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Innovation Input and Firm Value: Based on the Moderating Effect of Internal Control

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Abstract: Using the data of Chinese A-share listed firms with non-zero innovation investment between 2007 and 2017, this paper links the value relevance of innovation investment with internal control from the perspective of operating performance and market value, respectively. This paper empirically verifies that internal control significantly increases the value relevance of innovation input, that is, the better the internal control, the more innovation investment contributes to the operating performance and market value of a firm. Then, based on the potential mechanisms of alleviating agency problems and conducting better risk management, further investigation in this paper also indicates that internal control's moderating effect on the value relevance of innovation input is more prominent for firms with relatively more severe agency problems and for expensed R&D expenditure which represents the part of innovation investment with higher uncertainty.

Keywords: innovation input; internal control; firm value; agency problem; risk management

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1. Introduction

In the context of the knowledge economy, innovation has become the first driving force leading a country's economic development and growth, and it plays a vital role in sustaining national competitive advantage and the core competitiveness of firms [1–3]. Innovation investment has value relevance, which refers to the relation between innovation input and subsequent benefits and is normally measured from two perspectives, which are operating performance, such as the impact of innovation investment on profits, productivity or growth rate, and market value, such as the influence of innovation input on stock return or stock price, where the long-term effect of innovation input can be properly assessed [4]. However, as a high-risk, high-uncertainty activity, innovation investment may not be able to bring about desired effects in many cases [5]. Therefore, firms should not only focus on the quantity invested but also on the improvement of innovation quality. Therefore, how to make innovation investment contribute more to a firm's value is also an important issue that companies should pay attention to.

Strengthening internal control has become an increasingly important means to improve corporate governance all around the world. The Sarbanes–Oxley Act (SOX), for example, has been described as the most far-reaching reform of the United States since Franklin Delano Roosevelt's administration. In the past few years, the Chinese government has also made great efforts to promote internal control system construction in firms. In 2008 and 2010, the Ministry of Finance, National Audit Office, China Securities Regulatory Commission, China Banking Regulatory Commission and China Insurance Regulatory Commission jointly issued the Basic Standards for Internal Control (2008), which is known as the Chinese version of the Sarbanes–Oxley Act (C-SOX), and Guidelines for the Application of Internal Control in Enterprises (2010). Different from the SOX, which focuses on controlling the risk of financial misstatement and emphasizes the accounting responsibility of senior executives and the supervisory responsibility of independent directors, an important theme conveyed in the C-SOX is that, through a series of institutional arrangements, internal control emphasizes more risk management in daily operations in order to improve business operation efficiency and promote the realization of a firm's development strategy. According to the C-SOX, internal control refers to the process implemented by the board of directors, board of supervisors, managers and all employees of the firm to achieve the internal control objectives. The internal control objectives include five aspects, namely, reasonably ensuring the legal compliance of firm operation and management, asset security, complete and reliable financial report and information disclosure, improving efficiency in daily operation and promoting the realization of corporate strategy. Therefore, internal control quality strongly influences the firm's risk management and business performance, and good internal control could help achieve the sustainable development of the firm [6]. However, can better internal control contribute to the value relevance of a firm's innovation input? What are the potential mechanisms linking internal control with the value relevance of a firm's innovation input?

In view of this, using the data of Chinese A-share listed firms with non-zero innovation investment between 2007 and 2017, this paper links the value relevance of innovation investment with internal control from the perspective of operating performance and market value, respectively. This paper empirically verifies that internal control significantly increases the value relevance of innovation input, that is, the better the internal control, the more innovation investment contributes to the operating performance and market value of a firm. Then, based on the potential mechanisms of alleviating agency problems and conducting better risk management, further investigation in this paper also indicates that internal control's moderating effect on the value relevance of innovation input is more prominent for firms with relatively more severe agency problems and for expensed R&D expenditure which represents the part of innovation investment with higher uncertainty.

The contribution of this paper is mainly reflected in the following two aspects: On the one hand, this paper enriched the research in the field of internal control and the value relevance of innovation input with empirical evidence of Chinese firms. Although there has been abundant literature investigating the role internal control plays in firm innovation decisions and sustainable business growth [2,6], the few studies on related topics that link internal control with the value relevance with the innovation input for Chinese firms used data of listed firms from 2002 to 2006, before the new accounting standards of China and the C-SOX were issued [7]. On the other hand, from the perspective of innovation input, most existing literature takes innovation investment as the explained variable and investigates the influence of various factors on it, which approaches the problem of innovation investment from a quantitative perspective [2,8,9]. However, whether innovation input can turn into equivalent economic value eventually is uncertain, which means that the quality of innovation investment is also crucial. This paper links internal control with innovation input and explores whether internal control can play a moderator for the value relevance of a firm's innovation input. Meanwhile, this paper also provides implications for firms to improve their internal control and enhance the quality of their innovation input.

The remainder of this paper proceeds as follows. Section 2 discusses the literature review and provides hypothesis development. Section 3 describes sample selection, data sources, definitions of key variables and the empirical methodology. Section 4 presents the sample descriptive statistics and the empirical results of the relationship between internal control and the value relevance of a firm's innovation input. Robustness checks are discussed in Section 5. Finally, conclusions and implications are drawn in Section 6.

2. Literature Review and Hypothesis Development

2.1. Moderating Role of Internal Control on the Value Relevance of Innovation Input

Empirical evidence from many countries has shown that innovation input and R&D activities could have a positive impact on a firm's value [10–12]. Value relevance of innovation input, according to Lev and Sougiannis [4], is interpreted as the relation between innovation input and its future benefits, which can be measured from the perspective of a firm's operating performance, such as profits, productivity or growth rate, and from the perspective of the firm's market value, stock return or stock price.

For the value relevance of innovation input from the perspective of operating performance, many empirical studies evidence a positive relationship between innovation and operating performance at the firm level. For example, Lev and Sougiannis [4] used US data to prove that R&D investment has a positive effect on increasing a firm's future operating profit. Luo et al. [7] made use of Chinese data and also verified this positive correlation. However, since data on innovation investment was not directly disclosed before new accounting rules were adopted in China, there might be some noise in the data that might undermine the robustness of the results. In recent years, Guo et al. [11] used the R&D investment data from Chinese listed manufacturing firms from 2009 to 2016 and found that the R&D spending of firms with different strategic positions had a positive impact on the firm's future operating performance. Moreover, Chen et al. [13] used the Chinese A-share listed firms from 2009 to 2012 as the sample and found that the positive impact of R&D is most significant for the firm's operating profit one year later, and the positive effect two years later is no longer robust.

For the value relevance of innovation input from the perspective of market value, Lev and Sougiannis [4] first used US panel data and adopted the return model to prove that innovation investment could increase the stock return, which indicates that investors believe innovation investment can create value for firms. Eberhart et al. [14] divided portfolios based on whether the firm increased innovation investment during that calendar year and proved that the portfolio with an increase in innovation investment had a higher abnormal return. Franzen and Radhakrishnan [15] used the price model to explore the correlation between innovation investment and stock price and found that there was a strong value relevance for loss-making firms but not for profitable firms. Han and Manry [16] used data from the Korean stock market and also proved that there is a positive relationship between innovation investment and current year stock prices. Greenhalgh and Rogers [17] used innovation expenditure to measure knowledge assets and proved that the market has a positive valuation of current investment in innovation.

However, innovation and R&D investment is a high-risk activity that often comes along with enormous costs and high uncertainty [5]. Some of the earlier studies explored the key factors of success in innovation from the perspectives of both inside and outside the firm. Corporate governance and management structure design, project risk management and internal information communication are three factors that affect the transformation from innovation investment to the eventual innovation output or financial performance. For example, Birkinshaw and Morrison [18] pointed out that a well-established corporate organizational structure can promote internal knowledge sharing and enable the firm to have stronger innovation capabilities. Chung et al. [19] demonstrated that hiring an external board of directors can increase the R&D value relevance on Tobin's Q. Gu and Zhang [20] proxied corporate governance by CEO tenure and institutional ownerships and indicated that corporate governance promotes innovation output measured by the number of patents. Previous research also showed that better management of R&D risks and higher R&D efficiency also greatly contribute to the value relevance of innovation input [21].

Firms use internal control techniques and establish internal control systems in order to strengthen their corporate governance, promote business operation and risk management efficiency and enhance their financial reporting and information disclosure so as to achieve their goals and objectives [8,22]. From the firm's internal perspective, good internal control can optimize the organizational structure of a firm, promote internal knowledge sharing and motivate stronger innovation capability. It could improve the visibility of innovation activities within the firm so that the R&D and non-R&D personnel of the firm could form a virtuous circle of mutual restriction and stimulation, ensuring that the R&D activities were more in line with the firm's goals and served the firm's business strategy efficiently [23]. Moreover, internal control can also improve the commercialization of innovation activities by regulating management behaviors, enforcing better risk management and improving internal information transparency [24–26]. All these roles and effects of internal control make R&D activities more in line with the business strategic objectives of firms and promote the transformation of R&D input into better firm operating performance.

From the perspective of the external market, due to the high uncertainty involved in R&D investment, it is difficult for external investors to accurately measure the realized value of their investment and to supervise the firm's business operation. The study by Berger and Hann [27] showed that the management have the incentive to conceal negative information about the firm so as to avoid the supervision of outside investors. Hope and Thomas [28] further found that the reduction in the quality of information disclosure reduced investors' supervision of management's behavior and made management adopt self-interested behaviors that were not conducive to the firm, which can adversely affect firm performance and reduce firm value. In these cases, the internal control framework not only improves the level of corporate governance but also helps the firm to establish a more transparent external information disclosure system and reduce the information asymmetry between internal and external [8]. Therefore, internal control is helpful for enterprises by ensuring the reliability of external information disclosure of their innovation progress and achievements so as to provide sufficient information for investors to form an accurate judgment of the value of the firm and to gain investors' trust and confidence in the firm's stock market performance. In summary, effective internal control can contribute to the value relevance of innovation input through better corporate governance, risk management, internal communication and external information disclosure. Then, this paper proposes the following two hypotheses:

Hypothesis 1 (H1). For firms with better internal control, innovation input contributes more to operating performance. That is, internal control can increase the value relevance between operating performance and innovation input.

Hypothesis 2 (H2). For firms with better internal control, innovation input contributes more to market value. That is, internal control can increase the value relevance between market value and innovation input.

2.2. Moderating Role of Internal Control in the Value Relevance of Innovation Input: Mechanism of Alleviating Agency Problems

Berle and Means [29] first pointed out that the separation of ownership and management of a firm leads to the inconsistency in interests between its shareholders and managers. Such inconsistency in interests could inevitably lead managers' decisions to deviate from the goal of maximizing shareholder value and bring about agency problems [30]. The disclosure of R&D information is more susceptible to management manipulation due to the difficulty in the accounting verification, measurement, recording and reporting of R&D investment, which will facilitate the manager's pursuit of private interests. For example, if a manager believes that an innovation activity can bring private benefits, then even if the feasibility or necessity of innovation is not fully justified, the manager may also choose to invest in innovation activities for personal benefit [31]. On the contrary, due to the high failure rate of innovation activities, the managers of listed firms are more likely to reduce innovation investment to avoid stock price fluctuations [32]. Furthermore, the existence of agency problems may also make the risk-averse manager in a firm tend to reduce innovation investment effort in order to evade regulatory responsibilities under strict internal control requirements [33], resulting in insufficient innovation input in the firm's production and operation process. Therefore, from the perspective of corporate governance and management opportunism, it can be inferred that when there is a lack of supervision and the corporate governance structure is weak, the opportunistic behavior of the management may damage the quality of R&D activities. In this case, internal control can effectively alleviate this principal-agent problem and make R&D activities more consistent with the company's strategic goals.

Meanwhile, the management would conceal the information of the departments with lower profits to cover up the agency problems that the firm might have so as to avoid the supervision of outside investors [27]. Therefore, for firms with poor corporate governance and more severe agency problems, the introduction of effective internal control could not only help promote information transparency and innovation efficiency within the firm, but it could also improve financial reporting for better symmetric communication and information sharing between the management and the outside investors with the stakeholders outside [34,35]. This could enhance the firm transparency and facilitate effective monitoring, with which in place the management will have the incentive to avoid waste of resources and improve the efficiency and economic return of innovation input [8]. Therefore, internal control in these firms could better increase their business operational efficiency and innovation investment efficiency by reducing information asymmetry and increasing innovation investment efficiency [36–39]. On the contrary, in the case of better corporate governance, the severity of agency problems and management opportunism is relatively small, and therefore the probability of the management damaging the interests of shareholders is relatively low. Therefore, the marginal effect of internal control on promoting the value relevance of innovation input is relatively small. Thus, this paper proposes the following two hypotheses:

Hypothesis 3-1 (H3-1). Compared with firms with less severe agency problems, internal control has a more significant positive impact on the value relevance between operating performance and innovation input for firms with more severe agency problems.

Hypothesis 3-2 (H3-2). Compared with firms with less severe agency problems, internal control has a more significant positive impact on the value relevance between market value and innovation input for firms with more severe agency problems.

2.3. Moderating Role of Internal Control in the Value Relevance of Innovation Input: From the Perspective of Risk Management

Innovation activities may have to face several risks, for example, the risk of innovation output transformation and the risk of unintentional business operation errors. On the one hand, the risk could occur during the transformation stage of scientific and technological achievement, which refers to those R&D activities that fail to be timely or fully transformed into R&D output or those R&D achievements that cannot be effectively used by enterprises to meet market demands. On the other hand, the operational risk potentially exists along the whole business operation process, which refers to the risk of direct or indirect loss due to imperfect internal operating processes, personnel or systems. Both risks can lead to the failure of R&D investment, and it is difficult to avoid these kinds of risks. In other words, if the innovation input lacks reasonable and effective internal supervision and management, it will lead to the low efficiency of firm R&D investment and even cause the waste and loss of resources.

According to China's Accounting Standards for Enterprises, R&D expenditure is divided into capitalized R&D expenditure and expensed R&D expenditure. Capitalized R&D expenditure refers to what can be recorded in assets and amortized over the years and affects the profits of future years, while expensed R&D expenditure refers to the expenditure that needs to be included in the current profit and loss, and it only affects the profit of the current year. Capitalized R&D expenditure needs to meet a series of strict conditions, such as technical feasibility, and with demonstrated and expected economic benefits, it represents the part with relatively lower overall risk. However, expensed R&D expenditure represents the part with higher overall uncertainty and is usually incurred in the early stage of R&D activities [16,40,41]. The capitalized R&D expenditure incurred in the later development stage of the innovation process represents the portion of innovation input that will finally generate future revenue for the firm and is more relevant to the firm value. However, in comparison, the expensed R&D expenditure represents the write-down of current profit, and the uncertainty in the early development stage of innovation input is larger [21,41–43].

From the perspective of risk management, internal control helps to identify and analyze different aspects of risks in a timely manner throughout the entire innovation process, standardize operational procedures, establish clear implementation policies, strengthen budget control and reduce the risk of fraud, which can effectively reduce uncertainty in initial stages and correct biases in middle and later stages early [22,44]. However, as pointed out by Sood and Tellis [21], in comparison with expensed R&D expenditure, capitalized R&D expenditure represents the part with overall lower risk and foreseeable innovation output, and therefore the innovation activities in the subsequent development stage have stronger value relevance. On the contrary, the expensed R&D expenditure represents the part with higher risk, and the early stage of R&D development is more uncertain, and its value relevance is relatively small. For this reason, better internal control and risk management over the expensed R&D expenditure in the early development stage would have a more significant marginal effect on a firm's value relevance. Therefore, from the perspective of risk management, this paper proposes the following hypotheses:

Hypothesis 4-1 (H4-1). Compared with capitalized R&D expenditure, the positive effect of internal control on the value relevance between operating performance and innovation input is more prominent for expensed R&D expenditure.

Hypothesis 4-2 (H4-2). Compared with capitalized R&D expenditure, the positive effect of internal control on the value relevance between market value and innovation input is more prominent for expensed R&D expenditure.

3. Research Methodology Design

3.1. Sample Selection and Data Sources

The financial data used in this paper were collected from the China Stock Market & Accounting Research Database (CSMAR) and WIND database, and the internal control data were derived from the DIB Internal Control Database. Due to the implementation of new accounting standards in 2007 and the financial disclosure requirements before the new accounting standards not involving R&D investment, this paper selected China's A-share listed firms from 2007 to 2017 as the research sample.

The data were processed as follows: (1) Observations for listed firms with ST and *ST classes were excluded. (2) On the basis of comparability, considering that the accounting standards used by the financial industry are different from those used by other industries, financial and insurance industry observations were excluded. (3) Observations with missing data were excluded. (4) In order to ensure the robustness of the results and avoid the adverse interference of abnormal observations, the main continuous variables were Winsorized with two-way 1% quantiles. Finally, 9060 valid observations for the operating performance value relevance sample and 9094 valid observations for the stock market value relevance sample were obtained.

3.2. Variables

3.2.1. Explained Variables

This paper investigates the effect of innovation input on firm operating performance and stock market performance. The two main dependent variables in this study are operating profit (OPA), which is calculated according to the operating profit divided by the total assets at the beginning of the year and measures the firm's operating performance, and yearly stock return (RET), which is calculated from the logarithm of ending year stock price over beginning year price and measures the firm's stock market value [4,7].

In the robustness checks, this paper further adopts the gross profit (OPMA) and the increment of operating profit (DOPA) as the proxies for the firm's operating performance. For the market value variables, since the annual disclosure period of Chinese listed firms is 4 months after the beginning of the year, the investors often experience a time lag in absorbing the stock information of the previous year. Therefore, this paper uses the stock return at the end of April (RETL) and the adjusted stock price (ADP) as the proxies for the firm's stock market performance in the robustness checks [4,15].

3.2.2. Explanatory Variables

There are two main independent variables in this study. One is the innovation input, coded as RD and measured by the firm's R&D investment divided by its total asset at the beginning of each year [4,7,10,45]. The other main independent variable and also the moderator variable is the internal control quality, coded as Int and measured by the DIB internal control index of Chinese listed firms, with a higher value of the index representing a more effective implementation of internal control. The index is derived from the DIB Internal Control Database, which is a database widely used in relevant studies in China [2,8,13,46]. The index is designed based on the internal control system of domestic listed companies, including the realization of the five control objectives of compliance, reporting, asset safety, operation and realization of the objectives and strategy. While considering the internal control defects at the same time, the internal control index is constructed to comprehensively analyze and reflect the internal control and risk management of the listed firms.

In the robustness check, this paper uses whether internal control defects are reported in the previous year as the alternative moderator variable to proxy for the firm's internal control quality. The internal control defects reported in the previous year are divided into three categories: general defects, important defects and major defects. If any defect is reported by the firm in a given year, Sub_Int is denoted as 0, while if no internal control defect is reported, it is denoted as 1. These kinds of internal control defects data were collected from the CSMAR Database.

3.2.3. Control Variables

Referring to the previous literature [4,7,11,15,46,47], the selected control variables in the operating performance model include firm size (size), asset–liability ratio (Lev), firm age after IPO (Age), net tangible asset ratio (Tangi) and advertising expense ratio (Adv), and the selected control variables in the stock market value model include adjusted earnings per share (Adj_Eps), variations in adjusted earnings per share (ΔAdj_Eps), book value per share (BVE), accrued earnings (Acc) and asset–liability ratio (Lev). Moreover, the firm's financial report year dummy (Year), as well as the industry dummy under the 2012 standards of the China Securities Regulatory Commission (Indcd1 and Indcd2) are also adopted.

3.2.4. Other Variables

The other variables are selected to proxy for the firm's agency problems and risk management. Severity of agency problems is measured using the adjusted management fee ratio, coded as CG1, and whether the same person is serving as the chairman and CEO simultaneously, coded as CG2 [7,8,48,49]. The higher the management fee ratio, the more severe agency problems might be. In addition, if the same person is serving as the chairman and CEO simultaneously, the manager's power is more difficult to constrain, thus leading to higher chances for managerial opportunism. CG1 and CG2 are both dummy variables, wherein the adjusted management fee ratio larger than or equal to the median is recorded as 1, and smaller than the median is recorded as 0. For CG2, those firms with the same person serving as the chairman and CEO simultaneously are recorded as 1; otherwise 0. In this paper, we use the data for CG1 and CG2 one year previous to the year of R&D investment as the basis for grouping and mechanism analysis.

Moreover, to capture the different risk levels and management of R&D expenditures, they are further divided into expensed R&D expenditure (RDE), which represents the early stage and riskier part of innovation investment, and capitalized R&D expenditure (RDC), which represents the later stage of innovation investment with relatively lower uncertainty. All variable definitions and abbreviations are shown in Table 1.

Table 1. Summary of variables.

	Variable Code	Variable Name	Definition and Measurement
Explained Variables	OPA	Operating Profit	Operating Profit/Total Asset at the Beginning of the Year
	RET	Stock Return	Natural Logarithm of (Closing Price at the End of the Year/Closing Price at the End of Last Year)
	OPMA	Gross Profit	(Operating Income − Operating Cost)/Total Asset at the Beginning of the Year
	DOPA	Increment of Operating Profit	$OPA_{i,t} - OPA_{i,t-1}$
	RETL	Stock Return at the End of April	Natural Logarithm of (Closing Price at the End of April of the Next Year/Closing Price at the End of April of the Current Year)
	ADP	Adjusted Stock Price	Year-end Closing Price + Declared Dividend
Explanatory Variables	RD	R&D Intensity	R&D Investment/Total Asset at the Beginning of the Year
	Int	Internal Control Quality	DIB Internal Control Index, Collected from DIB Internal Control Database
	Sub_Int	Substitute Variable for Internal Control	Collected from the CSMAR Database. Value = 1 if No Internal Control Defect is Reported; Otherwise = 0
Control Variables	Size	Firm Size	The Natural Logarithm of Total Assets at the Beginning of the Year
	Lev	Asset–Liability Ratio	Total Debts/Total Assets
	Age	Firm Age after IPO	Number of Years Since the Enterprise's IPO within the Sample Period
	Tangi	Net Tangible Asset Ratio	(Common Equity − Intangible Assets − Goodwill − Long-term Deferred Assets)/Total Assets
	Adv	Advertising Expense Ratio	Sales Expense/Total Asset at the Beginning of the Year
	Adj_Eps	Adjusted Earnings per Share	(Net Profit − Non-recurring Gains and Losses)/Equity at the End of the Year
	ΔAdj_Eps	Variation of Adjusted Earnings per Share	Adjusted Earnings per Share of the Year−Adjusted Earnings per Share of Last Year
	BVE	Book Value per Share	Common Equity/Number of Shares Outstanding at the End of the Year
	Acc	Accrued Earnings	(Net Profit− Net Operating Cash Flow)/Equity at the End of the Year
	Year	Year Dummy	Firm's Financial Report Year
	Indcd1	Industry Dummy 1	CSRC Industry Classification–Level 1 Industry Category
	Indcd2	Industry Dummy 2	CSRC Industry Classification–Level 2 Industry Category
Other Variables	CG1	Proxy Variable for Agency Problem 1: Adjusted Management Fee Ratio	(Management Expense + Depreciation and Amortization + Bad-debt Provision + Price Reduction)/Operating Income. Value = 1 if the Ratio is Greater than or equal to the Median; otherwise = 0
	CG2	Proxy Variable for Agency Problem 2: Duality—Whether the Same Person Is Serving as the Chairman and CEO Simultaneously	Value = 1 if the Same Person Is Serving as the Chairman and CEO Simultaneously; otherwise = 0
	RDE	Expensed R&D Expenditure	R&D Expenditure Included in Expenses/Total Asset at the Beginning of the Year
	RDC	Capitalized R&D Expenditure	R&D Expenditure Included in Assets/Total Asset at the Beginning of the Year

3.3. Empirical Model and Methodology

3.3.1. Model Specification for Hypothesis 1

To test Hypothesis 1, this paper adopts the following model:

$$\begin{aligned} OPA_{i,t} &= \alpha + \beta_1 RD_{i,t-1} + \beta_2 Int_{i,t-1} + \beta_3 RD_{i,t-1} * Int_{i,t-1} + \beta_4 Size_{i,t-1} + \beta_5 Lev_{i,t-1} \\ &+ \beta_6 Age_{i,t-1} + \beta_7 Tangi_{i,t-1} + \beta_8 Adv_{i,t-1} + Year + Ind + \varepsilon_{i,t} \end{aligned} \quad (1)$$

$RD_{i,t}$ represents the R&D investment of Firm i at Year t. The model also controls the industry effect and year effect. Since there are interaction terms in model (1), the main explanatory variables and explained variables are standardized, and the same treatment is carried out in the other empirical models of this paper. If Hypothesis 1 is true, the coefficient of the interaction term in model (1) should be significantly positive. In addition, the coefficients of innovation input and internal control should both be significantly positive. Moreover, the main explanatory variables and control variables in this model all take the value that is lagged for one year, mainly for the following two considerations: First, lagged one-period data can alleviate the endogeneity problem caused by reverse causality. Second, R&D investment often has a lagging effect on the firm's operating performance in the next year [7,13].

3.3.2. Model Specification for Hypothesis 2

For Hypothesis 2, there are usually two types of models that can be used for empirical testing, namely, the return model and the price model. However, the return model is more commonly used. Christie [50] pointed out that there are more heteroscedasticity and misspecification problems in the price model. In addition, as Kothari and Zimmerman [51] pointed out, in an efficient market, the return model rather than the price model can measure the impact of information during the period. Therefore, this paper adopts the return model as the baseline model for market value relevance, with the price model left to be used for robustness checks. Then, referring to Lev and Sougiannis [4] and Luo et al. [7], this paper uses the following model to test Hypothesis 2:

$$\begin{aligned} RET_{i,t} &= \alpha + \beta_1 RD_{i,t} + \beta_2 Int_{i,t} + \beta_3 RD_{i,t} * Int_{i,t} + \beta_4 Adj\_Eps_{i,t} + \beta_5 \Delta Adj\_Eps_{i,t} \\ &+ \beta_6 BVE_{i,t-1} + \beta_7 Acc_{i,t-1} + \beta_8 Lev_{i,t-1} + Year + Ind + \varepsilon_{i,t} \end{aligned} \quad (2)$$

If Hypothesis 2 is true, the coefficient of the interaction term in model (2) should be significantly positive. In addition, the coefficients of innovation input and internal control should both be significantly positive.

3.3.3. Model Specification for Hypothesis 3

To study Hypothesis 3, this paper uses the management expense ratio (CG1) and whether the same person is serving as the firm's chairman and CEO simultaneously (CG2) one year previous to the year of R&D investment to divide the sample into two subsamples. Firstly, the subsamples under different groupings are regressed based on model (1) and model (2), respectively. Then, regression analysis is carried out based on the following model with the interaction term $RD_i * Int_i * CG_i$ included:

$$\begin{aligned} OPA_{i,t} &= \alpha + \beta_1 RD_{i,t-1} + \beta_2 I_{nt} t_{i,t-1} + \beta_3 CG_{i,t-2} + \beta_4 RD_{i,t-1} * CG_{i,t-2} + \beta_5 Int_{i,t-1} \\ &* CG_{i,t-2} + \beta_6 RD_{i,t-1} * Int_{i,t-1} + \beta_7 RD_{i,t-1} * Int_{i,t-1} * CG_{i,t-2} + \beta_8 Size_{i,t-1} + \beta_9 Lev_{i,t-1} \\ &+ \beta_{10} Tangi_{i,t-1} + \beta_{11} Agee_{i,t-1} + \beta_{12} Adv_{i,t-1} + Year + Ind + \varepsilon_{i,t} \mathrm{t} \end{aligned} \quad (3)$$

$$\begin{aligned} RET_{i,t} &= \alpha + \beta_1 RD_{i,t} + \beta_2 Int_{i,t} + \beta_3 CG_{i,t-1} + \beta_4 RD_{i,t} * CG_{i,t-1} + \beta_5 Int_{i,t} * CG_{i,t-1} \\ &+ \beta_6 RD_{i,t} * Int_{i,t} + \beta_7 RD_{i,t} * Int_{i,t} * CG_{i,t-1} + \beta_8 Adj\_Eps_{i,t} + \beta_9 \Delta Adj\_Eps_{i,t} \\ &+ \beta_{10} BVE_{i,t-1} + \beta_{11} Acc_{i,t-1} + \beta_{12} Lev_{i,t-1} + Year + Ind + \varepsilon_{i,t} \end{aligned} \quad (4)$$

If Hypothesis 3 is true, the coefficient of the interaction term $RD_i * Int_i * CG_i$ should be significantly positive; that is, the effect of internal control in firms with more severe agency problems is larger in terms of either statistical significance or economic magnitude.

3.3.4. Model Specification for Hypothesis 4

In order to test Hypothesis 4, this paper refers to the approach proposed by Sood and Tellis [21], which divided the announcements of R&D investment into the initial stage with higher risk and the subsequent development stage with relatively lower risk. According to the classification in Chinese accountant standards, this paper further divides the R&D investment into expensed and capitalized parts and empirically tests the following models:

$$\begin{aligned} OPA_{i,t} &= \alpha + \beta_1 RDC_{i,t-1} + \beta_2 RDE_{i,t-1} + \beta_3 Int_{i,t-1} + \beta_4 RDC_{i,t-1} * Int_{i,t-1} + \beta_5 RDE_{i,t-1} \\ &* Int_{i,t-1} + \beta_6 Size_{i,t-1} + \beta_7 Lev_{i,t-1} + \beta_8 Tangi_{i,t-1} + \beta_9 Age_{i,t-1} + \beta_{10} Adv_{i,t-1} + Year \\ &+ Ind + \varepsilon_{i,t} \end{aligned} \quad (5)$$

$$\begin{aligned} RET_{i,t} &= \alpha + \beta_1 RDC_{i,t} + \beta_2 RDE_{i,t} + \beta_3 \mathrm{Int}_{i,t} + \beta_4 RDC_{i,t} * Int_{i,t} + \beta_5 RDE_{i,t} * Int_{i,t} \\ &+ \beta_6 Adj\_Eps_{i,t} + \beta_7 \Delta Adj\_Eps_{i,t} + \beta_8 BVE_{i,t-1} + \beta_9 Acc_{i,t-1} + \beta_{10} Lev_{i,t-1} + Year + Ind \\ &+ \varepsilon_{i,t} \end{aligned} \quad (6)$$

If Hypothesis 4 is true, then the coefficient of the interaction term $RDE_i * Int_i$ should be larger either in statistical significance or in the coefficient magnitude, compared to the coefficient of the interaction term $RDC_i * Int_i$.

4. Empirical Analysis

4.1. Descriptive Statistics

Firstly, descriptive statistics of the main explanatory variables, explained variables and control variables are reported in Tables 2 and 3. Since there are interaction terms of continuous variables in the regression, to avoid multicollinearity and to better interpret the meaning of coefficients, this paper also standardized the main explained and explanatory variables, and descriptive statistical results for those standardized items are also displayed.

Among them, the number of observations in the operating performance value relevance sample is 9060, and the number of observations in the stock market value relevance sample is 9094. The sample intervals of innovation input in the two samples are consistent, and the small difference in the number of observations between the two samples is due to the deletion of missing values and Winsorization of data processing performed for the two samples separately so as to avoid excessive deletion of data. It can be seen that the descriptive statistics for the variables that coexist in the two samples, which are internal control and innovation input, are consistent, with only small deviations, indicating that the two samples are with consistent distribution characteristics.

Table 2. Descriptive sample statistics of the operating performance value relevance.

Variable	Unit	N	Mean	Std	Min	P25	Median	P75	Max
OPA	1	9060	0.12	0.10	−0.08	0.05	0.09	0.16	0.56
OPA (standardized)	-	9060	0.00	1.00	−1.97	−0.68	−0.23	0.42	4.34
RD	1	9060	0.02	0.02	1.2×10^{-7}	0.01	0.02	0.03	0.12
RD (standardized)	-	9060	0.00	1.00	−1.17	−0.73	−0.20	0.45	4.86
Int	1	9060	668.70	77.40	153.15	631.14	676.33	709.64	970.84
Int (standardized)	-	9060	0.00	1.00	−6.66	−0.49	0.10	0.53	4.09
Size	CNY	9060	21.91	1.26	17.64	21.02	21.71	22.57	28.51
Lev	%	9060	41.98	19.97	5.05	26.25	41.17	57.28	86.76
Age	year	9060	9.05	6.02	2	4	7	14	26
Tangi	%	9060	46.29	21.32	−1.49	30.29	45.82	62.49	89.76
Adv	%	9060	4.88	5.73	0.02	1.44	2.98	5.80	31.74

Table 3. Descriptive sample statistics of the stock market value relevance.

Variable	Unit	N	Mean	Std	Min	P25	Median	P75	Max
RET	CNY/share	9094	0.18	0.39	−0.96	−0.12	0.14	0.44	1.33
RET (standardized)	-	9094	0.00	1.00	−2.89	−0.76	−0.10	0.66	2.90
RD	1	9094	0.02	0.02	1.2×10^{-7}	0.01	0.02	0.03	0.12
RD (standardized)	-	9094	0.00	1.00	−1.27	−0.73	−0.20	0.44	4.93
Int	1	9094	668.03	77.28	153.15	630.67	675.87	709.06	970.84
Int (standardized)	-	9094	0.00	1.00	−6.66	−0.48	0.10	0.53	4.10
Adj_eps	CNY/share	9094	0.28	0.45	−3.60	0.06	0.21	0.44	4.70
ΔAdj_eps	CNY/share	9094	−0.02	0.34	−2.99	−0.15	0.00	0.12	2.473
Lev	%	9094	41.13	20.40	4.56	24.66	40.48	56.91	86.02
BVE	CNY/share	9094	4.01	2.30	0.02	2.45	3.52	4.99	24.47
Acc	CNY/share	9094	-0.01	0.59	−4.38	−0.23	0.00	0.21	3.94

4.2. Empirical Results

4.2.1. Moderating Effect of Internal Control on the Value Relevance of Innovation Input

Table 4 presents the regression results of Hypothesis 1, in which the first two columns are the regression results using the feasible generalized least squares (FGLS) approach, and the last two columns are the regression results under robust standard error. By comparing the coefficients of the two methods, there is no difference in the positive and negative directions of the coefficients whether using FGLS or the robust standard error approach. First, the results of Column (1) and Column (3) show that the coefficients of the firm's innovation input on its operating performance are 0.1807 and 0.1690, respectively, and they both have significant positive effects on the firm's operating performance at the 1% level. It indicates that increasing innovation input can promote a firm's operating performance. Then, after adding internal control and the interaction term between internal control and innovation input, the results in Column (2) and Column (4) show that the coefficient on internal control is also significantly positive, which means that internal control could effectively help improve the firm's operating performance. Furthermore, the correlation coefficient of the interaction term is significantly positive; that is, the better the internal control is, the stronger the positive promoting effect of innovation input on firm operating performance. Thus, the result is consistent with Hypothesis 1 and relevant existing literature [10,11].

In terms of market value, Table 5 shows the regression results of Hypothesis 2. The first two columns are the regression results under FGLS, and the last two columns are the regression results under robust standard error. First of all, innovation input and current stock return show a positive correlation, which is not consistent with Luo et al. [7] for the Chinese market evidence for two possible reasons. Firstly, the sample interval in Luo et al. [7] is before 2007 when new accounting standards were applied in China and the data on R&D investment were collected indirectly by deduction. Secondly, the Chinese market has been developing rapidly in recent years after 2007; therefore, the capital market efficiency has been improved, and more information can be easily reflected and absorbed by the market and investors. As for the moderating effect of internal control on innovation input, the results of Column (2) and Column (4) show that the coefficient of $Int_{it} \times RD_{i,t}$ is significantly positive as expected, which means that the better the internal control is, the stronger the positive promoting effect of innovation input on firm market value. Thus, Hypothesis 2 is supported.

Table 4. Regression results of operating performance value relevance.

Dependent: Operating Profit				
	FGLS		Robust	
$RD_{i,t-1}$	0.1807 ***	0.1596 ***	0.1690 ***	0.1467 ***
	(0.0083)	(0.0082)	(0.0095)	(0.0094)
$Int_{i,t-1}$		0.1212 ***		0.1456 ***
		(0.0066)		(0.0082)
$Int_{i,t-1} \times RD_{i,t-1}$		0.0312 ***		0.0263 ***
		(0.0068)		(0.0095)
$Size_{i,t-1}$	0.0622 ***	0.0306***	0.0979 ***	0.0544 ***
	(0.0057)	(0.0060)	(0.0079)	(0.0082)
$Lev_{i,t-1}$	−0.0108 ***	−0.0097 ***	−0.0109 ***	−0.0097 ***
	(0.0008)	(0.0008)	(0.0009)	(0.0009)
$Age_{i,t-1}$	−0.0022 *	−0.0019	−0.0032 **	−0.0021
	(0.0012)	(0.0012)	(0.0014)	(0.0013)
$Tangi_{i,t-1}$	0.0005	0.0006	0.0019 **	0.0021 ***
	(0.0007)	(0.0007)	(0.0008)	(0.0008)
$Adv_{i,t-1}$	0.1138 ***	0.1117 ***	0.1150 ***	0.1117 ***
	(0.0016)	(0.0017)	(0.0017)	(0.0017)
cons	−1.5995 ***	−1.0088 **	−2.3984 ***	−1.5661 ***
	(0.4129)	(0.4419)	(0.2667)	(0.2744)
N	9060	9060	9060	9060
Year	Yes	Yes	Yes	Yes
Indcd1	Yes	Yes	Yes	Yes
R^2	0.4937	0.4990	0.5746	0.5915

Robust standard errors in parentheses. * $p < 0.1$. ** $p < 0.05$. *** $p < 0.01$.

Table 5. Regression results of stock market value relevance.

Dependent: Stock Return				
	FGLS		Robust	
$RD_{i,t}$	0.0174 **	0.0126	0.0310 ***	0.0266 ***
	(0.0082)	(0.0082)	(0.0092)	(0.0090)
$Int_{i,t}$		0.0325 ***		0.0258 ***
		(0.0078)		(0.0090)
$Int_{\ i,t} \times RD_{i,t}$		0.0271 ***		0.0218 **
		(0.0071)		(0.0102)
$Adj\_Eps_{i,t}$	0.1398 ***	0.1184 ***	0.1228 ***	0.1039 ***
	(0.0198)	(0.0209)	(0.0214)	(0.0227)
$\Delta Adj\_Eps_{i,t}$	0.2869 ***	0.2824 ***	0.3175 ***	0.3132 ***
	(0.0231)	(0.0230)	(0.0279)	(0.0279)
$BVE_{i,t-1}$	−0.0326 ***	−0.0324 ***	−0.0412 ***	−0.0411 ***
	(0.0035)	(0.0035)	(0.0038)	(0.0038)
$Acc_{i,t-1}$	−0.0128	−0.0124	−0.0104	−0.0102
	(0.0128)	(0.0128)	(0.0141)	(0.0141)
$Lev_{i,t-1}$	−0.0012 ***	−0.0014 ***	−0.0026 ***	−0.0028 ***
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
cons	2.5558 ***	2.5584 ***	2.6509 ***	2.6518 ***
	(0.2307)	(0.2375)	(0.1529)	(0.1538)
N	9094	9094	9094	9094
Year	Yes	Yes	Yes	Yes
Ind1	Yes	Yes	Yes	Yes
R^2	0.5421	0.5432	0.5043	0.5051

Robust standard errors in parentheses. ** $p < 0.05$. *** $p < 0.01$.

The coefficient of Size is positive and significant, which means that the R&D strength of those large enterprises is often stronger and could help to improve their operating performance. The coefficient of Adv is positive and significant, which means that advertising intensity increases the exposure of the firm and can improve the firm's operating performance. The coefficients of Adj_Eps, ΔAdj_Eps and Acc are significantly positive, indicating the firm's positive profitability effect on its market value. The coefficient of BVE is significantly negative, which means that the higher BVE represents lower investment risk undertaken by the investor and lower excess return in the stock market. The coefficients of Lev are significantly negative, which means that unbalancing the debt-to-asset ratio could harm the firm's value, while optimizing the ratio of assets and liabilities can improve the firm's value. These regression results are consistent with relevant existing literature [2,4,7,11,15,47,52].

Comparing the magnitude of coefficients and their standard errors in the regression results of Tables 4 and 5, it can be found that results under robust standard error are more robust with larger estimated standard errors of those main variables. Moreover, the efficiency of the FGLS approach largely depends on whether the fitted weight matrix is accurate. If the accuracy of the fitted weight matrix cannot be assured, empirical results obtained using the FGLS model can be unstable. Therefore, in the following regression analysis, empirical results are derived adopting the OLS regression under robust standard error, unless otherwise specified.

4.2.2. Moderating Role of Internal Control in the Value Relevance of Innovation Input: Mechanism of Alleviating Agency Problems

For Hypothesis 3-1, Tables 6 and 7 give the regression results of firm operating performance and market value for different subsamples grouped according to the firm's severity of agency problems in the previous year, respectively. Panel A reports the regression results grouped by the adjusted management fee ratio (CG1), while Panel B reports the regression results grouped by whether the same person is serving as the chairman and CEO simultaneously (CG2).

As shown in Panel A of Tables 6 and 7, the promoting effects of internal control on a firm's value relevance with innovation input are only significant in the group with CG1 above the median. Moreover, the effects of internal control itself on firm value in terms of operating performance and market value are both greater either in statistical significance or coefficient magnitude in the groups with CG1 above the median. Therefore, the results show that under different levels of CG1, the moderating effects of internal control on a firm's value relevance with innovation input are significantly different. Moreover, in the full-sample regressions that control for CG1, the interaction term coefficients of internal control, R&D investment and CG1 are all significantly positive, which further proves that the promoting effect of internal control on a firm's value relevance with innovation input is more prominent in the group with a higher management fee ratio. One possible explanation for this result might be that for firms with a higher management fee ratio, the agency problems are more severe possibly because their corporate governance structure or business operation process are relatively weaker, and the strengthening of internal control could play a key role in finetuning and restructuring the business process, which can avoid the unreasonable arrangement of resources or wrongful decisions about the firm's innovation investment, thus finally improving the firm's value relevance with innovation input.

Table 6. Operating performance value relevance: grouped by severity of agency problems.

Dependent: Operating Profit				
Panel A: Grouped by CG1 (Adjusted Management Fee Ratio)				
	CG1 = 0	CG1 = 1	CG1	CG1
$RD_{i,t-1}$	0.1518 ***	0.1535 ***	0.1491 ***	0.1553 ***
	(0.0143)	(0.0127)	(0.0095)	(0.0139)
$Int_{i,t-1}$	0.1201 ***	0.1712 ***	0.1411 ***	0.1110 ***
	(0.0109)	(0.0133)	(0.0086)	(0.0108)
$Int_{i,t-1} \times RD_{i,t-1}$	−0.0008	0.0431 ***	0.0082	0.0032
	(0.0127)	(0.0127)	(0.0129)	(0.0128)
$CG_{i,t-2}$			−0.0069 (0.0156)	−0.0050 (0.0157)
$CG_{i,t-2} \times RD_{i,t-1}$				−0.0091 (0.0176)
$CG_{i,t-2} \times Int_{i,t-1}$				0.0693 *** (0.0167)
$CG_{i,t-2} \times Int_{i,t-1} \times RD_{i,t-1}$			0.0397 ** (0.0183)	0.0488 *** (0.0181)
cons	−1.0654 ***	−2.2237 ***	−1.5510 ***	−1.6094 ***
	(0.2416)	(0.3350)	(0.2776)	(0.2745)
N	4530	4530	9060	9060
Controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Indcd1	Yes	Yes	Yes	Yes
Robust	Yes	Yes	Yes	Yes
R^2	0.6398	0.5479	0.5918	0.5929
Panel B: grouped by CG2 (Duality—Whether the Same Person Is Serving as Chairman and CEO Simultaneously)				
	CG2 = 0	CG2 = 1	CG2	CG2
$RD_{i,t-1}$	0.1415 ***	0.1690 ***	0.1471 ***	0.1432 ***
	(0.0116)	(0.0158)	(0.0094)	(0.0112)
$Int_{i,t-1}$	0.1398 ***	0.1583 ***	0.1432 ***	0.1391 ***
	(0.0093)	(0.0184)	(0.0083)	(0.0092)
$Int_{i,t-1} \times RD_{i,t-1}$	0.0161	0.0529 ***	0.0163 *	0.0157
	(0.0100)	(0.0160)	(0.0098)	(0.0100)
$CG_{i,t-2}$			0.0161 (0.0167)	0.0155 (0.0167)
$CG_{i,t-2} \times RD_{i,t-1}$				0.0135 (0.0176)
$CG_{i,t-2} \times Int_{i,t-1}$				0.0193 (0.0195)
$CG_{i,t-2} \times Int_{i,t-1} \times RD_{i,t-1}$			0.0395 ** (0.0202)	0.0380 * (0.0200)
cons	cons	−1.3050 ***	−2.9053 ***	−1.5795 ***
		(0.2756)	(0.5193)	(0.2750)
N	6858	2202	9060	9060
Controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Indcd1	Yes	Yes	Yes	Yes
Robust	Yes	Yes	Yes	Yes
R^2	0.5959	0.5783	0.5918	0.5919

Robust standard errors in parentheses. * $p < 0.1$. ** $p < 0.05$. *** $p < 0.01$.

Table 7. Market value relevance: grouped by severity of agency problems.

Dependent: Stock Return				
Panel A: grouped by CG1 (Adjusted Management Fee Ratio)				
	CG1 = 0	CG1 = 1	CG1	CG1
$RD_{i,t}$	0.0310 **	0.0218 *	0.0253 ***	0.0267 **
	(0.0137)	(0.0116)	(0.0090)	(0.0133)
$Int_{i,t}$	0.0150	0.0389 ***	0.0241 ***	0.0216 *
	(0.0121)	(0.0130)	(0.0089)	(0.0118)
$Int_{i,t} \times RD_{i,t}$	0.0039	0.0383 **	0.0078	0.0068
	(0.0127)	(0.0157)	(0.0125)	(0.0129)
$CG_{i,t-1}$			0.0370 **	0.0370 **
			(0.0162)	(0.0162)
$CG_{i,t-1} \times RD_{i,t}$				−0.0023
				(0.0169)
$CG_{i,t-1} \times Int_{i,t}$				0.0058
				(0.0161)
$CG_{i,t-1} \times Int_{i,t} \times RD_{i,t}$			0.0331 *	0.0333 *
			(0.0196)	(0.0197)
cons	2.9221 ***	2.5076 ***	2.6110 ***	2.6104 ***
	(0.1054)	(0.1803)	(0.1581)	(0.1588)
N	4547	4547	9094	9094
Controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Indcd1	Yes	Yes	Yes	Yes
Robust	Yes	Yes	Yes	Yes
R^2	0.4950	0.5390	0.5057	0.5057
Panel B: grouped by CG2 (Duality—Whether the Same Person Is Serving as Chairman and CEO Simultaneously)				
	CG2 = 0	CG2 = 1	CG2	CG2
$RD_{i,t}$	0.0298 ***	0.0170	0.0267 ***	0.0301 ***
	(0.0108)	(0.0158)	(0.0090)	(0.0105)
$Int_{i,t}$	0.0237 **	0.0240	0.0236**	0.0275 ***
	(0.0109)	(0.0177)	(0.0093)	(0.0107)
$Int_{i,t} \times RD_{i,t}$	0.0100	0.0565 ***	0.0103	0.0109
	(0.0130)	(0.0178)	(0.0127)	(0.0129)
$CG_{i,t-1}$			0.0604 ***	0.0609 ***
			(0.0175)	(0.0176)
$CG_{i,t-1} \times RD_{i,t}$				−0.0121
				(0.0182)
$CG_{i,t-1} \times Int_{i,t}$				0.0176
				(0.0183)
$CG_{i,t-1} \times Int_{i,t} \times RD_{i,t}$			0.0427 *	0.0437 **
			(0.0221)	(0.0220)
cons	2.6085 ***	2.7219 ***	2.6386 ***	2.6401 ***
	(0.1397)	(0.2787)	(0.1519)	(0.1526)
N	6872	2222	9094	9094
Controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Indcd1	Yes	Yes	Yes	Yes
Robust	Yes	Yes	Yes	Yes
R^2	0.4947	0.5670	0.5062	0.5063

Robust standard errors in parentheses. * $p < 0.1$. ** $p < 0.05$. *** $p < 0.01$.

Panel B of Tables 6 and 7 exhibits the results for using whether the same person is serving as chairman and CEO simultaneously (CG2) as the proxy for the severity of agency problems. In the subsample regressions, the promoting effects of internal control on a firm's value relevance with innovation input are only significant in the group with the same person serving as chairman and CEO simultaneously. Moreover, the effects of internal control itself on firm value in terms of operating performance and market value are both greater either in statistical significance or coefficient magnitude in the groups with the same person serving as chairman and CEO simultaneously. In addition, in the full-sample regressions that control for CG2, the interaction term coefficients of internal control, R&D investment and CG2 are all significantly positive, which further proves that the promoting effect of internal control on a firm's value relevance with innovation input is more prominent in the group with the same person serving as chairman and CEO simultaneously. This is because the chairman leads the board of directors and is the most authoritative person in charge of the firm and the most authoritative representative of the interests of shareholders. The CEO is responsible for the firm's daily operations, the implementation of the firm business strategy and the execution of the decisions of the board of directors. Therefore, if the chairman is also the CEO of the firm, the chairman may shirk the supervision and management responsibility of the board of directors. Therefore, for firms with the same person serving as chairman and CEO simultaneously, the strengthening of internal control plays a bigger role in the supervision and management of various business operation processes along each stage of the innovation input, as well as in the improvement of the firm's external information disclosure, thus alleviating the negative effect of agency cost during the innovation process to a greater extent.

It is worth noting that the coefficients of CG1 and CG2 themselves are significantly positive in the regression results for stock return, which are inconsistent with expectations. One possible explanation for this could be that companies with more stringent corporate governance tend to be financially conservative [53], which can also explain why these positive effects only exist for a firm's stock return rather than operating performance. In addition, since this paper mainly focuses on the impact of $RD_i \times Int_i$, some factors related to corporate governance are likely not fully controlled in the regression models.

4.2.3. Moderating Role of Internal Control in the Value Relevance of Innovation Input: Mechanism from the Perspective of Risk Management

For Hypothesis 4, in order to further prove that internal control can improve a firm's value relevance with innovation input by reducing R&D risks and promoting the transformation of R&D outcomes, we further divide innovation input into expensed and capitalized R&D expenditure, with capitalized R&D expenditure representing the part with lower risk and expensed R&D expenditure representing the part with higher risk. Tables 8 and 9 report the regression results.

In the full samples of Tables 8 and 9, for observations with only total R&D expenditure entries without detailed expensed or capitalized R&D information, this paper assumes these R&D expenditures to be fully expensed according to the principle of China's new accounting standards. Meanwhile, in Column (3) and Column (4), these observations without detailed expensed or capitalized R&D information are deleted. Finally, 593 observations are deleted in the subsample of operating performance value relevance, and 596 observations are deleted in the subsample of market value relevance.

The results in Table 8 show that the interaction term between internal control and expensed R&D expenditure is significantly positive, while the interaction between internal control and capitalized R&D expenditure is positive but not significant. Similar results could be found for using stock return to evaluate the firm's value in Table 9. Therefore, it can be concluded that internal control could only play its promoting effect on the firm's value relevance with innovation input for expensed R&D expenditure. As mentioned earlier, this is because the expensed R&D expenditure represents the early development stage of innovation input with higher uncertainty and risk, and the value relevance was relatively small. Therefore, good internal control in the early innovation stages can better manage the innovation process by avoiding the waste of resources, alleviating operational risks, constraining management opportunistic behavior and improving information disclosure quality, thus leading to a more significant increase in the firm's value relevance with innovation input.

Table 8. Operating performance value relevance: risk management perspective.

	Dependent: Operating Profit			
	Full Sample		**Subsample—Null Deleted**	
$RDC_{i,t-1}$	0.0194 *	0.0181 *	0.0202 *	0.0195 *
	(0.0105)	(0.0102)	(0.0113)	(0.0109)
$RDE_{i,t-1}$	0.1718 ***	0.1495 ***	0.1745 ***	0.1522 ***
	(0.0096)	(0.0096)	(0.0099)	(0.0099)
$Int_{i,t-1}$		0.1442 ***		0.1502 ***
		(0.0083)		(0.0085)
$Int_{i,t-1} \times RDC_{i,t-1}$		0.0072		0.0092
		(0.0065)		(0.0070)
$Int_{i,t-1} \times RDE_{i,t-1}$		0.0238 **		0.0278 ***
		(0.0100)		(0.0098)
cons	−2.3106 ***	−1.4987 ***	−2.2774 ***	−1.4718 ***
	(0.2379)	(0.2481)	(0.2491)	(0.2536)
N	9060	9060	8467	8467
Controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Indcd1	Yes	Yes	Yes	Yes
Robust	No	No	Yes	Yes
R^2	0.5759	0.5924	0.5717	0.5894

Robust standard errors in parentheses. * $p < 0.1$. ** $p < 0.05$. *** $p < 0.01$.

Table 9. Market value relevance: risk management perspective.

	Dependent: Stock Return			
	Full Sample		**Subsample—Null Deleted**	
$RDC_{i,t}$	0.0179 **	0.0175 **	0.0188 **	0.0183 **
	(0.0079)	(0.0079)	(0.0082)	(0.0081)
$RDE_{i,t}$	0.0271 ***	0.0226 **	0.0290 ***	0.0241 **
	(0.0091)	(0.0089)	(0.0097)	(0.0094)
$Int_{,i,t}$		0.0257 ***		0.0277 ***
		(0.0091)		(0.0095)
$Int_{i,t} \times RDC_{i,t}$		0.0070		0.0034
		(0.0074)		(0.0080)
$Int_{i,t} \times RDE_{i,t}$		0.0212 **		0.0247 **
		(0.0104)		(0.0110)
cons	2.6406 ***	2.6405 ***	2.6382 ***	2.6381 ***
	(0.1459)	(0.1465)	(0.1472)	(0.1477)
N	9094	9094	8498	8498
Controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Indcd1	Yes	Yes	Yes	Yes
Robust	Yes	Yes	Yes	Yes
R^2	0.5044	0.5052	0.5028	0.5038

Robust standard errors in parentheses. ** $p < 0.05$. *** $p < 0.01$.

4.3. Discussion of Potential Endogeneity Problems

In order to prevent potential endogeneity problems from affecting the effectiveness of the results, this paper also adopts an instrumental variable approach and conducts 2SLS regression.

Firstly, referring to Luo et al. [7], this paper takes the industry average RD with the firm itself excluded in each time period as the instrument variable (IV_{RD}). According to Luo et al. [7], innovation investment in the same industry is highly positively correlated. At the same time, the operating profit of a certain firm is essentially not affected by the industrial average R&D investment level. Therefore, the industry average R&D investment (with the firm itself excluded) can be used as the IV for this study. In addition, although the DIB internal control index is a comprehensive indicator that has a good exogenous nature, in order to fully consider the endogeneity issue, referring to Chen et al. [13], this paper also makes use of the industry average Int with the firm itself excluded in each time period as the instrument variable (IV_{INT}) for internal control.

Table 10 presents the regression results for operating performance and stock return using the IV approach. The instrument variables for RD and Int both passed the under-identification test and weak IV test. Furthermore, compared with the regression results of baseline models, the main conclusions of this paper are still valid after considering the potential endogeneity problem.

Table 10. Value relevance for operating performance and market value: IV approach.

Panel A: Operating Profit	
$RD_{i,t-1}$	0.2629 **
	(0.1095)
$Int_{i,t-1}$	0.2266 ***
	(0.0752)
$Int_{i,t-1} \times RD_{i,t-1}$	0.3568 ***
	(0.1287)
cons	−1.7685 ***
	(0.6230)
Controls	Yes
N	9060
Year	Yes
Ind1	Yes
Under-identification (chi2)	33.945 ***
Weak identification (F)	6.79 *
Panel B: Stock Return	
$RD_{i,t}$	0.3298 ***
	(0.1218)
$Int_{i,t}$	0.1880 **
	(0.0734)
$Int_{i,t} \times RD_{i,t}$	0.2035 **
	(0.0887)
cons	2.4738 ***
	(0.4587)
Controls	Yes
N	9094
Year	Yes
Ind1	Yes
Under-identification (chi2)	51.654 ***
Weak identification (F)	10.348 **

Robust standard errors in parentheses. * $p < 0.1$. ** $p < 0.05$. *** $p < 0.01$.

5. Robustness Checks

5.1. Quantile Regressions

First, the OLS regression model mainly examines the mean effect and does not consider the possible influence that the distribution of variables may bring. In the robustness tests, this paper considers replacing the econometric model and referring to the method of Garciá-Manjón and Romero-Merino [54] to use the quantile regression method to verify the robustness of the relationship between internal control and the firm's value relevance with innovation input, as shown in Tables 11 and 12. By comparing with the results of OLS regression, the results of quantile regressions are essentially consistent with the OLS regression results. The main conclusions of this paper are still valid when the quantile regression model is adopted.

Table 11. Quantile regression results: operating performance value relevance.

	Dependent: Operating Profit			
	OLS	**0.25**	**0.5**	**0.75**
$RD_{i,t-1}$	0.1467 ***	0.1230 ***	0.1581 ***	0.1966 ***
	(0.0094)	(0.0073)	(0.0071)	(0.0100)
$Int_{i,t-1}$	0.1456 ***	0.1171 ***	0.1245 ***	0.1468 ***
	(0.0082)	(0.0071)	(0.0070)	(0.0097)
$Int_{i,t-1} \times RD_{i,t-1}$	0.0263 ***	0.0220 ***	0.0278 ***	0.0426 ***
	(0.0095)	(0.0066)	(0.0064)	(0.0090)
cons	−1.5661 ***	−1.6660 ***	−1.0351 ***	−1.0090 **
	(0.2744)	(0.3396)	(0.3325)	(0.4647)
N	9060	9060	9060	9060
Controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Indcd1	Yes	Yes	Yes	Yes
R^2	0.5915			

Robust standard errors in parentheses. ** $p < 0.05$. *** $p < 0.01$.

Table 12. Quantile regression results: stock market value relevance.

	Dependent: Stock Return			
	OLS	**0.25**	**0.5**	**0.75**
$RD_{i,t}$	0.0266 ***	0.0041	0.0117	0.0178
	(0.0090)	(0.0106)	(0.0098)	(0.0116)
$Int_{i,t}$	0.0258 ***	0.0109	0.0449 ***	0.0267 **
	(0.0090)	(0.0107)	(0.0099)	(0.0117)
$Int_{i,t} \times RD_{i,t}$	0.0218 **	0.0083	0.0182 **	0.0276 ***
	(0.0102)	(0.0095)	(0.0087)	(0.0104)
cons	2.6518 ***	2.2603 ***	2.6957 ***	2.8465 ***
	(0.1538)	(0.5148)	(0.4744)	(0.5623)
N	9094	9094	9094	9094
Controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Indcd1	Yes	Yes	Yes	Yes
R^2	0.5051			

Robust standard errors in parentheses. ** $p < 0.05$. *** $p < 0.01$.

5.2. Change the Explained Variable

This paper then adopts the method of changing explained variables to carry out the robustness test. For operating performance, this paper uses gross profit (OPMA) and the increment of OPA (DOPA) as the explained variables, and for stock market performance, this paper uses the stock return at the end of April (RETL) and the adjusted stock price (ADP) as the explained variables in the robustness test [4,15]. The regression results are reported in Tables 13 and 14. We can see that the coefficient of innovation input, the coefficient of internal control and the coefficients of the interaction term between internal control and innovation input are still significantly positive.

Table 13. Replacing explained variable: operating performance value relevance.

Dependent	**$DOPA_{i,t}$**		**$OPMA_{i,t}$**	
$RD_{i,t-1}$	0.1085 ***	0.0869 ***	0.1788 ***	0.1592 ***
	(0.0125)	(0.0125)	(0.0094)	(0.0093)
$Int_{i,t-1}$		0.1311 ***		0.1234 ***
		(0.0107)		(0.0083)
$Int_{i,t-1} \times RD_{i,t-1}$		0.0394 ***		0.0305 ***
		(0.0106)		(0.0088)
cons	−1.9393 ***	−1.2085 ***	−0.4747 **	0.2208
	(0.4070)	(0.4120)	(0.2067)	(0.2061)
N	9060	9060	9060	9060
Controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Indcd1	Yes	Yes	Yes	Yes
Robust	Yes	Yes	Yes	Yes
R^2	0.0697	0.0835	0.5539	0.5661

Robust standard errors in parentheses. ** $p < 0.05$. *** $p < 0.01$.

Table 14. Replacing explained variable: stock market value relevance.

Dependent	**$RETL_{i,t}$**		**$ADP_{i,t}$**	
$RD_{i,t}$	0.0273 ***	0.0230 ***	0.1547 ***	0.1517 ***
	(0.0078)	(0.0078)	(0.0098)	(0.0099)
$Int_{i,t}$		0.0263 ***		0.0214 **
		(0.0077)		(0.0107)
$Int_{i,t} \times RD_{i,t}$		0.0207 ***		0.0286 ***
		(0.0073)		(0.0098)
cons	−0.7955 ***	−0.7947 ***	−0.1857 **	−0.1827 **
	(0.2054)	(0.2016)	(0.0767)	(0.0737)
N	9094	9094	9094	9094
Controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Indcd1	Yes	Yes	Yes	Yes
Robust	No	Yes	Yes	No
R^2	0.5934	0.5941	0.4508	0.4521

Robust standard errors in parentheses. ** $p < 0.05$. *** $p < 0.01$.

5.3. Change the Moderator Variable

This paper also uses whether internal control defects are reported in the previous year as the alternative moderator variable for the DIB internal control index [25]. The internal control defects reported in the previous year are divided into three categories: general defects, important defects and major defects. If any defect is reported by the enterprise in the given year, Sub_Int is denoted as 0, and if no internal control defect is reported, it is denoted as 1. These kinds of internal control defects data were collected from the CSMAR Database. We can see from Tables 15 and 16 that the coefficients of the interaction terms are all significantly positive, indicating that the impact of innovation input on firm value is greater for enterprises without internal control defects.

Table 15. Replacing moderator variable: operating performance value relevance.

Dependent	$OPA_{i,t}$		$DOPA_{i,t}$		$OPMA_{i,t}$	
$RD_{i,t-1}$	0.1286 ***	0.1638 ***	0.0619 **	0.0980 ***	0.1070 ***	0.1548 ***
	(0.0220)	(0.0222)	(0.0258)	(0.0264)	(0.0203)	(0.0205)
$Sub\_Int_{i,t-1}$	0.0661 ***	0.0623 ***	0.0251	0.0241	0.0637 ***	0.0577 ***
	(0.0187)	(0.0184)	(0.0254)	(0.0256)	(0.0189)	(0.0183)
$Sub\_Int_{i,t-1} \times RD_{i,t-1}$	0.0468 **	0.0410 *	0.0554 **	0.0467 *	0.0849 ***	0.0724 ***
	(0.0233)	(0.0230)	(0.0276)	(0.0274)	(0.0217)	(0.0215)
cons	−2.5203 ***	−2.4933 ***	−1.9721 ***	−1.8203 ***	−0.5779 ***	−0.7725 ***
	(0.2695)	(0.2136)	(0.4090)	(0.2954)	(0.2118)	(0.2224)
N	9060	9060	9060	9060	9060	9060
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Indcd1	No	Yes	No	Yes	No	Yes
Indcd2	Yes	No	Yes	No	Yes	No
Robust	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.5753	0.5927	0.0701	0.0857	0.5552	0.5787

Robust standard errors in parentheses. * $p < 0.1$. ** $p < 0.05$. *** $p < 0.01$.

Table 16. Replacing moderator variable: market value relevance.

Dependent	$RET_{i,t}$		$RETL_{i,t}$		$ADP_{i,t}$	
$RD_{i,t}$	−0.0015	−0.0099	−0.0082	−0.0169	0.0821 ***	0.0860 ***
	(0.0209)	(0.0213)	(0.0152)	(0.0153)	(0.0181)	(0.0179)
$Sub\_Int_{i,t}$	0.0915 ***	0.0888 ***	0.0573 ***	0.0551 ***	0.1453 ***	0.1615 ***
	(0.0195)	(0.0197)	(0.0172)	(0.0173)	(0.0197)	(0.0191)
$Sub\_Int_{i,t} \times RD_{i,t}$	0.0377 *	0.0387 *	0.0422 **	0.0445 ***	0.0857 ***	0.0827 ***
	(0.0223)	(0.0224)	(0.0169)	(0.0168)	(0.0201)	(0.0196)
cons	2.5440 ***	1.6739 ***	−0.8607 ***	−0.5192 ***	−0.3531 ***	−0.0080
	(0.1520)	(0.1179)	(0.2062)	(0.1008)	(0.0770)	(0.1313)
N	9094	9094	9094	9094	9094	9094
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Ind1	Yes	No	Yes	No	Yes	No
Ind2	No	Yes	No	Yes	No	Yes
Robust	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.5057	0.5102	0.5940	0.5974	0.4546	0.4877

Robust standard errors in parentheses. * $p < 0.1$. ** $p < 0.05$. *** $p < 0.01$.

6. Conclusions and Discussions

More and more attention has been paid to firms' innovation in recent academic research. There is no doubt that innovation input can create great value for the sustainable development and rapid growth of firms. However, as a high-risk activity that involves great uncertainties, innovation input may not bring the expected effect on firms' R&D outcomes. Therefore, attention to innovation should not only be paid to the quantity invested but should also focus on the improvement of innovation quality. Therefore, how to make innovation input more related and transformable to a firm's ultimate value is an increasingly important issue.

Internal control is an important mechanism to improve corporate governance and strengthen corporate risk management. This paper uses the data of Chinese A-share listed firms with non-zero innovation investment from 2007 to 2017 and links the value relevance of innovation investment with internal control from the perspective of operating performance and market value. This paper empirically verifies that internal control significantly increases the value relevance of innovation input, that is, the better the internal control, the more innovation investment contributes to the operating performance and market value of a firm [10–12]. In addition, internal control's moderating effect on the value relevance of innovation input is more prominent for firms with relatively more severe agency problems and for expensed R&D expenditure which represents the part of innovation investment with higher uncertainty.

To further interpret the above findings, two potential mechanisms are listed as follows. On the one hand, internal control can improve corporate governance and help to alleviate the principal-agent problems so that the managers could make innovation input decisions more consistent with the shareholders' value [25]. Meanwhile, internal control could foster better information disclosure and bring about stricter supervision from outside investors, which also effectively reduces the management opportunism and facilitates better supervision and management of the firm's innovation and business operation process [34,35]. On the other hand, better internal control strengthens the firm's risk management. Good internal control in the early innovation stages can better manage the innovation process by avoiding the waste of resources, alleviating operational risks, constraining management opportunistic behavior and improving information disclosure quality [22,36,38,44].

This paper also provides relevant guidance for firms to improve their internal control and enhance the quality of their innovation input. On the one hand, firms should establish a complete and efficient internal control system to proactively monitor the innovation process and manage the risk so as to ensure that the goals and objectives of each phase of R&D could be achieved and improve innovation efficiency. On the other hand, firms should eradicate the potential obstacles that could hinder the progress of R&D in a timely manner by encouraging information sharing, imposing stricter supervision on management decisions and facilitating information disclosure with the external stakeholders so as to create a good innovation environment and a transparent information exchange and communication channel for both within the firm and with the outside stakeholders.

There are also some limitations in the current study. This study is based on the data of listed firms in the Chinese A-share market; hence, the results derived are based on the sample of data used for the study and may not apply to the practice of other countries. Therefore, further efforts need to be made to extend the research framework to find empirical evidence from other countries. In addition, in the quantile regression of the robustness checks, this paper finds that the higher the quantile, the stronger the positive effect of internal control on a firm's value relevance with innovation input. Thus, further in-depth investigation needs to be conducted to more accurately define the research question and identify the potential mechanisms.

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