

Research Article

The Different Effects of Firm Resources on Firm Performance under Volatility: An Examination Using Big Data

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According to the resource-based view, research and development (R&D) and advertising are critical resources firms use to improve their performance. This study aims to clarify the different effects of R&D and advertising on firm performance using distinct criteria—firm value and firm profitability. It also verifies whether the effects of R&D and advertising apply in a volatile environment. We run panel data regression models with a big data sample of manufacturing firms publicly listed on the Korea Composite Stock Price Index over an extended period of 27 years. We find that R&D has more positive effects on firm value than advertising, while advertising has more positive effects on firm profitability than R&D; these relationships are consistent even when volatility is considered. This suggests that firms should mix and match their investments between R&D and advertising resources for improved effectiveness and efficiency, and these resources should be accumulated and exploited consistently regardless of environmental dynamics.

1. Introduction

The resource-based view (RBV) indicates that firms develop and exploit their own resources to generate and sustain a competitive advantage [1]. Barney [1] introduced four empirical indicators for these resources: they are ‘valuable, rare, inimitable, and nonsubstitutable.’ Two key resources, research and development (R&D) and advertising, satisfy the characteristics of resources that generate a sustained competitive advantage [2–5]. As a source of innovation, R&D activities can lead a firm to develop new products for customers or upgrade existing products, while advertising activities enhance a firm’s marketing communications, create brand recognition, and build reputation [3]. Therefore, these two resources have been recognized as key resources that allow firms to differentiate and improve firm performance. How do these two resources differ? What are the different roles R&D and advertising play in firm performance?

Although previous studies have compared R&D and advertising, they primarily use one criterion for firm

performance and try to clarify the differences between the two resources in terms of their level of intensity in various industries (e.g., [3, 4]). This study uses different firm performance criteria—firm profitability and firm value—and compares the different effects on firm performance. It further investigates whether these resources maintain their effects in highly volatile environments. When faced with economic fluctuations and volatility, some firms treat R&D and advertising investments as aspects that can be postponed or reduced to address short-term liquidity. This study also examines whether it is appropriate for firms to slash R&D and advertising budgets in an unexpected environment. In today’s era of uncertainty, research on such issues is urgently needed, and it is possible to provide useful tips for firm survival. Thus, we perform an empirical analysis to reexamine the role R&D and advertising resources play in firm performance, while considering environmental volatility.

The RBV is a foundational and seminal theory that is widely disseminated in management science, and it is intertwined with three management research streams: the

traditional strategy perspective, the organizational economics paradigm, and industrial organizational research [6]. Accordingly, the RBV has contributed significantly to building foundations for various new follow-up theories, such as the organizational capability and dynamic capability views [7]. A few studies have conducted in-depth evaluations of the RBV, pointing out that it needs further development (e.g., [7, 8]). Priem and Butter [7] insist that the RBV needs to address black-box issues such as the processes through which resources are transformed into capabilities, how these resources improve firm performance, how various resources interact inside firms, and so on. Under the RBV, R&D and advertising are recognized as the proper resources for firms to promote for a sustainable competitive advantage. Thus, the idea that R&D and advertising generally enhance firm performance has garnered widespread support (see [7–11]). However, research is lacking on how the roles of R&D and advertising differ with respect to firm performance. This study investigates the underlying RBV processes through an in-depth analysis of the nature of a firm. We disclose two dimensions of firm performance and investigate the different roles R&D and advertising resources play in these dimensions. Furthermore, this study includes environmental volatility to examine whether it shifts the impacts of the resources. Therefore, it synthesizes the RBV with related theories such as the organizational and dynamic capability views.

South Korea has a market economy that ranked 12th worldwide in 2019 in terms of nominal gross domestic product (GDP). Despite being one of the major G-20 economies, it lacks natural resources and has a rather small domestic consumption market; thus, South Korea promotes an export-oriented policy. Currently, the country is highly dependent on trade, with the highest export-to-GDP ratio among the G-20 countries. Due to its export-oriented and open economic structure, South Korea experiences substantial economic volatility influenced by the global economic cycle. Two of the world's most devastating financial crises hit its economy hard: the country came close to a national bankruptcy because of the 1997 Asian financial crisis and experienced a sharp decline in international trade during the 2008 global financial crisis. Therefore, the Korean context provides an appropriate research setting for investigating the effects of key resources in the context of substantial volatility.

This study contributes to the strategic management literature and further develops the RBV, as it reexamines the RBV and particularly investigates its underlying processes in depth. We restrict the examined resources to R&D and advertising to simplify the research model, avoid interference from too many resources, and investigate their dynamic effects on firm performance. We especially contribute to discovering the contrasting effects of R&D and advertising on firm performance when it is classified into two dimensions: firm value and firm profitability. Our results imply that R&D and advertising in substance have a mutually dependent relationship in improving overall firm performance. We also reflect environmental volatility as an important factor in this analysis and observe how the effects of R&D and advertising are affected by volatility. Finally, we

use a large dataset of manufacturing firms that are publicly listed on the Korea Composite Stock Price Index (KOSPI) over an extensive period from 1993 to 2019. We believe that the findings from our empirical analysis are generalizable and adequately reflect environmental dynamism.

The next section reviews and analyses the RBV and other related theories. In particular, we investigate the nature of firms and lay the foundation for developing our hypotheses. The relevant hypotheses are formulated by closely following the reviewed theories. We then describe the dataset and statistical methods used to test the hypotheses. Our interpretation of the empirical results leads to discussions of the study's theoretical contributions and practical implications. Finally, we discuss the study limitations and provide directions for future research.

2. Theory and Hypotheses

2.1. Resource-Based View. Seminal works on the RBV literature include Wernerfelt [12] and Barney [1]. Upon analysing firms' diversification strategies from the perspective of resources, Wernerfelt [12] insists that firms should pay attention to their own resources, while many scholars at that time asserted that firm management should focus on products or external opportunities and threats. Barney [1] provides a more detailed resource-based perspective at the business level. He maintains that organizational resources that satisfy four attributes—(1) valuable, (2) rare, (3) difficult to imitate, and (4) nonsubstitutable—can create a sustained competitive advantage [1]. Such resources are mainly intangible, including R&D and marketing resources, rather than tangible resources like buildings and machines.

Wernerfelt [12] and Barney [1] laid the foundation for many RBV studies [13–15], and the development of RBV research relates to three major management research streams: strategy, organizational economics, and industrial organization [6]. To gain an in-depth understanding of the RBV, we review the interrelationships among these fields of study. First, the RBV is useful in explaining firm performance, an area of considerable focus in the strategic management field, thus making it an important theory in strategic management. Firms with heterogeneous resources make distinctive strategic choices and create different economic rents, ultimately leading to sustained competitive advantages in their industries [1, 15].

The RBV is also closely associated with the organizational economics paradigm [16]. The theories from these two research fields share the same background of the neoclassical theory of the firm [6]. The fields both found that the neoclassical theory of the firm has limitations, as it neglects the following points: transaction costs, bounded rationality, technological uncertainty, organizational learning, and price as a signal of quality [6]. Studies of the RBV and the organizational economics paradigm have tried to overcome these limitations. The RBV is fundamentally linked to the organizational economics paradigm, as both emphasize 'firm-specific' and 'distinctive competencies' based on resources [16].

The RBV also relates to industrial organization research. While industrial organization research places importance on firms' external market environments and industry structures [17, 18], the RBV focuses on firms' internal aspects and resources. However, these two streams both involve product or resource constraint issues [12], and both pursue the same fundamental goal of rent generation.

The RBV is a cornerstone in the field of management; it has influenced various studies and is closely interrelated with other mainstream management fields. To make the RBV even more useful in strategic management research, acknowledging rigorous critiques can help overcome its limitations. Our study aims to contribute to further developing the RBV in this sense. The RBV contends that firms can attain a competitive edge from resources that are heterogeneous, scarce, and difficult to replicate [1]. Such arguments draw criticism of the RBV in that it does not pay much attention to the process or dynamism influenced by environmental factors [19]. Firms cannot be isolated from external factors, all of which affect their internal factors. As such, the RBV needs to address the process black box, that is, the question of how, for example, resources generate sustainable competitive advantages apart from the effect of heterogeneity, how resources interact with other resources, and how resources respond to external environments [7]. This recognition brings attention to the paradigm of organizational capability and the dynamic capability view.

The organizational capability view departs from knowledge-based resources, insisting that such resources are developed into capabilities that do not remain stationary inside firms [20, 21]. Rather, this view emphasizes the dynamism and interactive process between internal and external factors that turn resources into capabilities. The organizational capability view is consistent with the dynamic capability view. The seminal work by Teece et al. [22] points out that dynamic capability focuses on adjusting to the external environment by integrating, building, and reconfiguring the firm's internal resources. Thus, dynamic capability is said to be developed within the stream of the RBV. Meanwhile, other scholars contend that the dynamic capability view belongs to the evolutionary economic stream, especially reflecting the Schumpeterian "capability building" theory. However, these capabilities, after all, come from strategically using, integrating, and reconfiguring resources; thus, some studies of the RBV share the terms "resource" and "capability." Regarding resources, this study also embraces the concept that resources are developed into capabilities through integration, reconfiguration, and so on and monitors how the effects of resources interact with environmental volatility.

2.2. Firm Performance. Firm performance is an important topic and goal in management science. Accordingly, various management scholars have studied the relationship between their fields of expertise and firm performance. In particular, strategic management research focuses on firm performance, so the related research topics mainly consist of rent-seeking behaviours [23]. Well-known related literature includes

Chandler's diversification strategy [24], Porter's competition strategy [25], and Pearce et al.'s corporate strategic plan [26]. These studies have all conducted in-depth research on the relationship between various strategies and firm performance. Nevertheless, why is the topic of firm performance important? What is the nature of firm performance? Here, we disclose the hidden dimensions of firm performance.

Firm performance, by nature, is related to firm survival. Firms that sustain and survive should satisfy value > price > cost [27].

Fundamentally, firms produce products, sell these products to customers, and receive the price for their survival. To be successful in competition, firms should not only satisfy their customers, but also gain sufficient rewards. Meanwhile, customers buy products only when they perceive that the value of the offered products is higher than the price they pay for the products [28]. As shown in the above inequalities, this logic is reflected on the first inequality. If customers do not perceive the value that the products deserve, no matter how much effort firms put into making the products, they may lose their customers. Thus, this determines the effectiveness of firms according to how firms realize the first inequality [29].

On the producers' side, firms can survive only when the price of products is higher than the cost of the products, and this logic is reflected on the second inequality. Thus, the necessary condition for firms' survival is to increase the price or decrease the cost of production. Firms will be shunned by their customers if product prices become exorbitant because the cost increases due to inefficiencies. Thus, whether firms perform well for the second inequality depends on their efficiency [30]. Furthermore, as each firm has limited resources, efficiency is the solution to the problem of resource limitation to improve or maintain firm performance.

Overall, firms must simultaneously achieve both the inequalities; otherwise, they cannot survive, especially in the longer term. Thus, to improve firm performance to achieve sustainability or survive, firm management should consider these two dimensions simultaneously. First, firms should increase the difference between value and price (V-P) as much as possible. This represents firm value and symbolizes firm effectiveness [25]. Second, firms should increase the difference between price and cost (P-C) as much as possible, which represents firm profitability and symbolizes firm efficiency [31].

In this study, we investigate the relationship between resources and firm performance; thus, our focus is on observing how resources influence the two dimensions or categories of firm performance. Only when resources have positive effects on both the value and profitability of a firm do such resources conform to the RBV. However, we expect different effects on value or profits depending on the type of resource. In this study, we restrict our investigation to R&D and advertising resources to simplify the research model and framework.

2.3. R&D and Advertising Resources. R&D and advertising are the key resources implicated in the RBV. However, firms

must spend money to accumulate R&D and advertising resources, and current accounting rules for such expenses mean that they have an immediate negative impact on financial performance. Accordingly, firm management is prompted to cut R&D or advertising investments under adverse conditions.

Many studies have found that R&D and advertising resources, as intangible resources, contribute to firm performance. However, some studies are biased towards the finance perspective when analysing R&D and advertising effects [3–5]. Our study addresses this limitation by performing an in-depth analysis of the effects of these resources in conjunction with strategic management theories. The features of intangible resources include tacitness (hard to codify) and immobility (not easily traded) because of imperfect market factors. Hence, intangible resources satisfy the characteristics of ‘valuable, rare, not easily imitable, and nonsubstitutable,’ [1] and accordingly create a competitive advantage. R&D and advertising resources are typical critical intangible resources, as advocated by the RBV [32, 33].

Firm resources can be sorted into three categories: physical, human, and organizational [1]. Organizational resources refer to the capability to organize and coordinate internal resources to produce the desired results. A firm’s objective is to maximize revenue with constrained resources and reinforced competitiveness. This requires a large input of organizational resources. For manufacturing firms, organizational resources help produce attractive products that sell at acceptable prices in the right places and help publicize the products through promotion. R&D and advertising affiliated with organizational resources display these critical roles in such processes.

R&D resources, as intangible resources, can be defined as a firm’s ability to generate new technology or products/services and improve existing technology or products/services to attain certain goals [32]. Thus, these capabilities are also presented as high-quality technological processes or innovations. R&D’s objective is, after all, to satisfy customers’ infinite needs, especially their shifting needs, over time. Even when R&D brings about innovative technology or products/services that customers do not expect, it adds value for them as these items resolve their unexpected difficulties or bring them joy. Thus, R&D realizes firms’ effectiveness, which represents the first inequality in the equation highlighted earlier. Several studies have found a significantly positive relationship between R&D resources and firm performance. For example, Chan et al. [9] have reported that R&D increases stock returns. Lev and Sougiannis [10] have shown that R&D increases market value, while Kotabe [11] has shown that R&D improves profitability. Admitting that it is within the same context of firm performance improvement, this study conjectures that R&D is biased towards improving firm value, which is closely associated with customers’ perceived value.

Advertising is firms’ second most important organizational resource. Advertising resources can be defined as the capability or process of integrating and designing a firm’s related knowledge, skills, and resources to lead a strong orientation towards markets, consumers, and competitive

demands [34]. Market-oriented advertising can enhance firm performance [35–37]. Advertising allows firms to develop brands for their products and services and form market barriers against rival firms. Advertising realizes product differentiation, which leads to price differentiation for firms; accordingly, it improves efficiency to overcome resource limitations. Advertising sets out the firm’s communication strategy to create brand equity by promoting ideas, goods, or services. The targeted result is to ensure that consumers willingly pay the price that firms deserve. Even if firms develop more innovative and wonderful products through R&D resources, they cannot add price premiums and expand their target market without exploiting advertising resources.

Therefore, we hypothesize that R&D (advertising), as a resource, has a greater impact on firm value (firm profitability) than advertising (R&D):

- (i) H1 : compared with advertising resources, R&D resources have a more positive impact on firm value
- (ii) H2 : compared with R&D resources, advertising resources have a more positive impact on firm profitability

2.4. Environmental Volatility. Environmental volatility refers to the external environment’s instability and turbulence. It comes from economic change, political events, and/or changes in the industry structure, which lead to changes in customers’ preferences, technological uncertainty, and industrial competition structure/strength [38]. Thus, it can increase firm unpredictability and cause a substantial number of products to fall into disuse or lead to the inability to procure certain materials, leaving an unresolved gap in supply and demand. When confronting such environmental fluctuations and volatility, firms should quickly adjust or reconfigure their value chain; however, many firms fail to adapt to such environmental changes and suffer serious damage [39]. Meanwhile, some firms successfully overcome such difficulties using their own resources or capabilities. Therefore, the question arises as to whether a completely new resource or capability is needed to overcome environmental volatility or whether the existing resources or capabilities are sufficient in the face of such environmental changes. The critics of the RBV argue that it does not provide a good explanation of the effects resources have on firms in a fluctuating environment due to its rather static approach [22, 40]. This study aims to contribute to developing the RBV to overcome such limitations.

In situations of environmental stability vis-à-vis environmental volatility, resources seem to have a more positive impact on firm performance. Some studies insist that environmental change/volatility has a detrimental effect on firm performance [39, 41], while others argue that it strengthens the positive relationship between resources and firm performance [40, 42]. When an environmental change happens, the balance between supply and demand will be disturbed by technological uncertainty or changes in consumer tastes. Although these environmental changes generally have adverse impacts on firm performance, when

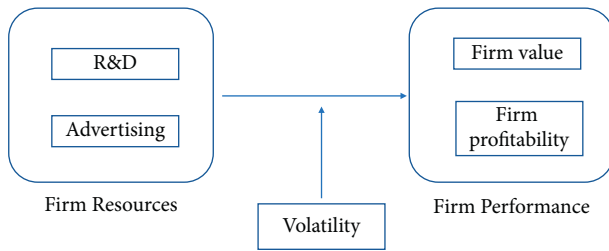


FIGURE 1: Relationships among the relevant factors in this research.

firms correctly predict an environmental change and prepare new products or services at the appropriate time, they can overcome such crises. They may even improve firm performance with an adequate price offered to the right customers. Some critical resources such as R&D and advertising may help firms relish these challenges and even reverse a downward trend.

While the business environment is full of fluctuations, firms are concerned that as consumers reduce or delay purchases, the firms will be unable to achieve their expected sales or profits even if they invest considerable money in R&D and advertising [43]. However, the opposite view is that, even in a greatly fluctuating environment, resources are valuable and helpful [42]. It is argued that firms can produce differentiated products to satisfy consumers' specific needs and implement active communication with consumers through R&D and advertising resources, even in a volatile environment, leading to a sustainable increase in firm value and profitability. Therefore, we suggest conservatively that economic volatility does not decrease the effects of R&D and advertising resources on each dimension of firm performance:

- (i) H3: the impact of R&D resources on firm value is not reduced in a volatile environment
- (ii) H4: the impact of advertising resources on firm profitability is not reduced in a volatile environment

This study investigates the outward relationship between firm resources and firm performance, while we dig into the inside details of the constructs of firm resources and firm performance. We select R&D and advertising, which are two of the critical firm resources, and firm profitability and firm value, which are two distinct firm performance criteria. The first and second hypotheses depict the dynamic relationships of these factors. In addition, we add volatility to the relationships as proposed in the third and fourth hypotheses. Figure 1 illustrates a general outline of the relationships among the relevant factors in our research.

3. Data and Methodology

3.1. Data Collection. The data were obtained from the KisValue Database of the Korea NICE Holdings Company. From this database, we construct a data sample that includes manufacturing firms publicly listed on the KOSPI for the period 1993–2019, making it appropriate for panel data analysis. The sample consists of 447 firms, comprising 8,071 firm-year observations. The reason this study limits the

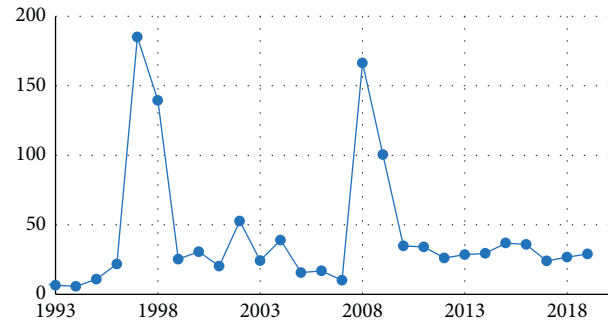


FIGURE 2: Volatility trend of the exchange rates from 1993 to 2019.

research data to manufacturing firms publicly listed on the KOSPI is that only manufacturing firms make relatively even investments in R&D and advertising [6, 11], and only KOSPI firms provide market value data, which is needed to calculate firm value.

3.2. Variables and Measurements. The independent variables are R&D and advertising resources, which are measured as the intensity of such resources for the firm's sales. R&D (advertising) intensity is defined as the ratio of R&D (advertising) expenditure to a firm's total net sales. To control for factors that may affect firm performance, we select the following firm-level control variables: firm size, age, and export-related variables. Firm size indicates a firm's workload, which can affect its performance [44]. Firm size can be measured by two variables; one is the logarithm of a firm's number of employees, and the other is the logarithm of firm assets. In previous empirical studies, the effects of firm size on firm performance have been found to be both positive and negative, since they may depend on the different cases. Firm age points to a firm's experience level and generally has positive effects on firm performance. Firm age is measured by the length of a firm's existence (in years) since it was established to the time of observation.

As South Korea has an export-oriented economy, its firms generally have export sales and expenditures. As export-related variables may also impact firm performance, we control for the export ratio and overseas sales expenditure. A firm's export ratio is measured as its export sales divided by its total net sales. When a firm's export ratio increases, it means the firm's business scope may have expanded to more foreign markets. Consequently, the export ratio may have a negative relationship with firm performance because an expanded business scope indicates an increased workload and higher coordination costs, which may harm firm performance [45]. We also control for overseas sales expenditure, measured by the ratio of overseas sales expenditure to the firm's total net sales, and expect the same negative sign as with the export ratio.

Each year's economic volatility is calculated as the standard deviation of the year's daily exchange rates between the Korean won and the U.S. dollar, which follows the measurement used in previous studies [46, 47]. The variance in the daily exchange rates can reflect economic volatility, especially in relation to the international economy. Figure 2

shows the trend of the exchange rate volatility, which is very high during both the 1997 and 2008 financial crises—two of the world's most devastating financial crises in history. When we include the exchange rate volatility, we also control for the yearly mean exchange rate in the relevant year.

The dependent variables in this study represent two categories of firm performance: firm value and firm profitability. Firm value (firm profitability) is measured using Tobin's Q (return on assets [ROA]). Tobin's Q captures firm value, measured by the ratio of the market value of all assets owned by a firm to the replacement value of book assets [48]. A higher Tobin's Q means higher firm value. As a common measurement for firm profitability, ROA reflects a firm's profitability relative to its total assets and thus refers to the degree to which a firm manages its assets efficiently to generate earnings [49, 50].

3.3. Data Analysis Method. Equations (1)–(9) are the regression models used in this study.

$$Q_{i,t} = \alpha_0 + \alpha_1 RD_{i,t} + \alpha_2 AD_{i,t} + \alpha_3 Asset_{i,t} + \alpha_4 Emp_{i,t} + \alpha_5 Age_{i,t} + \alpha_6 Expratio_{i,t} + \alpha_7 OverseasExp_{i,t} + \varepsilon_{i,t}, \quad (1)$$

$$P_{i,t} = \alpha_0 + \alpha_1 RD_{i,t} + \alpha_2 AD_{i,t} + \alpha_3 Asset_{i,t} + \alpha_4 Emp_{i,t} + \alpha_5 Age_{i,t} + \alpha_6 Expratio_{i,t} + \alpha_7 OverseasExp_{i,t} + \varepsilon_{i,t}, \quad (2)$$

$$Q_{i,t} = \alpha_0 + \alpha_1 RD_{i,t} + \alpha_2 AD_{i,t} + \alpha_3 Vol_t + \alpha_4 Ex_t + \alpha_5 Asset_{i,t} + \alpha_6 Emp_{i,t} + \alpha_7 Age_{i,t} + \alpha_8 Expratio_{i,t} + \alpha_9 OverseasExp_{i,t} + \varepsilon_{i,t}, \quad (3)$$

$$P_{i,t} = \alpha_0 + \alpha_1 RD_{i,t} + \alpha_2 AD_{i,t} + \alpha_3 Vol_t + \alpha_4 Ex_t + \alpha_5 Asset_{i,t} + \alpha_6 Emp_{i,t} + \alpha_7 Age_{i,t} + \alpha_8 Expratio_{i,t} + \alpha_9 OverseasExp_{i,t} + \varepsilon_{i,t}, \quad (4)$$

$$Q_{i,t} = \alpha_0 + \alpha_1 RD_{i,t} + \alpha_2 AD_{i,t} + \alpha_3 RD_{i,t} \times Vol_t + \alpha_4 Vol_t + \alpha_5 Ex_t + \alpha_6 Asset_{i,t} + \alpha_7 Emp_{i,t} + \alpha_8 Age_{i,t} + \alpha_9 Expratio_{i,t} + \alpha_{10} OverseasExp_{i,t} + \varepsilon_{i,t}, \quad (5)$$

$$P_{i,t} = \alpha_0 + \alpha_1 RD_{i,t} + \alpha_2 AD_{i,t} + \alpha_3 AD_{i,t} \times Vol_t + \alpha_4 Vol_t + \alpha_5 Ex_t + \alpha_6 Asset_{i,t} + \alpha_7 Emp_{i,t} + \alpha_8 Age_{i,t} + \alpha_9 Expratio_{i,t} + \alpha_{10} OverseasExp_{i,t} + \varepsilon_{i,t}, \quad (6)$$

$$Q_{i,t} = \alpha_0 + \alpha_1 RD_{i,t} + \alpha_2 AD_{i,t} + \alpha_3 RD_{i,t} \times Vol_t + \alpha_4 AD_{i,t} \times Vol_t + \alpha_5 Vol_t + \alpha_6 Ex_t + \alpha_7 Asset_{i,t} + \alpha_8 Emp_{i,t} + \alpha_9 Age_{i,t} + \alpha_{10} Expratio_{i,t} + \alpha_{11} OverseasExp_{i,t} + \varepsilon_{i,t}, \quad (7)$$

$$P_{i,t} = \alpha_0 + \alpha_1 RD_{i,t} + \alpha_2 AD_{i,t} + \alpha_3 RD_{i,t} \times Vol_t + \alpha_4 AD_{i,t} \times Vol_t + \alpha_5 Vol_t + \alpha_6 Ex_t + \alpha_7 Asset_{i,t} + \alpha_8 Emp_{i,t} + \alpha_9 Age_{i,t} + \alpha_{10} Expratio_{i,t} + \alpha_{11} OverseasExp_{i,t} + \varepsilon_{i,t}, \quad (8)$$

Note: $Q_{i,t}$ is Tobin's Q of firm i in period t ; $P_{i,t}$ is the ROA of firm i in period t ; $RD_{i,t}$ is the R&D intensity of firm i in period t ; $AD_{i,t}$ is the advertising intensity of firm i in period t ; $Asset_{i,t}$ is the natural logarithm of assets of firm i in period t ; $Emp_{i,t}$ is the logarithm of number of employees of firm i in period t ; $Age_{i,t}$ is the length of existence of firm i in period t ; $Expratio_{i,t}$ is the export ratio of firm i in period t ; $OverseasExp_{i,t}$ is the overseas sales expenditure of firm i in period t ; Vol_t is the volatility of exchange rate during period t ; Ex_t is the exchange rate during period t ; $\alpha_1 \dots \alpha_{11}$ is the coefficient of each variable, and α_0 is constant; $\varepsilon_{i,t}$ is the error term.

Equation (1) shows the effects of R&D and advertising resources on Tobin's Q, without considering environmental volatility. Equation (2) shows the effects of the two resources on ROA, also without considering environmental volatility. Equation (3) captures the effects of R&D and advertising resources on Tobin's Q while controlling for the environment-related variables, and (4) captures the effects of the two resources on ROA while controlling for the environment-related variables. Equations (5) and (6) add the interaction between volatility and R&D/advertising resources to the previous corresponding models and show how these effects change. Equations (7) and (8) include both the interaction of volatility and R&D and the interaction of volatility and advertising to capture how the effects of the main resources shift along with the hierarchical regression models. All eight models control for firm size, firm age, and firm export-related variables. The subscript letter i refers to the firm number, and t refers to the observation year. Additionally, $\varepsilon_{i,t}$ denotes each equation's error term, which is assumed to follow a normal distribution. Based on these models, we run panel analytic hierarchical regressions. The variance inflation factor (VIF) values derived from the VIF test are much less than 10, confirming that there is no multicollinearity problem in these regressions, thereby guaranteeing the reliability of the empirical analysis to a certain degree.

4. Results

4.1. Main Results. The descriptive statistics of the variables used in the regressions are shown in Table 1, and Table 2 shows the correlation coefficients of the explanatory and dependent variables. Tables 3 and 4 show the results of the panel analytic hierarchical regressions for the eight models above. In Tables 3 and 4, the overall R^2 increases gradually from Models 1 to 8 as the explanatory variables are added to the regression models one at a time. This means that as the fitted variables are added, the explanatory power increases.

Table 3 presents the regression results with Tobin's Q as the dependent variable. In Model 1, the coefficient of R&D intensity is 7.512, which is positive and significant at the 1% level, while the coefficient of advertising is 0.256 and not significant.

TABLE 1: Descriptive statistics.

	Tobin's Q	ROA	R&D	Advertising	Asset	Employee	Age	Export ratio	Overseas expenditure	Volatility	Exchange rate
Mean	1.074	0.050	0.015	0.017	26.232	6.203	33.168	0.277	0.002	42.980	1,088.287
Standard deviation	0.655	0.070	0.108	0.025	1.525	1.381	16.966	0.292	0.005	45.016	150.394

TABLE 2: Correlation matrix.

	Tobin's q (ROA)	R&D	Advertising	Asset	Employee	Age	Export ratio	Overseas expenditure	Volatility	Exchange rate
Tobin's Q (ROA)	1(1)									
R&D	0.292 *** (-0.038 ***)	1								
Advertising	0.031 (0.109 ***)	0.044 **	1							
Asset	0.051 *** (0.012)	0.034 ***	-0.219 ***	1						
Employee	0.105 *** (0.152 ***)	0.049 ***	-0.126 ***	0.726 ***	1					
Age	-0.076 *** (-0.148 ***)	-0.016	0.110 ***	0.142 ***	-0.003	1				
Export ratio	-0.045 *** (-0.093 ***)	-0.011	-0.312 ***	0.146 ***	0.047 ***	-0.075 ***	1			
Overseas expenditure	0.088 *** (0.033)	0.200 ***	0.040	0.193 ***	0.234 ***	0.132 ***	-0.032	1		
Volatility	-0.071 *** (-0.006)	-0.010	0.032	-0.003	-0.003	-0.015	0.028 **	0.036	1	
Exchange rate	-0.063 *** (-0.086 ***)	0.019 *	-0.025	0.131 ***	0.011	0.092 ***	0.058 ***	0.082 ***	0.301 ***	1

Note. The symbols ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

TABLE 3: Regression results for the dependent variable-Tobin's Q.

Dependent variable: Tobin's Q(t)	Model (1)	Model (3)	Model (5)	Model (7)
R&D(t)	7.512 ***	7.617 ***	9.384 ***	9.596 ***
Advertising(t)	0.256	0.302	0.641	0.0169
R&D(t) × Volatility(t)			-0.048 *	-0.055 *
Advertising(t) × Volatility(t)				0.012
Volatility(t)		-0.000	0.000	-0.000
Exchange rate(t)		-0.000 *	-0.000	-0.000
Asset(t)	0.001	0.006	0.005	0.005
Employee(t)	0.011	0.008	0.008	0.008
Age(t)	-0.004 ***	-0.004 ***	-0.004 ***	-0.004 ***
Export ratio(t)	-0.233 ***	-0.216 **	-0.214 **	-0.210 **
Overseas expenditure(t)	2.257	2.726	3.048	3.066
Constant	1.097 **	1.169 ***	1.165 **	1.180 ***
N	597	597	597	597
Overall R ²	0.165	0.171	0.175	0.176

Note. The symbols ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Therefore, hypothesis 1, that R&D resources have a more positive impact on firm value than advertising resources, is supported. Model 3 adds the control variables—exchange rate volatility and the yearly mean exchange rate—to Model 1; the results show that the coefficient of R&D intensity does not lose its positive significance, and the coefficient of advertising intensity remains insignificant. Model 5 adds the interaction term of volatility and R&D to Model 3, showing that the coefficient of R&D intensity maintains its positive significance, and the coefficient of the interaction term of volatility and R&D is negative (-0.048) and significant at the 10% level. However, this coefficient's magnitude is very small; thus, it nearly loses its economic significance. Model 7 inserts the interaction term of advertising intensity and volatility, and its

results are consistent with those of Model 5. Therefore, volatility does not influence the effects of R&D on firm value. These results support hypothesis 3.

Table 4 presents the regression results with ROA as the dependent variable. In Model 2, the coefficient of advertising intensity is 0.956, which is positive and significant at the 1% level. The magnitude of the advertising coefficient is rather small, and our data sample of manufacturing firms provides a reason. Previous research has found that the advertising effect is relatively small in manufacturing firms compared with nonmanufacturing firms [4]. The coefficient of R&D intensity is -0.142, which is negative and insignificant. Thus, hypothesis 2, that advertising resources have a more positive impact on firm profitability than R&D resources, is supported. Model 4

TABLE 4: Regression results for the dependent variable-ROA.

Dependent variable: ROA(t)	Model (2)	Model (4)	Model (6)	Model (8)
R&D(t)	-0.142	-0.129	-0.131	0.091
Advertising(t)	0.956 ***	0.957 ***	0.925 ***	0.874 ***
R&D(t) × Volatility(t)				-0.006
Advertising(t) × Volatility(t)			0.001	0.003
Volatility(t)		-0.000	-0.000	-8.16e-06
Exchange rate(t)		-0.000	-0.000	-0.000
Asset(t)	0.001	0.002	0.002	0.002
Employee(t)	0.007 ***	0.007 ***	0.007 ***	0.007 ***
Age(t)	-0.001 ***	-0.001 ***	-0.001 ***	-0.001 ***
Export ratio(t)	-0.023 *	-0.021 *	-0.021 *	-0.020 *
Overseas expenditure(t)	-0.287	-0.246	-0.248	-0.214
Constant	0.001	0.006	0.007	0.008
N	634	634	634	634
Overall R ²	0.106	0.108	0.108	0.111

Note. The symbols ***, **, and * stand for significance at the 1%, 5%, and 10% levels, respectively.

TABLE 5: Regression results for the dependent variable-Tobin's Q (one-year lag).

Dependent variable: Tobin's Q(t)	Model (1)	Model (3)	Model (5)	Model (7)
R&D(t-1)	10.610 ***	10.756 ***	11.887 ***	11.630 ***
Advertising(t-1)	0.825	0.745	0.958	1.533
R&D(t-1) × Volatility(t-1)			-0.030	-0.022
Advertising(t-1) × Volatility(t-1)				-0.015
Volatility(t-1)		0.000	0.001	0.001
Exchange rate(t-1)		-0.000	-0.000	-0.000
Asset(t-1)	-0.014	-0.011	-0.011	-0.010
Employee(t-1)	0.030 *	0.028	0.028	0.028
Age(t-1)	-0.005 ***	-0.004 ***	-0.005 ***	-0.004 ***
Export ratio(t-1)	-0.004 ***	-0.003 ***	-0.004 ***	-0.003 ***
Overseas expenditure(t-1)	0.464	0.520	0.710	0.685
Constant	1.321 ***	1.345 ***	1.340 ***	1.322 ***
N	583	583	583	583
Overall R ²	0.257	0.258	0.260	0.260

Note. The symbols ***, **, and * stand for significance at the 1%, 5%, and 10% levels, respectively.

adds the control variables—exchange rate volatility and the yearly mean exchange rate—to Model 2. The coefficient of advertising intensity remains positive and significant, and the coefficient of R&D intensity remains negative and insignificant. Model 6 adds the interaction term of volatility and advertising, and the results show that the coefficient of advertising intensity maintains a positive sign and significance, while the coefficient of the interaction term of volatility and advertising is 0.001 and not significant. Model 8 inserts the interaction term of R&D intensity and volatility, and its results are consistent with those of Model 6. This means that the volatility factor does not influence the effects of advertising on firm profitability. Thus, the results support hypothesis 4.

These results are achieved under the premise that all substantially important firm-level variables are controlled. The signs of these control variables are generally in line with the estimations, but firm age always has negative and significant coefficients, despite their small magnitude. This implies that, in South Korea, firms can achieve better performance and adapt to a dynamically changing environment more easily when firms are younger. The coefficient of the export ratio has a significantly negative sign, as assumed.

4.2. Robustness Tests. We conducted several robustness checks to ensure the reliability of our empirical results. First, we implemented a one-year lag for the independent and control variables, as it may take a certain amount of time for firms to see the effects of R&D and advertising resources for exploration or exploitation on firm performance. Tables 5 and 6 show the one-year lagged regression results, which correspond well with the results in Tables 3 and 4, providing further evidence to support the respective hypotheses. Particularly noteworthy is the result that the coefficient of the interaction term of R&D and volatility lost significance in this robustness test; thus, hypothesis 3 that the effects of R&D resources on firm value are not impacted by a volatile environment is more strongly supported.

As a second robustness test, we use an alternative measurement for volatility; we calculate the annual standard deviation of the daily KOSPI 200. The KOSPI 200 is an index tracking 200 large firms that trade on the Korea Exchange, representing the state of the stock market and South Korea's economy. Thus, the measurement using the KOSPI 200 better reflects the volatility of the Korean domestic economy compared to that of the exchange rate. The KOSPI 200 data in this study cover 2003 to 2016, which is a relatively short timeframe.

TABLE 6: Regression results for the dependent variable-ROA (one-year lag).

Dependent variable: ROA(t)	Model (2)	Model (4)	Model (6)	Model (8)
R&D(t-1)	0.046	0.023	0.033	0.135
Advertising(t-1)	0.802 ***	0.814 ***	0.936 ***	0.913 ***
R&D(t-1) × Volatility(t-1)				-0.003
Advertising(t-1) × Volatility(t-1)			-0.003	-0.002
Volatility(t-1)		-0.000	-3.68e-06	0.000
Exchange rate(t-1)		0.000	0.000	0.000
Asset(t-1)	-0.002	-0.002	-0.002	-0.002
Employee(t-1)	0.008 ***	0.009 ***	0.009 ***	0.009 ***
Age(t-1)	-0.001 ***	-0.001 ***	-0.001 ***	-0.001 ***
Export ratio(t-1)	-0.000 **	-0.000 **	-0.000 **	-0.000 **
Overseas expenditure(t-1)	0.353	0.348	0.353	0.368
Constant	0.072	0.068	0.065	0.065
N	612	612	612	612
Overall R ²	0.123	0.125	0.127	0.128

Note. The symbols ***, **, and * stand for significance at the 1%, 5%, and 10% levels, respectively.

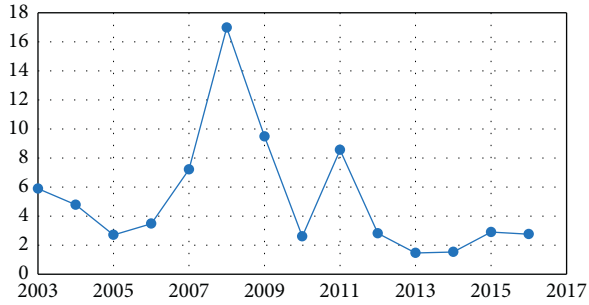


FIGURE 3: Volatility trend of the KOSPI 200 from 2003 to 2016.

Figure 3 shows the KOSPI 200's volatility trend, revealing that the volatility in 2008 is very high, similar to the exchange rate volatility trend. However, we cannot observe the status in 1997 due to limited data. When we include the KOSPI 200 volatility, we also control for the yearly mean of the KOSPI 200 index. For this robustness test, we run the following regression models of equations (9)–(14), replacing the exchange rate volatility with the KOSPI 200 volatility. Tables 7 and 8 report the regression results and show that the main effects are consistent with those in Tables 5 and 6, as the signs and significances are maintained; thus, all the hypotheses are supported.

$$Q_{i,t} = \alpha_0 + \alpha_1 RD_{i,t} + \alpha_2 AD_{i,t} + \alpha_3 Vol_t + \alpha_4 Kospi_t + \alpha_5 Asset_{i,t} + \alpha_6 Emp_{i,t} + \alpha_7 Age_{i,t} + \alpha_8 Expratio_{i,t} + \alpha_9 OverseasExp_{i,t} + \varepsilon_{i,t}, \quad (9)$$

$$P_{i,t} = \alpha_0 + \alpha_1 RD_{i,t} + \alpha_2 AD_{i,t} + \alpha_3 Vol_t + \alpha_4 Kospi_t + \alpha_5 Asset_{i,t} + \alpha_6 Emp_{i,t} + \alpha_7 Age_{i,t} + \alpha_8 Expratio_{i,t} + \alpha_9 OverseasExp_{i,t} + \varepsilon_{i,t}, \quad (10)$$

$$Q_{i,t} = \alpha_0 + \alpha_1 RD_{i,t} + \alpha_2 AD_{i,t} + \alpha_3 RD_{i,t} \times Vol_t + \alpha_4 Vol_t + \alpha_5 Kospi_t + \alpha_6 Asset_{i,t} + \alpha_7 Emp_{i,t} + \alpha_8 Age_{i,t} + \alpha_9 Expratio_{i,t} + \alpha_{10} OverseasExp_{i,t} + \varepsilon_{i,t}, \quad (11)$$

$$P_{i,t} = \alpha_0 + \alpha_1 RD_{i,t} + \alpha_2 AD_{i,t} + \alpha_3 AD_{i,t} \times Vol_t + \alpha_4 Vol_t + \alpha_5 Kospi_t + \alpha_6 Asset_{i,t} + \alpha_7 Emp_{i,t} + \alpha_8 Age_{i,t} + \alpha_9 Expratio_{i,t} + \alpha_{10} OverseasExp_{i,t} + \varepsilon_{i,t}, \quad (12)$$

$$Q_{i,t} = \alpha_0 + \alpha_1 RD_{i,t} + \alpha_2 AD_{i,t} + \alpha_3 RD_{i,t} \times Vol_t + \alpha_4 AD_{i,t} \times Vol_t + \alpha_5 Vol_t + \alpha_6 Kospi_t + \alpha_7 Asset_{i,t} + \alpha_8 Emp_{i,t} + \alpha_9 Age_{i,t} + \alpha_{10} Expratio_{i,t} + \alpha_{11} OverseasExp_{i,t} + \varepsilon_{i,t}, \quad (13)$$

$$P_{i,t} = \alpha_0 + \alpha_1 RD_{i,t} + \alpha_2 AD_{i,t} + \alpha_3 RD_{i,t} \times Vol_t + \alpha_4 AD_{i,t} \times Vol_t + \alpha_5 Vol_t + \alpha_6 Kospi_t + \alpha_7 Asset_{i,t} + \alpha_8 Emp_{i,t} + \alpha_9 Age_{i,t} + \alpha_{10} Expratio_{i,t} + \alpha_{11} OverseasExp_{i,t} + \varepsilon_{i,t}. \quad (14)$$

Note: Vol_t is the volatility of the KOSPI 200 in period t ; $Kospi_t$ is the mean of the KOSPI 200 in period t .

As a third robustness test, we use another alternative measurement for volatility by calculating the standard deviation of the annual corporate bond daily market interest rate. Previous research has reviewed use of this measurement as the volatility of the domestic economy [51]. In this study, the corporate bond market interest rate data cover the period 1995–2020, and the trend during the period is presented in Figure 4. The volatility in 1997 and 1998 is very high, which corresponds to that of the exchange rate volatility. However, the volatility in 2008 is not as high as the exchange rate volatility. This may be because South Korea's domestic economy did not sustain much damage from the 2008 financial crisis. When we include the corporate bond market interest rate volatility variable, we also control for the yearly mean of the corporate bond market interest rate. Tables 9 and 10 repeat the regressions used in Equations (15)–(20) shown below, replacing the KOSPI 200

TABLE 7: Regression results for the dependent variable-Tobin's Q (KOSPI 200 volatility).

Dependent variable: Tobin's Q(t)	Model (9)	Model (11)	Model (13)
R&D(t)	5.465 ***	7.368 ***	7.371 ***
Advertising(t)	6.237 **	6.970***	6.959*
R&D(t) × Volatility(t)		-0.534	-0.535
Advertising(t) × Volatility(t)			0.002
Volatility(t)	0.005	0.015	0.015
KOSPI 200(t)	-0.013	-0.013	-0.013
Asset(t)	0.043	0.037	0.043
Employee(t)	0.021	0.019	0.019
Age(t)	-0.007 ***	-0.007 ***	-0.007 ***
Export ratio(t)	-0.313	-0.290 *	-0.290*
Overseas expenditure(t)	-5.242	-4.375	-4.375
Constant	0.406	0.357	0.357
N	255	255	255
Overall R ²	0.217	0.221	0.221

Note. The symbols ***, **, and * stand for significance at the 1%, 5%, and 10% levels, respectively.

TABLE 8: Regression results for the dependent variable-ROA (KOSPI 200 volatility).

Dependent variable: ROA(t)	Model (10)	Model (12)	Model (14)
R&D(t)	-0.086	-0.085	0.116
Advertising(t)	0.998 ***	1.088 ***	0.984 *
R&D(t) × volatility(t)			-0.057
Advertising(t) × volatility(t)		0.013	0.013
Volatility(t)	-0.004 *	-0.004 *	-0.004 *
KOSPI 200(t)	0.003 ***	0.003 ***	0.003 ***
Asset(t)	0.013 ***	0.013 ***	0.013 ***
Employee(t)	-0.001	-0.002	-0.002
Age(t)	-0.001 ***	-0.001 ***	-0.001 ***
Export ratio(t)	-0.059 ***	-0.059 ***	-0.057 ***
Overseas expenditure(t)	0.292	0.331	0.388
Constant	-0.296 ***	-0.296 ***	-0.300 ***
N	268	268	268
Overall R ²	0.258	0.258	0.262

Note. The symbols ***, **, and * stand for significance at the 1%, 5%, and 10% levels, respectively.

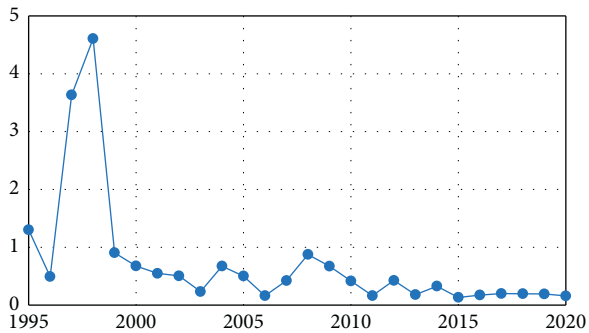


FIGURE 4: Volatility trend of market interest rates from 1995 to 2020.

volatility with the corporate bond market interest rate volatility. The results in Tables 9 and 10 exhibit the same pattern as in the previous tables, indicating that

our main results are robust to these replacements or changes.

$$Q_{i,t} = \alpha_0 + \alpha_1 RD_{i,t} + \alpha_2 AD_{i,t} + \alpha_3 Vol_t + \alpha_4 Int_t + \alpha_5 Asset_{i,t} + \alpha_6 Emp_{i,t} + \alpha_7 Age_{i,t} + \alpha_8 Expratio_{i,t} + \alpha_9 OverseasExp_{i,t} + \varepsilon_{i,t}, \quad (15)$$

$$P_{i,t} = \alpha_0 + \alpha_1 RD_{i,t} + \alpha_2 AD_{i,t} + \alpha_3 Vol_t + \alpha_4 Int_t + \alpha_5 Asset_{i,t} + \alpha_6 Emp_{i,t} + \alpha_7 Age_{i,t} + \alpha_8 Expratio_{i,t} + \alpha_9 OverseasExp_{i,t} + \varepsilon_{i,t}, \quad (16)$$

$$Q_{i,t} = \alpha_0 + \alpha_1 RD_{i,t} + \alpha_2 AD_{i,t} + \alpha_3 RD_{i,t} \times Vol_t + \alpha_4 Vol_t + \alpha_5 Int_t + \alpha_6 Asset_{i,t} + \alpha_7 Emp_{i,t} + \alpha_8 Age_{i,t} + \alpha_9 Expratio_{i,t} + \alpha_{10} OverseasExp_{i,t} + \varepsilon_{i,t}, \quad (17)$$

$$P_{i,t} = \alpha_0 + \alpha_1 RD_{i,t} + \alpha_2 AD_{i,t} + \alpha_3 AD_{i,t} \times Vol_t + \alpha_4 Vol_t + \alpha_5 Int_t + \alpha_6 Asset_{i,t} + \alpha_7 Emp_{i,t} + \alpha_8 Age_{i,t} + \alpha_9 Expratio_{i,t} + \alpha_{10} OverseasExp_{i,t} + \varepsilon_{i,t}, \quad (18)$$

$$Q_{i,t} = \alpha_0 + \alpha_1 RD_{i,t} + \alpha_2 AD_{i,t} + \alpha_3 RD_{i,t} \times Vol_t + \alpha_4 AD_{i,t} \times Vol_t + \alpha_5 Vol_t + \alpha_6 Int_t + \alpha_7 Asset_{i,t} + \alpha_8 Emp_{i,t} + \alpha_9 Age_{i,t} + \alpha_{10} Expratio_{i,t} + \alpha_{11} OverseasExp_{i,t} + \varepsilon_{i,t}, \quad (19)$$

$$P_{i,t} = \alpha_0 + \alpha_1 RD_{i,t} + \alpha_2 AD_{i,t} + \alpha_3 RD_{i,t} \times Vol_t + \alpha_4 AD_{i,t} \times Vol_t + \alpha_5 Vol_t + \alpha_6 Int_t + \alpha_7 Asset_{i,t} + \alpha_8 Emp_{i,t} + \alpha_9 Age_{i,t} + \alpha_{10} Expratio_{i,t} + \alpha_{11} OverseasExp_{i,t} + \varepsilon_{i,t}. \quad (20)$$

TABLE 9: Regression results for the dependent variable-Tobin's Q (interest rate volatility).

Dependent variable: Tobin's Q(t)	Model (15)	Model (17)	Model (19)
R&D(t)	6.584 ***	8.115 ***	7.862 ***
Advertising(t)	1.387	1.824	3.678**
R&D(t) × volatility(t)		-3.551 **	-2.843 **
Advertising(t) × volatility(t)			-2.387 **
Volatility(t)	0.034	0.063 **	0.087 **
Interest rate(t)	-0.027 **	-0.026 ***	-0.027 ***
Asset(t)	-0.002	0.001	0.006
Employee(t)	0.018	0.017	0.014
Age(t)	-0.004 ***	-0.004 ***	-0.004 ***
Export ratio(t)	-0.195 **	-0.185 **	-0.208 **
Overseas expenditure(t)	0.613	0.335	0.102
Constant	1.318 **	1.210 **	1.086 **
N	529	529	529
Overall R ²	0.192	0.202	0.208

Note. The symbols ***, **, and * stand for significance at the 1%, 5%, and 10% levels, respectively.

TABLE 10: Regression results for the dependent variable-ROA (interest rate volatility).

Dependent variable: ROA(t)	Model (16)	Model (18)	Model (20)
R&D(t)	-0.150	-0.148	-0.143
Advertising(t)	0.907 ***	1.019 ***	1.019 ***
R&D(t) × volatility(t)			-0.010
Advertising(t) × volatility(t)		-0.137	-0.135
Volatility(t)	-0.005	-0.003	-0.003
Interest rate(t)	0.001	0.001	0.001
Asset(t)	0.005	0.005	0.005
Employee(t)	0.005 *	0.005 *	0.005 *
Age(t)	-0.001 ***	-0.001 ***	-0.001 ***
Export ratio(t)	-0.032 **	-0.034 **	-0.034 **
Overseas expenditure(t)	-0.259	-0.277	-0.277
Constant	-0.086	-0.095	-0.095
N	556	556	556
Overall R ²	0.121	0.122	0.122

Note. The symbols ***, **, and * stand for significance at the 1%, 5%, and 10% levels, respectively.

Note: Vol_t is the volatility of market interest rate in period t ; Int_t is the mean of market interest rate in period t .

5. Conclusions and Implications

The RBV has been developed as an influential theoretical lens in the management field [6]. Although the importance of resources for firm performance is generally recognized by academia, debate continues regarding the types of resources that aid in firm performance, how resources contribute to firm performance, and whether the effects of these resources are sustained in a volatile environment. Our findings address these debates and provide some solutions.

First, using a sample of Korean KOSPI manufacturing firms, this study provides additional evidence that critical intangible resources such as R&D and advertising positively affect firm performance. However, when firm performance is broken down into firm value and firm profitability, there is an obvious contrast between the effects of R&D and advertising. R&D resources have a larger effect on firm value than advertising resources. Meanwhile, advertising resources have a larger effect on firm

profitability than R&D resources. Firm value and firm profitability represent two different dimensions of or criteria for firm performance. Firm value primarily represents consumers' appreciation and the effectiveness of firm operations. R&D resources contribute more towards satisfying and improving value for consumers, thus helping maximize effectiveness. By contrast, firm profitability is more concerned with a firm's intrinsic side, which is associated with efficiency. Advertising resources play an important role in creating price premiums or increasing sales to enhance efficiency. In such mechanisms, R&D and advertising resources contribute to firm performance. This study adopts accounting data to measure firm performance, which is a more objective performance measurement than survey data. According to preceding studies, the relationship between resources and firm performance is stronger when subjective performance indicators are used [42]. Therefore, this study's results provide more conservative estimates for hypotheses testing, as it uses objective performance measurements. Previous research also finds that panel data analysis reports much weaker resource effects than cross-sectional data analysis [42]. Thus, the results of this study, which uses panel data, indicate that the effects of the two resources on firm performance are significant and sustained.

Second, the finding that R&D affects firm value more than advertising does and that advertising has a greater impact on firm profitability than R&D does indicates the relatedness and mutual dependence of these two resources. A firm not only pays attention to firm value, but also simultaneously manages firm profitability, since a proper balance between effectiveness and efficiency is at the heart of a firm's sustainability. This interrelationship implies that a good combination of R&D and advertising resources may amplify the independent effect of either R&D or advertising on firm performance [52]. With R&D resources, firms develop more innovative and differentiated products, while with advertising resources, firms promote these new products to exploit and create a market. Thus, firms can improve their performance through the synergy of R&D and advertising, creating a vital competitive edge that is not easily visible in average firms.

Third, our findings confirm that the effects of R&D and advertising resources are not diminished in volatile environments. Although our study does not find that environmental volatility has significantly negative effect on firm performance, previous research [39] has found that changing environments harm firm performance. Accordingly, there is concern that resource effects on firm performance are reduced or lost in an adverse environment. By contrast, this study finds that the effects of R&D and advertising resources on firm performance are maintained in a volatile environment. Some earlier studies on the effects of resources do not consider environmental dynamism or use a single and stable environmental setting (e.g., [53–55]). To overcome these earlier limitations, this study incorporates environmental volatility in the regressions. The results show that the effects of R&D and advertising resources remain constant in any environment. Some recent literature has found that environmental fluctuations strengthen the relationship between dynamic capability and firm performance [42]; however, in our study, environmental factors do not positively moderate the relationship between R&D/advertising resources and firm performance. Thus, we infer that R&D and advertising resources may be considered “ordinary capabilities,” serving as cornerstones of firm operations, rather than “dynamic capabilities” [40].

Finally, the effects of some of the control variables used in this study also have implications. The effects of firm age and the export ratio remain negative and significant in all regressions, including robustness tests, although the magnitudes of their coefficients are so small that they almost lose economic significance. However, we infer from the consistent results that firm age may have a negative effect on firm performance under conditions of environmental volatility. This means that a firm with a longer history may have difficulty adapting to environmental changes because of organizational inertia, and the effects of experience are not as helpful in such a dynamic environment [37]. The fact that the export ratio also has a negative effect on firm performance indicates that, under conditions of environmental volatility, a higher export ratio is not good for firm performance because export sales may cause more uncertainty and problems than domestic sales [46].

Regarding its practical implications, this study presents strategic guidelines for firms aiming to improve firm performance. First, managers should clearly distinguish between firm value and firm profitability when considering firm performance. They should sort out which resources play major roles in improving each criterion of firm performance. R&D resources contribute more to firm value, while advertising resources contribute more to firm profitability. Firm value represents effectiveness, while firm profitability represents efficiency. Thus, for firm sustainability, managers should analyse which is lacking, effectiveness or efficiency. If effectiveness (efficiency) is more urgent for the firm, within the range of these two resources, managers should invest more in R&D (advertising) resources. The inseparable relationship between effectiveness and efficiency for firm performance highlights that R&D and advertising resources are closely related to each other. Therefore, management should consider R&D and advertising resources jointly in decision-making

because the combination of the two resources may create great synergy, especially for manufacturing firms. This finding also warns that firms cannot achieve the expected return if they invest disproportionately in these two resources.

Next, the support for the hypotheses that environmental volatility does not lessen the impact of R&D and advertising on each criterion of firm performance more strongly underscores the importance of R&D and advertising resources for firms. When faced with economic fluctuations and volatility, firms mistakenly believe R&D and advertising investment are things that can be postponed or reduced to address short-term liquidity. It is a misguided strategy to reduce the budget for R&D and advertising to recover from a negative environment. Firms should accumulate and exploit these two resources consistently, regardless of environmental dynamics, to sustain their competitive advantage.

Finally, the effects of firm age and the export ratio in our empirical analysis can also provide practical implications for firm officials. Firm age may have negative effects on firm performance, especially under conditions of environmental volatility; therefore, firms with a longer history should care more about adapting to environmental change. They should overcome organizational inertia, which impedes innovation and creativity, and stimulate passion for challenging new things. The negative effects of the export ratio highlight the domestic market’s importance, especially under conditions of environmental volatility. Firms are aggressive in opening up overseas markets, but they must remember that sales in the domestic market are fundamental for firm performance, especially in the presence of environmental uncertainty. Thus, firms should secure a certain amount of domestic sales regardless of the circumstances, including cases in which the overseas market shows explosive growth.

We acknowledge that this study has some limitations and suggest further research to overcome these limitations. First, future research can provide additional evidence by examining this topic in the context of other countries to improve reliability in terms of generalizing the study’s implications. Second, this study focuses on R&D and advertising resources to explain the impact of firm resources on firm performance; future research can investigate other critical resources, such as human capital management, knowledge management, strategic decision-making, and cooperation. Third, although this study’s estimation using financial performance measures provides a more conservative estimation of the resource-performance relationship, future research that implements surveys can yield new insights through a process-oriented approach. Such studies may investigate a more detailed mechanism through which resources work for firm performance. Fourth, we restricted environmental volatility to economic volatility, although we measure economic volatility using three different indexes, including robustness tests. Future research can expand the concept of volatility to other dimensions, such as political uncertainty and industrial turbulence. These types of volatility may require firms to use other resources to overcome them and adjust.

Notwithstanding these limitations, we believe that this study has both theoretical and practical contributions.

Specifically, it reaffirms the RBV and shows the importance of R&D and advertising resources. More importantly, we investigate how R&D and advertising resources contribute differently to firm performance by separating firm performance into firm value and firm profitability. As firms benefit from the simultaneous realization of effectiveness and efficiency, the effects of R&D and advertising are inseparable, and they are interrelated in achieving firm sustainability. Furthermore, the effects of R&D and advertising do not disappear in a volatile environment. The robustness of our results suggests that R&D and advertising resources are reliable sources of success, and firms should not curtail investments in these resources when they are confronted with an adverse environment. This study reaffirms that firm heterogeneity comes from heterogeneous resources.

Data Availability

The data used to support the findings of this study were supplied by KISVALUE under license and so cannot be made freely available. Requests for access to these data should be made to KISVALUE, <https://www.kisvalue.com/web/index.jsp>.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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