mainly related to biotech firms and the effect of R & D intensity of dividend policy—and present our hypotheses. In Section 3, we share our research design and dataset, which was used to test our hypotheses. In Section 4, we conduct regression analysis, using the results to support our hypotheses, and we describe the additional tests we conducted in order to ensure validity. We discuss the results and the implications of our analysis before concluding the paper with suggestions for future lines of research.

2. Backgrounds and Hypotheses

2.1. Biotech Firms and R & D Intensity

Most of the literature believes that technological innovation drives sustainable economic success and job creation, meaning the sustainable growth rates of innovative firms should be higher than those which lack innovation [8,16,17]. This seems to be supported by a Korea Small Business Institute report, which shows that, between 2002 and 2005, the employment growth ratio of innovative firms grew 6.2% each year, which is 1.9 percentage points higher than all other firms [18]. Other studies also suggest that innovative firms generate higher profitability and more growth opportunities, which results in the potential for excessive stock returns [15,19].

The literature also suggests that R & D investment is vital to innovation and has a positive long-term effect on the value of a firm [15]. Furthermore, the size of a firm's market share is positively correlated to the effect of R & D investment [20]. Blundell et al. [21] quantify the impact of R & D investment on innovation by connecting it to the number of patents produced. Besides patents, R & D investment also produces intangible assets, such as acquired knowledge [20]. In a study of Taiwanese firms, Yang and Chen [22] agree that innovative firms generate higher profitability, more growth opportunities, and more excessive stock returns compared to other firms.

In order to function, biotech firms require R & D investment, which replaces investment in property, plant, and equipment. Since innovation determines the competitive ability and the potential for growth of a firm, biotech companies are continually increasing the amounts they invest in R & D [23,24]. For many biotech firms, their potential and their sustainability depend on knowledge and innovation [25].

In general, the biotech industry produces knowledge and technology, which are then used to promote health. The production of biotech products sustainability increases economic growth while also improving quality of life [26]. In this respect, considering its connection to personal lives and the environment, the biotech industry is unique. One branch of biotech is the pharmaceutical industry, which also depends on intense R & D. For major pharmaceutical companies, R & D investment accounts for about 18% of its sales, which is more than double the percentage of the electronics industry. The biotech industry is defined by a number of characteristics that explain the general policy of intense innovation.

One characteristic of the biotech industry is that one innovation often leads to only one new product. In other industries, such as electronics, an innovation can lead to an entirely new market, whereas innovations within the biotech industry are usually isolated and cannot be complemented by other innovations. This isolation also removes the barrier of high transaction costs of patents in other industries, since no additional, pre-existing technology is used.

Another characteristic of the biotech industry is a relatively long technological lifespan of innovations. Compared again with the electronics industry, the cumulative number of inventions is low. The longest patent period in the electronics industry is 20 years, but innovation happens so rapidly that many patents become obsolete in that time. The biotech industry, however, features a relatively long patent period, because the path from R & D to commercially available products is so long. Due to this characteristic, it is more difficult for smaller or less productive companies to compete with larger, successful ones. In the biotech industry, first-movers establish a significant and long lasting market advantage. This characteristic makes the acquisition of intellectual property and patents exceedingly important in the biotech industry.

As for the costs of R & D, the process is so uncertain, and the risk of failure is high. This combined with the amount of time it takes to bring a product to market creates a high barrier of entry for biotech firms. All of these characteristics make biotech a high-tech industry in which innovation through R & D is vital [26]. However, R & D also comes with high risk and uncertainty, and R & D-intensive firms demand constant financial support [24,27,28].

2.2. R & D Intensity and Dividend Policy

Prior studies have found that investment in R & D increases informational asymmetry between the firm and creditors and investors outside of the firm. One reason for this is that firms engaged in R & D are often hesitant to share resulting proprietary information for fear that competitors may take advantage [29]. Firms that have assets with high specificity are especially prone to information asymmetry, since they are more difficult to control [30].

Pecking order theory suggests that firms with high informational asymmetry should choose to finance through self-financing, low-risk debt, and stock issuance, in that order [31]. When investors lack the information management has regarding the inartistic value of a firm's assets and prospects, the firm may be undervalued by the market. Stock issuance is the least desirable method, because if a firm issues shares in order to finance a project with high informational asymmetry, new shareholders have an advantage if the net present value is greater than the cost of the project, thereby hurting existing shareholders. In order to promote self-financing, firms with a high degree of informational asymmetry should pay out lower dividends while increasing internal cash holdings.

In studying the implications of pecking order theory, Bharat et al. [32] indicate that firms prefer to access financial markets and issue stocks in an environment in which informational asymmetry is low. Furthermore, An et al. [33] report that firms operating with high informational asymmetry are generally less able to access bank credit lines. Firms that operate in a transparent information environment, however, are more likely to choose bank credit lines over cash. Overall, R & D is a significant factor in the degree of transparency or asymmetry in the information environment of a firm, since management may wish to conceal proprietary information in order to preserve the competitive advantage of the firm, therefore offering lower dividends in order to secure internal financing.

Another series of studies focused on R & D's tendency to generate strong growth opportunities for a firm [34–37]. The idea of a growth opportunity was introduced when Myers [38] studied the effect of the nature of investment on a firm's financing decisions. In that study, he explains that a firm's value equals the sum of its assets in place and defines growth opportunities as potential options presented to firms, which they may or may not choose to pursue. If a firm does choose to pursue a growth opportunity, additional discretionary expenditure is required. Assets in place, however, are a part of a firm's patrimony, thus they require no such expenditure and in no way influence the potential for future growth. Agency theory explains that financial structures within a firm are affected by growth opportunities in three major ways: underinvestment, asset substitution, and free cash-flow limitation.

Myers [38] explains the problem of underinvestment. He explains that firms with higher debt have fewer investment possibilities, and decreasing that debt value delivers profits to debt holders rather than shareholders. After a certain level of debt has been reached, managers who prioritize protecting the interest of shareholders may decline growth opportunities, since they would lead to increased debt value rather than equity value. In other words, a firm may intentionally reject a potentially profitable project if that profit will only be distributed to debt holders. A potential solution to this problem according to Myers [38] is to finance those projects through short-term and internal debts, which mature before the growth option can be exercised, allowing a continual and gradual debt negotiation.

As for the problem of asset substitution, Black and Scoles [39] and Jensen and Meckling [40] both find that debt issuance may result in the replacement of an owner-management investment policy with a riskier one. Though the new policy may have a lower economic value, the change gives management the opportunity to shift wealth from creditors to shareholders. In order to solve this problem, Jensen and Meckling [40] suggest that firms with strong growth options finance internally.

Finally, the problem of free cash-flow is related to the residual liquidity following the financing of investments [41]. This often becomes a problem when management does not hold the entirety of a firm's capital, which means they are unable to profit from the firm's success. Management may therefore choose to focus attention on personally beneficial projects rather than on trying to control the firm. When free cash-flow is at the discretionary disposal of management, this can become a problem. One solution is to increase dividend payments. Another solution is to modify the financial policy to increase debt, which decreases liquidity and limits the potentially opportunistic behavior of management. Similarly, the pursuit of growth opportunities decreases free cash-flow, leading to lower dividends without resorting to debt. A number of researchers have found that firms with high growth opportunities pay lower dividends because the growth opportunities absorb free cash-flow [42–44].

2.3. Hypothesis Development

Dividend policy is integral to the financial management of a firm and serves as a tool to limit opportunism on the part of management. Prior studies have offered different explanations for dividend payout policy. A widely supported explanation is the dividends are used to signal the future profitability of a firm [45–47]. More precisely, they communicate positive insider information regarding the future success of the firm to the market. Dividends are a reliable indicator because they are costly to the firm and have the potential to damage its long-term value. This policy also allows existing shareholders to accumulate wealth in less time than it takes future high cash flows to develop [45]. At first, this theory was thought to be correct, since the initiation of or the increase in dividends also increases the share price of a firm, while firms that decrease or cease payment of dividends experience a share price decrease [48]. However, later studies found that changes to dividends do not predict the future earnings sustainability of a firm, undermining the theory [49,50].

Another piece of literature that was generally overlooked for years [41,51] suggests dividend policies function as a remedy to reduce information asymmetry between shareholders and insiders. Specifically, these streams of research reporting that separation of ownership from shareholders and control from management under modern capitalism [52] can cause the asymmetric information problem between management and shareholders. This phenomenon of information asymmetry occurs as managers acquire more information than shareholders. Through dividend, however, profits are distributed to shareholders in order to prevent insiders from hoarding them for personal use or investing them in unprofitable but personally beneficial projects by using information asymmetry. This is the reason why outside shareholders prefer dividends rather than retained earnings. Though there are different theories about how shareholders can coerce firms to distribute cash, the overarching idea is that, when firms fail to disgorge cash, its shareholders suffer, and the cash may be wasted.

Dividends are a useful tool in addressing the agency problem between insiders and outsiders [53]. Firms that pay dividends limit management's ability to misuse earnings by forcing them to distribute the profits to investors. Furthermore, dividends are preferable to retained earnings because there is a chance retained earnings never develop into future dividends. By paying out dividends, firms become more likely to eventually rely on the capital markets to externally raise funds, a need that would give outside investors leverage over corporate insiders [54]. Finally, when improvements to corporate governance improve transparency and bolster the rights of shareholders, the dividend policy of firms becomes more impactful to the firm value, leading to increased dividend payouts.

However, dividend policy is connected to investment policy, and when firms—especially biotech firms—pay out dividends, they increase the efficiency of marginal investments. Looking at the development of dividend payouts, Fama and French [11] find that firms that do not pay out dividends tend to invest at a higher rate and more intensely conduct R & D. Since biotech shares are characterized by consistent R & D investments with good growth prospects, this negative relation between dividend payouts and R & D expenditures means that biotech firms generally pay out dividends at a relatively low rate. Lahiri and Chakraborty [3] support this suggestion, finding that firms that intensely conduct R & D tend to pay fewer dividends than those with a lower R & D intensity. R & D intensive firms therefore have a lower leverage level, and since R & D is dependent upon free cash flow, dividends are decreased. The authors also suggest that management tends to prefer to invest earnings in R & D rather than distribute them via dividends in order to limit the degree and the nature of information that is revealed to the market. In analyzing growth opportunities in a study of the relationship between ownership structures and dividends, Gugler [55] finds that firms with low growth opportunities distribute dividends regardless of ownership, suggesting a direct negative correlation between R & D intensity and dividend payout.

The aforementioned evidence suggests that the dividend policies of biotech firms with good growth prospects and positive R & D investment will differ from the policies of non-biotech firms [3,11]. Biotech firms must determine the method by which to fund R & D endeavors. Though some results of R & D, such as products, may be directly profitable to outside investors, other results, such as learned information, are often not. This can make certain projects less appealing to investors, which in turn makes funding more difficult for firms to acquire. In order to defend against this unreliability in funding, firms may choose to maintain sizable cash balances. This way, if liquidity is needed, the value of the firm will not be compromised. Furthermore, the market values information regarding the success or the failure of a firm's R & D endeavors, and revealing that information to its competition may damage the firm. Since simply financing via the capital market can expose sensitive information about the firm, many R & D-intensive biotech firms choose to finance internally, especially as competition increases. This brings us to our first hypothesis:

Hypothesis 1. *There is a negative relation between R & D intensity and cash dividend payouts, and there is a positive relation between R & D intensity of the firm having high levels of cash and cash dividend payout ratio. However, this will not be the case for biotech firms.*

Our second hypothesis expands on the first, as we analyze ways in which R & D intensity affects the long-term relationship between the value and the cash holding of a biotech firm. R & D investment, which reflects a firm's strategy and commitment to scientific advancement, is intended to create a competitive advantage and thereby increase firm value [56]. Firms build upon R & D capabilities and establish routines to acquire new knowledge, which can then be applied to its current products and services. In a number of prior studies, R & D investment has been found to have a positive effect on long-term performance, including the price of stock returns [57], Tobin's q [58], sales growth rates [59], market value [24], and investment opportunities [60].

We attempt to further prove the positive long-term effects investment in R & D have on firm performance. When a firm decides to begin an R & D investment, it is generally assumed that the project will result in a positive net present value. The pecking order theory suggests that debt and equity are costlier than internal funding, making it the most efficient financing option. If the project does indeed have a positive effect on firm value, that change should be reflected in the price of equity, and if long-term performance is defined as firm value by Tobin's q, internal funds should also increase. Overall, in recognizing the willingness of biotech firms to reinvest resources in R & D—a way to generate sustainable growth opportunities—the market will evaluate firms favorably. This brings us to our second hypothesis:

Hypothesis 2. *The firms that do not distribute cash dividends despite high cash availability are negatively associated with market value, but this will not be the case for biotech firms.*

The reputation effect hypothesis assumes that management pays out dividends in order to establish a positive market reputation. If management is able to convince the market that investors are treated well, it may be easier to raise funds or defend against hostile takeovers by outside investors [61]. Since investment in R & D is a constant, multi-year expense, it is very likely to result in the need for additional financing in the future, and firms that conduct intense R & D are more likely to be targeted by hostile investors than other firms [62,63]. Therefore, biotech firms that pay dividends are expected to do so in order to increase their internal holdings. This study argues that an increase in stock dividends by a biotech firm would have the same effect as Hypothesis 2; it would increase firm value by protecting internal funds. Stock dividends, though they reduce retained earnings within a firm, may lead investors to believe that the firm has a reliable plan to increase future profitability. This leads us to an additional hypothesis:

Hypothesis 2-1. *Stock dividend declaration of biotech firms will have a positive impact on market value of biotech firms that do not distribute cash dividends despite high cash availability.*

3. Research Design

3.1. Sample Selection

The data used in this research are from the Korea Investors Service, Inc. with a sample period of 2000–2017 and include publicly traded firms on the Korean Stock Exchange that end their fiscal years on December 31. Financial firms are not included. The sample size is 18,253 firm-year observations for cash dividend payout analysis and 21,673 firm-year observations for market value analysis (in parentheses), respectively. Each continuous variable is winsorized at the top 1% and the bottom 1%. Table 1 presents sample distribution by industry.

Table 1. Sample distribution by industry.

Industry	Number of Firms Years	%
Agriculture/Fishing/Forestry/Mining	95 (111)	1.04 (0.51)
Manufacturing	10,159 (12,455)	55.66 (59.52)
Electricity/Environment/Water supply	184 (213)	1.01 (0.98)
Construction	735 (843)	4.03 (3.89)
Retail/Wholesale	1435 (1661)	7.86 (7.66)
Transportation/Warehousing	341 (389)	1.87 (1.79)
Lodging/Restaurants	6 (10)	0.03 (0.05)
Broadcasting/Communication/Publication	1255 (1523)	6.88 (7.03)
Computer/Information/Medical	513 (614)	2.81 (2.83)
Leasing/Real Estate/Renting	49 (57)	0.27 (0.26)
Biotechpharma/Biotechtech	1667 (1667)	9.13 (5.64)
Others	1814 (2130)	9.94 (9.83)
Total	18,253 (21,673)	100 (100)

3.2. Regression Model and Measurement of Variables

Hypothesis 1 is examined using the following Ordinary Least Squares (OLS) regression model:

$$\begin{aligned} \text{CashDIV}_{i,t} = \alpha + \beta 1\text{RD}_{i,t} + \beta 2\text{RDHcash}_{i,t} + \beta 3\text{HRDHcashbio}_{i.t} + \sum \alpha_j X_j \\ + \sum \alpha_k \text{IND}_k + \sum \alpha_l \text{YEAR}_l + \varepsilon_{i,t} \end{aligned} \tag{1}$$

CashDIVi,t, a dependent variable, is computed by dividing cash dividend payouts by assets. $\text{RD}_{i,t}$ equals 1 if R & D intensity is above the median and 0 otherwise. $\text{RDHcash}_{i,t}$ is the interaction between RD and Hcash, which equals 1 if Cash, cash, and cash equivalents divided by total assets is above the median. $\text{RDHcashbio}_{i,t}$ represents the interaction between RDHcash and BIO, the biotechnology dummy variable, which refers to both biopharmaceutical and biotechnology firms. When the aim is to provide statistical information on each effect, we need to run a hierarchical regression to test interaction effects and should keep the main effects in the model for identifiability [64–67]. However, the inclusion of a two-way interaction term in a model without including the main effects may be valid and even necessary [68] when inclusion of the main effects would make the model worse. According to University of California, Los Angeles (UCLA) Institute for Digital Research and Education, statistically, we do not always need main effects for the use of the interaction term, as that would be just a reparameterization of the full model. For this study, the hypothesis could be true regardless of a factor of the main effects, thus we omit the main effects and include only the interaction for improvement of prediction precision.

For certain key variables, dummies are used instead of continuous variables. The first reason we use dummy variables instead of continuous variables is that the general linear model does not really care if a predictor is continuous or categorical. Secondly, when we test the interaction terms without including the main effects, it is necessary to make the model remain the same, while the coefficients are reparameterizations of the original estimates. The use of categorical variables does not change the degrees of freedom or the fit of the model. Next, when the relationship is not linear, and some quantitative variables have natural, meaningful qualitative differences, categorical variables can be used. As the most common reason, the use of binary split of individuals into two groups simplifies the statistical analysis and leads to easy interpretation and presentation of results.

$X_{i.t}$ is included as the other factor affecting dividend payout decision. These have been most commonly used in prior research and include the following: tangible assets, which are calculated by dividing tangible assets by total assets; the market-to-book ratio, which is calculated by dividing the market value of equity by the book value; size, which is the natural log of total assets; return on asset (ROA), which is the net income divided by total assets; the natural log of total sales; liquidity, which is the current assets divided by current liabilities. YEAR represents the year dummy variable, and IND represents the industry sector variable, as defined by the Korea Standard Industry Code.

Hypothesis 2 is tested using the following OLS model, with Tobin's q as the dependent variable:

$$\begin{aligned} \text{Tobin's } q_{i,t} = \alpha + \beta 1\text{HcashNdiv}_{i.t} + \beta 2\text{HcashNdivbio}_{i.t} + \sum \alpha_j X_j + \sum \alpha_k \text{IND}_k \\ + \sum \alpha_l \text{YEAR}_l + \varepsilon_{i,t} \end{aligned} \tag{2}$$

As in prior studies, the value of a firm is quantified using Tobin's q, which equals the market value of equity plus liabilities divided by total assets [69–72]. HcashNdivi,t is the interaction between Hcash and Ndiv, which equals 1 if the firm does not pay cash dividend in year t and 0 otherwise. HcashNdivbioi,t represents the interaction between HcashNdiv and BIO, the biotechnology dummy variable. Other factors that affect Tobin's q (explained below) are represented by $X_{i.t}$. IND is the industry indicator variable, and YEAR is the year indicator variable. The model includes a number of other control variables that affect firm value. Size, which is the natural log of total assets, is included here in order to control for side effects, and it may be positively correlated with market value. Leverage, which equals 1 if the value of total liabilities divided by total assets is above the median, may be negatively correlated with market value [73]. Sales growth controls for growth, and the market-to-book ratio is calculated by dividing the market value of equity by the book value. Investment is a control variable because the investment decisions of a firm my affect its value. Two final controls are the year dummy variable and the industry sector dummy variable, as defined by the Korea Standard Industry Code.

Hypothesis 2-1 is tested using the following OLS regression model:

$$\begin{aligned}\text{Tobin's } q_{i,t} = \alpha + \beta 1\text{HcashNdiv}_{i.t} + \beta 2\text{HcashNdivbio}_{i.t} + \beta 3\text{HCNDstdivbio}_{i.t} \\ + \sum \alpha_j X_j + \sum \alpha_k \text{IND}_k + \sum \alpha_l \text{YEAR}_l + \varepsilon_{i,t}\end{aligned} \quad (3)$$

HCNDstdivbioi,t is the interaction between HcashNdivbio and stdiv, which equals 1 if the firm pays stock dividend in year t and 0 otherwise. The model includes a number of other control variables that affect firm value, and again, IND is the industry indicator variable, and YEAR is the year indicator variable.

4. Empirical Results

4.1. Descriptive Statistics

Table 2 <Panel A.> shows the definition of each variable. Table 2 <Panel B.> presents descriptive stats for each variable. The mean values for the two dependent variables, cashDIV and TQ, are 0.0073 and 1.3813, respectively. The median values for cashDIV and TQ are 0.0110 and 0.5816, respectively. The descriptive statistics for the explanatory variables mean that 28% (3% of biotechnology firms) of the sample firms are R & D intensive firms with high levels of cash, and 19% (2% of biotechnology firms) are firms that have high levels of cash but do not pay dividends.

The Pearson correlation results to determine if the linear sample data relationship effectively models the population relationship are presented in two panels in Table 3. The results show significant positive correlations between cash dividend payouts (cashDIV) and the three explanatory variables: HRDint, HRDintHcash, and HRDintHcashbiotech ($p < 0.01$). The significant positive correlations between cash dividend payouts (cashDIV) and HRDintHcash and HRDintHcashbiotech suggest that Hypothesis 1 can be demonstrated. There are also significant positive correlations between cashDIV and all control variables except for tangible ($p < 0.01$). Finally, there are significant positive correlations between TQ and two explanatory variables, HcashNdivbiotech and HCNDstdivbiotech ($p < 0.01$), as well as several control variables, including SIZE, SalesGROW, MTB, and INV ($p < 0.01$). This is in line with previous research results [15,57,74–76]. The significant positive correlations between TQ and HcashNdivbiotech and HCNDstdivbiotech also suggest that hypotheses 2 and 2.1 can be demonstrated. There is a significant negative correlation between HcashNdiv and TQ. In order to test for multi-collinearity, variance inflation factors (VIFs) are computed, and VIFs for all variables are less than 10. Therefore, we find no multi-collinearity problems.

Table 2. Variables description.

<Panel A.> Variables Definition	
Variables	**Definition**
cashDIV	cash dividend payouts divided by total assets
RD	coded as 1 if research and development (R & D) intensity, which is total R & D investments divided by sales, is above the median and as 0 otherwise
RDHcash	the interaction between RD and Hcash dummy variable, coded as 1 if cash and cash equivalents divided by assets is above the median and as 0 otherwise
RDHcashbio	the interaction between RDHcash and the biotechtech dummy variable
Tangible	tangible assets divided by total assets
Growth	assets growth, the changes in assets = ($assets_t - assets_{t-1}$)/$assets_{t-1}$
SIZE	natural logarithm of total assets
ROA	net income divided by total assets
Lnsales	natural logarithm of sales
Liquidity	current assets divided by current liabilities
TQ	*Tobin's Q*, the market value of equity plus liabilities, all divided by total assets
HcashNdiv	the interaction between Hcash and Ndiv, which equals 1 if the firm does not pay cash dividend in year t and 0 otherwise
HcashNdivbio	the interaction between HcashNdiv and BIO
HCNDstdivbio	the interaction between HcashNdivbio and stdiv, which equals 1 if the firm pays stock dividend in year t and 0 otherwise
LEV	short term liabilities divided by total assets
SalesGROW	sales growth, the changes in sales = ($sales_t - sales_{t-1}$)/$sales_{t-1}$
MTB	market-to-book ratio, market value of equity divided by book value of equity
INV	plant, property, and equipment (except land and construction in progress) divided by total assets

<Panel B.> Descriptive Statistics					
Variables	**Mean**	**StdDev**	**Median**	**Q1**	**Q3**
cashDIV	0.0073	0.011	0.0024	0	0.0111
HRDint	0.5053	0.5	1	0	1
HRDintHcash	0.2833	0.4506	0	0	1
HRDintHcashbiotech	0.0246	0.1549	0	0	0
Tangible	0.2887	0.2708	0.2708	0.1345	0.4161
SIZE	18.5675	1.4969	18.3605	17.5686	19.3327
ROA	0.0254	0.1166	0.0368	0.0045	0.0797
Lnsales	18.3055	1.6509	18.1465	17.2237	19.1948
Liquidity	3.233	17.72	1.5677	1.0163	2.7535
TQ	1.3813	2.9469	0.5816	0.3109	1.1562
HcashNdiv	0.1931	0.3948	0	0	0
HcashNdivbiotech	0.0151	0.1221	0	0	0
HCNDstdivbiotech	0.0002	0.0137	0	0	0
LEV	0.1025	0.1161	0.0632	0	0.1671
SalesGROW	0.3835	2.2159	−0.0205	−0.1767	0.0747
MTB	1.3705	1.0436	1.0196	0.6183	1.7639
INV	0.2506	0.4946	0.1323	0.0547	0.2533

Table 3. Pearson correlations.

<Panel A.>

Variable	*cashDIV*	*RD*	*RDHcash*	*RDHcashbio*	*Tangible*	*MTB*	*SIZE*	*ROA*	*Lnsales*	*Liquidity*
cashDIV	1									
RD	0.0001	1								
RDHcash	0.0603 *	0.6221 *	1							
RDHcashbio	0.003	0.1572 *	0.2527 *	1						
Tangible	−0.0731 *	−0.1024 *	−0.1934 *	−0.0286 *	1					
MTB	0.0923 *	0.1823 *	0.1799 *	0.1375 *	−0.1849 *	1				
SIZE	0.0922 *	−0.1157 *	−0.1646 *	−0.0669 *	0.1337 *	−0.1272 *	1			
ROA	0.3524 *	−0.0400 *	0.0416 *	−0.0408 *	−0.0097	−0.0794 *	0.0687 *	1		
Lnsales	0.1408 *	0.0253 *	−0.1566 *	−0.1191 *	0.1609 *	−0.1335 *	0.8791 *	0.1726 *	1	
Liquidity	0.0342 *	−0.0005	0.0224 *	0.0314 *	−0.1047 *	0.0011	−0.0201 *	0.0082	−0.1127 *	1

<Panel B.>

Variable	*TQ*	*HcashNdiv*	*HcashNdivbio*	*HCNDstdivbio*	*SIZE*	*LEV*	*SalesGROW*	*MTB*	*INV*
TQ	1								
HcashNdiv	−0.0136	1							
HcashNdivbio	0.0681 *	0.2534 *	1						
HCNDstdivbio	0.0233 *	0.0279 *	0.1101 *	1					
SIZE	0.1030 *	−0.2859 *	−0.1163 *	0.0035	1				
LEV	−0.1325 *	−0.0600 *	−0.0340 *	−0.0038	−0.0632 *	1			
SalesGROW	0.6701 *	−0.0674 *	−0.0218 *	−0.0036	0.2086 *	−0.0074	1		
MTB	0.3776 *	0.1255 *	0.1485 *	0.0238 *	−0.1272 *	−0.0891 *	0.0234 *	1	
INV	0.5812 *	−0.0853	−0.0204 *	−0.0015	0.2381 *	0.0294 *	0.7540 *	−0.0141 *	1

Note. See Table 2 <Panel B.> for variable definitions. * Significant at the 0.05 level.

4.2. Regression Results and Discussion

4.2.1. Regression Results—Hypothesis 1

The regression results for Hypothesis 1 are presented in Table 4. It shows that R & D intensity exerts a negative and significant impact on cash dividend payout ($p < 0.01$). The correlation between cash dividend payout ratio and R & D intensity of the firm with high levels of cash is significantly positive ($p < 0.01$). That correlation for biotechnology firms is also positive but less significant.

Cash dividend payouts are significantly correlated to the control variables. MTB, ROA, Lnsales, and Liquidity are all positively correlated to cash dividend payouts. Tangible and SIZE are negatively correlated. The results of robust regression analysis are consistent with the OLS results for the explanatory variables.

Table 4. Regression results.

Variables	Expected Sign	Dependent Variable: *Cash Dividend Payouts*	
		OLS Regression	**Robust Regression**
Constant	?	0.0027 * (1.93)	0.0027 ** (2.17)
RD	−	−0.0005 *** (−2.71)	−0.0005 ** (−2.98)
RDHcash	+	0.0013 *** (6.37)	0.0013 *** (6.39)
RDHcashbio	+	0.0010 * (1.84)	0.0010 * (1.73)
Tangible	−	−0.0030 *** (−7.18)	−0.0030 *** (−7.45)
MTB	+	0.0012 *** (15.67)	0.0012 *** (12.39)
SIZE	+/−	−0.0010 *** (−8.63)	−0.0010 *** (−8.45)
ROA	+	0.0376 *** (58.87)	0.0376 *** (48.68)
Lnsales	+	0.0011 *** (10.51)	0.0011 *** (10.91)
Liquidity	+	0.0001 *** (4.72)	0.0001 *** (2.68)
Industry dummies		Included	Included
Year dummies		Included	Included
F value		159.02 ***	107.69 ***
Adjusted R^2		0.2325	0.2340
N		18,253	18,253

Note: See Table 2 <Panel B.> for variable definitions. t-values are shown in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. OLS: Ordinary Least Square.

4.2.2. Discussion—Hypothesis 1

The results support Hypothesis 1. A firm's dividend policy is determined based on its earnings and future cash flows. Rapidly growing firms tend to reinvest their earnings back into the firm instead of returning them to shareholders. Free cash flow for R & D intensive firms is entirely utilized for growth opportunities [73]; therefore, R & D intensive firms and biotech firms are less likely to distribute cash dividends to shareholders where R & D investment is always in urgent need. As seen in the results, however, if a firm has enough available cash, it is more likely to distribute cash dividends. The results for Hypothesis 1 affirm that such R & D intensive firms focus more on securing cash flow for R & D investment rather than pursuing the shareholder-friendly policy. Of course, there is an exceptional tendency when cash flow is abundant.

4.2.3. Regression Results—Hypothesis 2

Table 5 represents the regression results for Hypothesis 2. The firms that do not distribute cash dividends despite high cash availability have significant negative associations with market value ($p < 0.01$). However, for biotech firms, the results are different. In a case where a firm chooses not to distribute dividends even when the firm reserves enough cash, if the firm is a biotech firm, it has a significant positive association with market value ($p < 0.01$).

Table 5. Regression results.

Variables	Expected Sign	Dependent Variable: *TQ*	
		OLS Regression	**Robust Regression**
Constant	?	0.1093 (0.42)	0.1093 (0.46)
HcashNdiv	−	−0.1039 *** (−2.82)	−0.1039 *** (−3.62)
HcashNdivbio	+	0.5434 *** (4.08)	0.5434 * (1.90)
SIZE	+/−	−0.0280 *** (-2.90)	−0.0280 *** (−2.95)
LEV	−	−2.5457 *** (−22.83)	−2.5457 *** (−26.28)
GROW	+	0.6257 *** (72.87)	0.6257 *** (22.29)
MTB	+	0.9172 *** (71.37)	0.9172 *** (44.82)
INV	+	1.1454 *** (29.48)	1.1454 *** (9.37)
Industry dummies		Included	Included
Year dummies		Included	Included
F value		1056.82 ***	165.72 ***
Adjusted R^2		0.6303	0.6309
N		21,673	21,673

Note: See Table 2 <Panel B.> for variable definitions. t-values are shown in parentheses. * $p < 0.10$, *** $p < 0.01$.

Market value is also significantly correlated to the control variables; MTB, GROW, and INV are positively correlated, while SIZE and LEV are negatively correlated. Once again, the results of robust regression analysis are consistent with the OLS results for the explanatory variables.

4.2.4. Discussion—Hypothesis 2

The results indicate that the market recognizes that biotech firms are willing to reinvest available resources in R & D for future sustainable growth opportunities and consequently evaluates the firms positively, supporting Hypothesis 2. Shareholders may expect a bigger return in the long-term rather than immediate, small profits. The implications of the results are in line with recent R & D related research results [76–78]. Ravšelj and Aristovnik [76] indicate the positive impact of R & D subsidies on firm performance using Slovenian companies. Ravšelj and Aristovnik [77] also prove that private R & D spending and tax incentives for R & D have a positive impact on the sustainable growth of companies in 14 Organization for Economic Cooperation and Development (OECD) countries. Moreover, Shin et al. [78] show there is improved performance in technological innovation of biotech companies that receive R & D subsidies from the government compared to non-subsidized firms.

4.2.5. Regression Results—Hypothesis 2.1

Table 6 presents the regression results for Hypotheses 2-1. The results support Hypothesis 2-1. Again, the market value of a firm is significantly correlated to the control variables; MTB, GROW, and INV are positively correlated, while SIZE and LEV are negatively correlated. As in the prior datasets, the results of robust regression analysis are consistent with the OLS results for the main explanatory variables. Exceptionally, the positive association between biotech firm's stock dividends and market value is not significant in the results of robust regression.

Table 6. Regression results.

Variables	Expected Sign	Dependent Variable: *TQ*	
		OLS Regression	Robust Regression
Constant	?	0.1078 (0.41)	0.1078 (0.46)
HcashNdiv	−	−0.1037 *** (−2.81)	−0.1037 *** (−3.61)
HcashNdivbio	+	0.4860 *** (3.72)	0.4860 * (−1.71)
HCNDstdivbio	+	4.0254 ** (3.86)	4.0254 (1.15)
SIZE	+/−	−0.0279 ** (−2.89)	−0.0279 ** (−2.94)
LEV	−	−2.5446 *** (−22.83)	−2.5446 *** (−26.27)
GROW	+	0.6258 *** (72.90)	0.6258 *** (22.29)
MTB	+	0.9166 *** (71.35)	0.9166 *** (44.80)
INV	+	1.1451 *** (29.48)	1.1450 *** (9.36)
Industry dummies		Included	Included
Year dummies		Included	Included
F value		1028.53 ***	161.17 ***
Adjusted R^2		0.6306	0.6312
N		21,673	21,673

Note: See Table 2 <Panel B.> for variable definitions. t-values are shown in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4.2.6. Discussion—Hypothesis 2.1

For biotech firms, declarations of stock dividends would be a way to solve asymmetric information problems by reducing the agency conflicts without consuming cash. Based on "signaling hypothesis" [79], firms can deliver a positive signal about the firm's prospects by declaring stock dividends, and there may be positive stock price reactions. The results may also have "retained earnings hypothesis" [80–82] and "attention hypothesis" [81–84] implications. Although stock dividend declaration reduces retained earnings, this is rather perceived as a strong confidence in a firm's future profitability improvement. By attracting market attention, firms can make it an opportunity for revaluation of their future cash flows. The results for biotechnology companies are likely to more prominently confirm the theories. The market seems to have the utmost confidence in how the available resources will be used and will result in sustainable future growth.

4.3. Results of Heteroskedastic Panel Regressions

Panel data analysis offers a more precise inference of model parameters and pools information to produce more precise predictions of individual outcomes and confident outcomes [85]. However, panel data heterogeneity may lead to misspecification problems and inconsistency. Therefore, for verifying the hypothesis of the study, the heteroskedastic panel regressions are conducted. Table 7 Panel A is used to reexamine cash dividend payout ratio and R & D intensity of a firm with high levels of cash, and both Panels B and C are used to reconsider how the firms that do not distribute cash dividends despite high cash availability are associated with market value. As shown in Table 7 Panels A–C, the findings are compatible with OLS results for the main explanatory variables. Exceptionally, the positive association between a biotech firm's stock dividends and market value is not significant in the results of heteroskedastic panel regressions.

Table 7. Fixed effect regression results.

<Panel A.>		
Variables	**Expected Sign**	**Dependent Variable:** ***Cash Dividend Payouts***
		Heteroskedastic Panel Regression
Constant	?	0.0027 ** (2.22)
RD	−	−0.0005 *** (−2.90)
RDHcash	+	0.0013 *** (6.26)
RDHcashbio	+	0.0010 * (1.77)
Tangible	−	−0.0030 *** (−7.32)
MTB	+	0.0012 *** (12.96)
SIZE	+/−	−0.0010 *** (−8.46)
ROA	+	0.0376 *** (54.62)
Lnsales	+	0.0011 *** (10.71)
Liquidity	+	0.0001 *** (3.03)
Industry dummies		Included
Year dummies		Included
Wald chi^2		4663.16 ***
R^2		0.234
N		18,253

<Panel B.>		
Variables	**Expected Sign**	**Dependent Variable:** ***TQ***
		Heteroskedastic Panel Regression
Constant	?	0.1093 (0.42)
HcashNdiv	−	−0.1039 *** (−2.90)
HcashNdivbio	+	0.5434 ** (2.01)
SIZE	+/−	−0.0280 *** (−2.47)
LEV	−	−2.5457 *** (−25.18)
GROW	+	0.6257 *** (45.44)
MTB	+	0.9172 *** (52.79)
INV	+	1.1454 *** (17.85)
Industry dummies		Included
Year dummies		Included
Wald chi^2		15598.54 ***
R^2		0.6309
N		21,673

<Panel C.>		
Variables	**Expected Sign**	**Dependent Variable:** ***TQ***
		Heteroskedastic Panel Regression
Constant	?	0.1078 (0.42)
HcashNdiv	−	−0.1037 *** (−2.89)
HcashNdivbio	+	0.4860 * (1.82)
HCNDstdivbio	+	4.0254 (1.11)
SIZE	+/−	−0.0279 ** (−2.46)
LEV	−	−2.5446 *** (−25.18)
GROW	+	0.6258 *** (45.45)
MTB	+	0.9166 *** (52.86)
INV	+	1.1451 *** (17.85)
Industry dummies		Included
Year dummies		Included
Wald chi^2		15601.33 ***
R^2		0.6312
N		21,673

Note: See Table 2 <Panel B.> for variable definitions. t-values are shown in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4.4. Additional Analyses

Additionally, logit regressions are conducted to examine whether firms in their "R & D mature stage" [25,84] or their "maturity stage in corporate life cycle" [84] distribute cash dividends. The mature stage is described as the steady state of the R & D intensity of a company following the classification of Oswald [84]. The steady state is described as the state where the amount of capitalized R & D is similar in magnitude to the amount of amortization. Alternatively, firms in a steady state are defined as firms that capitalize R & D spending only to maintain the current level of capitalized R & D. Dickinson [86] introduces five life cycle stages: Introduction, Growth, Maturity, Shake-Out, and Decline, based on cash flow patterns. Dickinson [84] uses positive or negative signs of three cash flow activities, such as operating, investing, and financing. The maturity stage is defined if operating cash flow takes a positive sign, investing cash flow takes a negative sign, and financing cash flow takes a negative sign.

As can be seen in Table 8, the correlation between cash dividend payout and mature stage is significantly positive ($p < 0.01$). Firms in an "R & D steady state" or the "maturity stage in corporate life cycle" tend to distribute cash dividends.

Table 8. Regression results.

Variables	Dependent Variable: *Cash Dividend Payouts*	
	Logit Regression	
Constant	−12.7695 *** (−35.97)	−12.4620 *** (−34.94)
Mature	0.4110 *** (12.05)	-
Maturebio	0.3579 *** (3.78)	-
LCmature	-	0.5436 *** (15.67)
LCmaturebio	-	0.5904 *** (4.63)
Tangible	−0.4148 *** (−4.54)	−0.4655 *** (−5.09)
MTB	−0.0444 *** (−5.66)	−0.0472 *** (−5.96)
SIZE	0.3799 *** (13.90)	0.4002 *** (14.57)
ROA	9.6082 *** (41.72)	9.1295 *** (39.71)
Lnsales	0.2682 *** (10.63)	0.2456 *** (9.71)
Liquidity	0.0260 *** (6.52)	0.0230 *** (6.23)
Industry dummies	Included	Included
Year dummies	Included	Included
Chi−Square	7022.51 ***	7160.11 ***
Pseudo R^2	0.2217	0.2260
N	22,954	22,954

Notes: *Mature*: coded as 1 if the difference between the amount of R & D capitalized and the amount amortized is less than the median and 0 otherwise. *Maturebio*: dummy variable for mature biotech firm. *LCmature*: coded as 1 if a firm is in its maturity stage in corporate life cycle and 0 otherwise. Mature if Operating Cash Flow > 0, Investing Cash Flow < 0, and Financing Cash Flow < 0. *LCmaturebioh*: LCmature dummy variable interaction term with biotechnology dummy variable. See Table 2 <Panel B.> for variable definitions. t-values are shown in parentheses. *** $p < 0.01$.

5. Conclusions

In emerging markets, biotech industries face a number of difficulties due to the shifting landscape of the global biotechnology market. The environment of rapidly changing technologies, competitors, and customers' rewards biotech firms that consistently invest in R & D [75]. In response, biotech firms invest substantial amounts of money in R & D in order to gain competitive advantages over competition and achieve future profitability. However, since many R & D projects require constant financing and take a long time to complete, firms cannot generate enough profit to offset the high cost of R & D if they depend solely on large-scale external financing. This is driving the long-term financing model of biotech firms away from external financing, such as debt and equity, toward the low-cost policy of internal financing. Still, research on the dividend payout policies of biotech firms is scarce.

In this study, we find that dividend payouts are significantly negatively correlated to the level of R & D intensity of biotech firms. Furthermore, since R & D is generally unrecognized, and estimates of future profits are rarely reported, firms with a higher level of R & D intensity are also likely to have higher information asymmetry between management and outside investors. This results in an increase in the cost of external financing, which means that biotech firms with sufficient cash holding are incentivized to finance internally. As we predicted, this policy leads to lower dividend payouts among firms with a high level of R & D intensity, even after controlling for other factors. We also predicted that biotech firms that require continual internal financing would be evaluated positively, since investors understand that those firms are willing to invest in R & D, which promotes future sustainable growth opportunities. Even after controlling for different testing methods of robust regression, the findings are robust.

This study offers multiple contributions to the collection of literature. First of all, it explores the negative consequences of R & D intensity. By utilizing a new measure of dividend payout, we advance the debate regarding what impact R & D intensity has on the profitability and the value of a firm. Our results should also be of interest to investors who evaluate biotech firms. Investors outside of Korea, for example, may more efficiently evaluate different financing techniques, as financing decisions can affect the long-term sustainability of a firm. This study can be exerted by future research that investigates other emerging markers using other proxies for consequences of R & D. Second, this study provides an insightful understanding on the influence of intra-industry variations on dividend payout policy and firm value. Korea BIO reports that 281 of the 926 (30.3%) biotech companies have documented either no or almost no profits, and 343 (37.0%) of those firms are yet to reach the breakeven point (Korea Biotechnology Industry Organization). Nonetheless, the growth rate of biotech companies can be implausible, and researchers consider their stock prices to be overestimated in spite of their low fundamentals. Thus, to recognize this inconsistency, regulatory bodies and capital investors should appreciate the behaviors of biotech firms, as empirically displayed in this paper, and consider methods to support their long-term sustainability and profitability. Finally, even if prior literature explores the relation between R & D intensity, external financing, and ultimate firm value mostly by concentrating on developed nations such as the European Union (EU) and the United States (US), there is scarce evidence reporting from emerging markets such as South Korea because of the discrepancies in the growth rate of the biotech industry. This study can fill this gap by recording the diverse form of investment financing for R & D activities in biotech firms.

Caution should be made when evaluating the dividend policy of R & D intensive biotech firms. For example, notwithstanding the fact that concentrating on the biotech industry can provide a powerful setting to examine research issues, it can also confine the generalization of the empirical outcomes to other industries. Moreover, even though this paper includes robust regression, there could be possible problems regarding the omitted variables. We cannot fully measure R & D intensity because R & D intensity is subject to be influenced by the management discretionary estimation on R & D activity. Nonetheless, this study still gives profound understanding to the prior studies through its investigation of the relation between R & D and dividend payout, dividend types, and firm value of biotech firms by comparing them with the behaviors of non-biotech firms. Additionally, it is crucial to consider the distinctive settings of South Korea, where financial regulatory bodies have recently executed new plans to support the R & D of biotech firms. Administrative authorities are now focused on error adjustment rather than penalty, which encourages possible development of that industry.

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