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Supervision or Collusion? Common Institutional Ownership and Corporate R&D Manipulation

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Abstract: R&D manipulation is a subjective manipulation of R&D accounting accounts by management that ignores the facts about R&D. It has a negative impact on the innovation performance of the company as well as the decision-making activities of external stakeholders. Hence, it is crucial to seek solutions to control this dishonest behaviour accurately. In recent years, the phenomenon of common institutional ownership has become increasingly widespread in the capital markets and has a significant impact on the strategic decisions of companies. There are currently two views on the corporate governance role of common institutional ownership: the synergistic governance effect and the collusive fraud effect. This paper selects Chinese A-share listed firms from 2009-2021 as a research sample to examine the impact of common institutional ownership on corporate R&D manipulation. The study found that common institutional ownership can inhibit corporate R&D manipulation. The higher the degree of their linkage and the greater the shareholding, the more pronounced the synergistic effect. The findings remained valid after testing using propensity score matching (PSM) and changing the sample period. Heterogeneity analysis shows that the inhibiting effect of common institutional ownership on corporate R&D manipulation is more pronounced in high-tech firms and firms which stay in the growth and maturity stage. This paper enriches the research on the economic consequences of common institutional ownership and provides management implications for implementing the innovation-driven strategy in China.

Keywords: Common Institutional Ownership; R&D Manipulation; Synergistic Governance Effect; Collusive Fraud Effect.

1. Introduction

Innovation is one of the most potent driving forces leading development (Frenz & Prevezer, 2012; Triguero et al., 2014; Wang et al., 2021). To achieve high-quality development and cultivate differentiated competitive advantages, enterprises must focus on independent innovation and R&D activities (Sun, 2021). In order to promote and support enterprises' R&D innovation and enhance their incentive to invest in R&D, China has introduced a series of tax incentives and preferential policies: including supportive tax incentives to support high-tech enterprises and universal tax preferences represented by R&D expenses plus deductions (Zhou et al., 2017; Tian et al., 2021). However, it should be noted that while the above policies have reduced the R&D burden of enterprises and motivated them to improve their innovation, they have also induced R&D manipulation by some enterprises (Walter et al., 2020). Some enterprises strategically keep their R&D expenditure near the threshold of the innovation incentive policy to meet the minimum R&D subsidy application criteria, i.e., they do not engage in substantive R&D and innovation activities to seek technological advancement or product upgrading but in R&D manipulation and innovation pandering for the purpose of stealing policy dividends (Wang et al., 2021). At the same time, manipulation of R&D for improper purposes by inflating or adjusting R&D investment occurs due to various incentives such as tax policy bonuses, profit smoothing, reducing tax liabilities and satisfying managers' self-interest (Lim et al., 2004). This has seriously undermined the original positive effect of policy innovation incentives and has led to an innovation strategy of "quantity over quality" (Bereskin et al., 2018). As such, adverse selection behaviour by firms can divert some of the scarce innovation resources to firms that cater to policy rather than substantive innovation, resulting in implementing government innovation incentives that run counter to the policy objectives.

R&D activities are characterized by high uncertainty and complexity, which further increases the degree of information asymmetry between external and corporate R&D activities and provides a "breeding ground" for companies to engage in R&D manipulation (Bushman et al., 2004; Acharya & Xu, 2017; Bianchini & Pellegrino, 2019). Existing studies have shown that the motives for enterprises to implement R&D manipulation usually include the following categories: firstly, strategic motivations. Under the tax relief incentive of specific thresholds, enterprises can only obtain high-tech enterprise recognition and thus enjoy various tax incentives if they meet the R&D level standards (Kothari et al., 2016; Bennett et al., 2017). To obtain these resources, enterprises have an intrinsic incentive to manipulate R&D. Secondly, the tax avoidance motivation. To reduce the tax burden, there is a possibility of upward manipulation and other distortions used by companies to obtain the universal tax benefits represented by the deduction of R&D expenses (Chan et al., 2013). The rise in R&D manipulation not only hinders R&D efficiency and leads to a decline in future innovation output and innovation quality but also negatively affects market performance, distorts the content of innovation incentives and results in a drain on national tax resources (Chen et al., 2016). Therefore, how to curb enterprises' innovation catering behaviour and ensure that government innovation incentives' positive effects are not distorted is an important issue facing the effective implementation of China's innovation-driven strategy.

Since 2000, when the China Securities Regulatory Commission (CSRC) first proposed the "extraordinary development of institutional investors", the scale of institutional investors in China has expanded rapidly. In recent years, the phenomenon of institutional investors

holding stakes in multiple firms in the same industry has gradually increased, which is referred to as "common institutional ownership" (He & Huang, 2017; Azar et al., 2018). Common institutional ownership has led to increasing linkages between firms in the same industry and has had a significant impact on micro-firm behaviour (Brooks et al., 2018). Compared to other shareholders and institutional investors, co-institutional investors act as "industry pivots" in the capital market and have an advantage regarding private information, management knowledge and industry experience (Chen et al., 2021). Moreover, co-institutional investors act as specialized majority shareholders, often with the aim of holding stakes in multiple companies (Gao et al., 2019). With the goal of enhancing portfolio value, co-institutional investors are more concerned about the economic consequences of major corporate decisions (Gao et al., 2019) and can exert substantial influence on corporate management and investment decisions by influencing the board of directors and management (Gilje et al., 2020; Koch et al., 2021). So, does the introduction of common institutional ownership have an impact on corporate R&D manipulation? Does it function as synergistic governance or collusive fraud?

Based on the review and discussion of the abovementioned important literature, this paper selects Chinese A-share listed firms from 2009-2021 as a research sample to study the impact of common institutional ownership on corporate R&D manipulation. The main contributions of this paper are as follows. First, this paper contributes to the study of how to effectively respond to corporate R&D manipulation by identifying the common institutional ownership from the perspective of external governance mechanisms. In addition, this paper enriches the research on the economic consequences of common institutional ownership. Finally, this study may provide practical implications for policymakers to effectively curb the trend of corporate R&D manipulation and implement the innovation-driven strategy.

2. Hypothesis Development

Although the government has implemented a series of innovation incentive policies, such as government financial subsidies, R&D expenses plus deductions and high-tech enterprise qualification, to encourage enterprises to innovate on their own, enterprises as complex and rational individuals may disguise themselves in this cooperative game with the government to obtain various policy benefits (Gunny, 2010; Kothari et al., 2016). Firms can manipulate R&D investment to signal to the government that they are falsely catering for innovation capacity, countering the innovation incentive as a tax avoidance channel for firms (Le Bas et al., 2015; Cortes, 2021). At the same time, due to the high cost of information collection and screening, the government, as a supplier of policy incentives, is unable to distinguish in a timely manner whether an enterprise that meets the rigid policy threshold is a "genuine innovation" or a "pseudo-innovation" enterprise, thus leading to a failure of government choice and rendering the incentive mechanism of industrial policy a mere formality (Melnyk et al., 2014; Liu et al., 2019). In recent years, the corporate governance role of common institutional ownership has attracted much attention from academics and industry. However, there is no unanimous conclusion on the corporate governance role of common institutional ownership, and there are mainly two types of views: "synergistic governance" and "collusive fraud". Based on this, the paper argues that common institutional ownership may have a dual impact on the corporate R&D manipulation and formulates the following competing hypotheses.

2.1. The Synergistic Governance Effect of Common Institutional Ownership

Co-institutional investors hold equity for the long term and are more concerned about the strategic decisions and economic consequences of the companies they are linked to (Koch et al., 2021). As a result, co-institutional investors tend to be more forward-thinking in strategy, have a higher risk-taking capacity, and have longer-term investment horizons (Schmalz, 2018; Ramalingegowda et al., 2020). Hence, the introduction of common institutional ownership and a diversified shareholding structure will not only increase the incentive for shareholders to participate in monitoring but will also provide a suitable mechanism for monitoring and checking the manipulation of R&D investment by major shareholders, thus promoting the practice of "genuine innovation". Moreover, companies engaging in R&D manipulation behaviour can leave the benefits of innovation in an ineffective lockstep for a long time (Papageorgiou et al., 2001). In the long run, this is detrimental to the company's ability to increase its core competencies and corporate value and indirectly harms the interests of co-institutional investors (Salinas et al., 2018). In this case, the co-institutional investor plays a supervisory role in the long-term health of the company and its long-term interests so that R&D manipulation behaviour does not occur easily.

Compared to individual institutional investors, co-institutional investors have a greater incentive and ability to monitor and govern the companies within their portfolio and to professionalize the corporate governance structure (Gao et al., 2019). In addition, co-institutional investors can effectively curb executives' short-sighted and self-interested tendencies and reduce agency costs between shareholders and executives (Koch et al., 2021), thereby enhancing the "genuine innovation" by executives. On the other hand, co-institutional investors have an advantage over ordinary institutional investors in terms of private information, management knowledge and industry experience. They can play a more vital external oversight role, exerting substantial influence on corporate management and investment decisions through the board of directors (Ramalingegowda et al., 2020). Voting against and the threat of exit are effective means of monitoring governance by co-institutional investors. Co-institutional ownership increases the probability of voting against management, suggesting that co-institutional investors can take into account the negative externalities of poor governance on other companies in the portfolio (Schmalz, 2018), as is the case of corporate R&D manipulation. Accordingly, this paper proposes the following hypothesis:

Hypothesis 1a: Common institutional ownership can inhibit corporate R&D manipulation.

2.2. The Collusive Fraud Effect of Common Institutional Ownership

The preceding discussion is based on shareholder activism, i.e., co-institutional investors use their industry-specific strengths to improve corporate governance actively. However, because of the profit-seeking nature of capital, co-institutional investors naturally act with an eye to those who affect their interests. This means that the governance effects of co-institutional investors are not always effective and positive.

For example, institutional investors may hold multiple companies in the same industry for risk diversification or frequent trading and have no incentive to participate actively in governance. In this case, co-institutional investors are "profit-seeking" and aim to maximize the value of their short-term gains (Azar et al., 2018). Still, they may instead coincide with the preference of professional managers to pursue the benefits of corporate R&D manipulation, resulting in only theoretical supervision of R&D manipulation behaviour. Companies are naturally inert in environmental governance and need external pressure to take practical action (Kim et al., 2021; Nardi, 2022). However, suppose the regulatory environment is lax or external force is insufficient. In that case, it is challenging to meet the institutional requirements for ethical restraint and the fulfilment of "genuine innovation", providing sufficient conditions for companies to manipulate R&D investment and conduct "pseudo-innovation".

Co-institutional investors have the incentive and ability to lead the creation of "collusive alliances" (Azar et al., 2018), where the need to profit from information advantages may replace the need for cultivating firms' core capabilities. With this motivation, common institutional ownership may create information barriers between companies in the same industry (Ramalingegowda et al., 2020), resulting in information asymmetry in the industry. Based on the theory of information asymmetry, when the government, investors and the media have limited and differentiated information within a company, this bias can lead to a failure of government choice and misallocation of resources (Dyck et al., 2010), the inability of a large number of investors to access the financial market (Chan et al., 2015), and the difficulty of various media to adequately perform their monitoring functions (Osma, 2008; Gomber et al., 2018), which seriously hinders the effective operation of innovation resources. Accordingly, this paper proposes the following hypothesis:

Hypothesis 1b: Common institutional ownership can exacerbate corporate R&D manipulation.

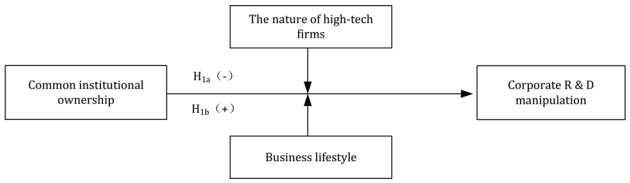

Figure 1. Conceptual framework

3. Methodology

3.1. Sample and Data Collection

To examine the hypotheses above, we selected Chinese-listed firms on the Shanghai and Shenzhen Stock Exchanges from 2009 to 2021 as the research sample. Due to the outbreak of the financial crisis in 2008, protectionist thinking began to spread, and a trend of "counter-globalization" emerged, which had a substantial impact on the business environment of domestic and foreign markets. Therefore, given the background of the financial crisis and the lack of data, this paper has selected data from 2009 onwards. We ended our research period in 2021 because it was the most recent data we could obtain when we started this study. We collected the data mainly from the Chinese Securities Market and Accounting Research (CSMAR) database, which provides detailed financial data and has been widely used in other relevant studies (Chen et al., 2016; Shi & Zhu, 2021). The data used to calculate the degree of R&D manipulation was derived from the CMSAR database. Common institutional ownership data was obtained manually from the CSMAR database at the corporate governance quarterly level. Data such as financial data and basic company characteristics used in this study are obtained from the CSMAR database. In contrast, data on relevant corporate annual reports are obtained from the official websites of the Shenzhen Stock Exchange and the Shanghai Stock Exchange.

Considering the financial industry's unique characteristics and data reliability, we excluded firms from the financial industry sector. All continuous variables were winsorized at the 1st and 99th percentiles to alleviate the effect of extreme values on the empirical results. Besides, we excluded the firms with the "special treatment" label and newly listed firms to make the data more reliable. After eliminating the samples with missing values, we finally obtained unbalanced panel data with 23072 firm-year observations.

3.2. Measures

3.2.1. Dependent Variable

The dependent variable in this paper is *R&D manipulation* (ABRD). Referring to the existing literature (Sun, 2021), the following model is used for estimation in this paper:

$$\frac{RD_{i,t}}{TA_{i,t-1}} = \beta_0 + \beta_1 \times \frac{1}{TA_{i,t-1}} + \beta_2 \times MV_{i,t} + \beta_3 \times TBQ_{i,t} + \beta_4 \times \frac{INT_{i,t}}{TA_{i,t-1}} + \beta_5 \times \frac{RD_{i,t-1}}{TA_{i,t-1}} + \varepsilon_{i,t} \quad (1)$$

$$NORMAL\_RD_{i,t} = \hat{\beta}_0 + \hat{\beta}_1 \times \frac{1}{TA_{i,t-1}} + \hat{\beta}_2 \times MV_{i,t} + \hat{\beta}_3 \times TBQ_{i,t} + \hat{\beta}_4 \times \frac{INT_{i,t}}{TA_{i,t-1}} + \hat{\beta}_5 \times \frac{RD_{i,t-1}}{TA_{i,t-1}} \quad (2)$$

$$ABNORMAL\_RD_{i,t} = \frac{RD_{i,t}}{TA_{i,t-1}} - NORMAL\_RD_{i,t} \quad (3)$$

In the above model, RD is the R&D expenditure for the year, MV is the market capitalization of the firm taking the natural logarithm, INT is the operating profit, TA is the total assets, NORMAL_RD is the normal R&D expenditure estimated from models (1) and (2), and ABNORAML_RD then represents the company's abnormal R&D expenditure, i.e., the amount of R&D manipulation.

To count the degree of R&D manipulation, the absolute value of the abnormal R&D expenditure amount (ABNORMAL_RD) is treated in this paper. Finally, to eliminate the problem of significant differences in the order of magnitude between variables, the absolute value is multiplied by 100, and the larger the value of this variable is, the stronger the degree of R&D manipulation of the company.

3.2.2. Independent Variable

The independent variable in this paper is *common institutional ownership* (Coz). Referring to the existing literature (He and Huang, 2017; Chen et al., 2021), this paper constructs indicators from three dimensions:

(1) A common institutional ownership dummy variable (*Coz*), if there is a co-institutional investor in the year holdings in the listed company, Coz1 is 1; otherwise, it is 0, where co-institutional investors are those who hold shares in two or more companies in the same industry both institutional investors holding not less than 5% of shares in two or more companies in the same industry.

(2) The degree of common institutional ownership linkage (*Coz2*) indicates the number of common institutional investors that collectively own the listed company, plus one to take the natural logarithm.

(3) Common institutional ownership shareholding (*Coz3*) equals the sum of the shareholdings of all co-institutional investors owned by a listed company during the year.

During the calculations, the independent variables are constructed based on quarterly data. Suppose a co-institutional investor holds a firm in any quarter of a year. In that case, the firm is judged to have common institutional ownership during the year. The average value of the quarterly indicators is taken as the corresponding annual indicator data.

3.2.3. Control Variables

Referring to existing research on common institutional ownership and R&D manipulation (He & Huang, 2017; Kang et al., 2018; Sun, 2021), several following control variables were considered in this paper. First, the size of a firm is a fundamental factor influencing strategic decisions and a significant source of firm heterogeneity. We controlled the firm size (*Size*) and measured it as the natural logarithm of its total assets. Besides, we controlled the firm age (*Age*) and measured it as the natural logarithm of the years a firm has existed since its foundation. Then, as mentioned above, financial factors are essential antecedents that drive firms' R&D manipulation behaviour. We controlled three main financial indicators of the firm. Asset-liability ratio (*Lev*) was measured as the total liabilities at the end of the year divided by total assets at the end of the year. We controlled return on assets (*ROA*) and measured it as net profit divided by the average balance of total assets. The percentage of fixed assets (*Fixed*) was calculated as the ratio of net fixed assets to total assets. Loss-making enterprises (*Loss*), which was a dummy variable and net profit of the enterprise for the year less than 0 is taken as "1", otherwise "0".

Besides, stakeholders inside and outside the firm play essential roles in corporate governance and are likely to influence firms' R&D manipulation behaviour. Hence, we took the following control variables into account. CEO Duality (*Dual*), which was a dummy variable and "1" indicated the chairman and managing director are the same person, "0" otherwise. Big Four Accounting Firms (*Big4*), which was also a dummy variable and "1" indicated the firm was audited by one of the Big Four accounting firms (PwC, Deloitte, KPMG, Ernst & Young), "0" otherwise. Management shareholding (*Mshare*) was calculated as the shareholdings of management divided by total share capital. Ownership Concentration (*Top1*) was measured as shares held by the top shareholder divided by the total shares. Finally, we controlled the year and industry dummy to account for unobserved factors influencing corporate R&D manipulation.

4. Results

4.1. Descriptive Statistics and Correlation Analysis

Table 1 presents the descriptive statistics of all variables. For each variable, we report the number of firm-year observations, mean, standard deviation, minimum value and maximum value. As shown in Table 1, the mean value of *ABRD* is 0.534, indicating that corporate R&D manipulation is a common problem. The mean of *Coz* is 0.106, indicating that the proportion of sample firms with common institutional ownership is 10.6%. Besides, the descriptive statistics of control variables are within a reasonable range, implying that outliers are unlikely to be a severe problem in this paper.

Table 1. Descriptive statistics

	Observations	Mean	SD	Min	Max
1.ABRD	23072	0.534	0.677	0.004	8.607
2.Coz	23072	0.106	0.308	0.000	1.000
3.Size	23072	21.969	1.276	19.236	26.398
4.Lev	23072	0.433	0.206	0.027	0.991
5.Age	23072	2.746	0.411	0.693	3.555
6.ROA	23072	0.041	0.066	-0.398	0.245
7.Fixed	23072	0.229	0.170	0.002	0.806
8.Loss	23072	0.100	0.300	0.000	1.000
9.Dual	23072	0.246	0.431	0.000	1.000
10.Big4	23072	0.057	0.232	0.000	1.000
11.Mshare	23072	0.118	0.193	0.000	0.706
12.Top1	23072	0.356	0.152	0.083	0.758

Table 2 shows the Pearson correlation coefficient matrix for the main variables examined in this paper. The maximum correlation coefficient is 0.51, indicating the multicollinearity problem between the variables is not severe, and the regression analysis can be further conducted.

Table 2. Correlation analysis

	1	2	3	4	5	6	7	8	9	10	11	12
1.ABRD	1.00											
2.Coz	-0.02***	1.00										
3.Size	-0.11***	0.26***	1.00									
4.Lev	-0.11***	0.12***	0.44***	1.00								
5.Age	-0.10**	0.06***	0.24***	0.11***	1.00							
6.ROA	0.09***	-0.00	0.00	-0.39***	-0.10***	1.00						
7.Fixed	-0.08***	0.13***	0.06***	0.11***	-0.09***	-0.10***	1.00					
8.Loss	0.01	-0.01*	-0.06***	0.20**	0.06**	-0.51***	0.07***	1.00				
9.Dual	0.06***	-0.08***	-0.13***	-0.16***	0.00	0.07***	-0.13***	-0.01***	1.00			
10.Big4	-0.02***	0.17***	0.34***	0.09***	0.01**	0.04***	0.06***	-0.03***	-0.05***	1.00		
11.Mshare	0.08***	-0.14***	-0.26***	-0.34***	-0.10***	0.20***	-0.21***	-0.09***	0.28***	-0.10***	1.00	
12.Top1	-0.03***	0.04***	0.17***	0.05***	-0.20***	0.13***	0.10***	-0.10***	-0.07***	0.13***	-0.11***	1.00

Note: This table reports the Pearson correlation metrics; ***p <0.01, **p <0.05, *p < 0.1

4.2. Regression Results

In this paper, we adopted fixed-effects ordinary least squares (OLS) estimation to control any potential time-invariant unobserved heterogeneity. We also controlled year and industry effects in our study to exclude the possible effects of time factors and industry characteristics.

Table 3. Regression analysis

	Model 1	Model 2
Variables	ABRD	ABRD
Size	-0.024***	-0.027***
	(-3.34)	(-3.27)
Lev	0.036*	0.039*
	(1.64)	(1.83)
Age	-0.047*	-0.048*
	(-1.79)	(-1.80)
ROA	1.534***	1.526***
	(2.92)	(2.88)
Fixed	-0.280***	-0.284***
	(-6.03)	(-6.05)
Loss	0.220***	0.219***
	(8.37)	(8.22)
Dual	0.035***	0.036***
	(6.58)	(6.59)
Big4	0.038**	0.033**
	(2.37)	(2.24)
Mshare	-0.022	-0.017
	(-0.35)	(-0.27)
Top1	0.015	0.017
	(0.60)	(0.68)
Coz		**-0.049*** **
		(-3.10)
Constant	1.078***	1.135***
	(8.89)	(4.68)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Adjusted-R^2	0.094	0.102
Observations	23072	23072

Note: t-statistics in parentheses. ***p <0.01, **p <0.05, *p < 0.1

Table 3 displays the fixed-effects OLS regression results.

Model 1 is the baseline model that includes all the control variables. Model 2 examines the relationship between common institutional ownership and corporate R&D manipulation. The coefficient of *Coz* is significantly negative (β = -0.049, p < .01), indicating a negative relationship between the common institutional ownership and corporate R&D manipulation. In other words, common institutional ownership can inhibit corporate R&D manipulation behaviour, supporting Hypothesis 1a.

4.3. Robustness Tests

4.3.1. Propensity Score Matching

Considering that sample selection bias may bring about endogeneity problems, this paper adopts the propensity score matching method for correction. Propensity score matching (PSM) is a common method to mitigate the endogeneity problem caused by omitted variables and sample selection bias. Drawing on existing research, we adopt the one-to-one nearest neighbour matching method and select a series of control variables mentioned above as matching variables to find the control group with similar characteristics to the treatment group. In this paper, firms with common institutional ownership are used as the treatment group, and firms without common institutional ownership are used as the control group.

Table 4. Robustness test: Propensity score matching

	Model 1
Variables	ABRD
Size	-0.017*
	(-1.87)
Lev	0.013
	(0.30)
Age	-0.061***
	(-2.71)
ROA	2.315***
	(6.48)
Fixed	-0.204***
	(-3.48)
Loss	0.213***
	(6.74)
Dual	0.051***
	(9.66)
Big4	0.003
	(0.15)
Mshare	0.068
	(0.57)
Top1	0.107**
	(5.37)
Coz	**-0.032****
	(-2.38)
Constant	0.987***
	(4.02)
Year FE	Yes
Industry FE	Yes
Adjusted-R^2	0.124
Observations	9288

Note: t-statistics in parentheses. ***p <0.01, **p <0.05, *p < 0.1

First, we draw propensity score density plots before and after matching to test whether the treatment and control group satisfy the common support assumption. As shown in Figures 1 and 2, propensity score matching well eliminates the bias in the propensity score distribution between the two groups, allowing them to meet the common support assumption. Second, the regression results after propensity score matching are presented in Table 4. In Model 1, the coefficient of *Coz* is significantly negative (β = -0.032, p < .05), indicating a negative relationship between the common institutional ownership and corporate R&D manipulation. The result remains highly consistent with the empirical results above and supports Hypothesis 1a of this paper.

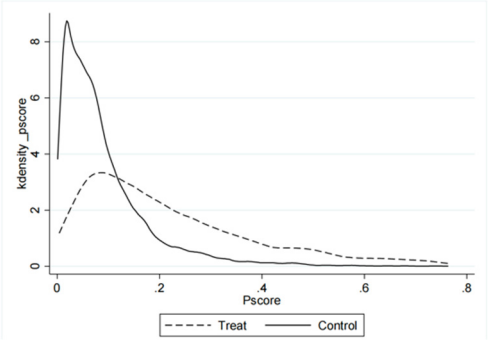

Figure 2. Density plot before matching

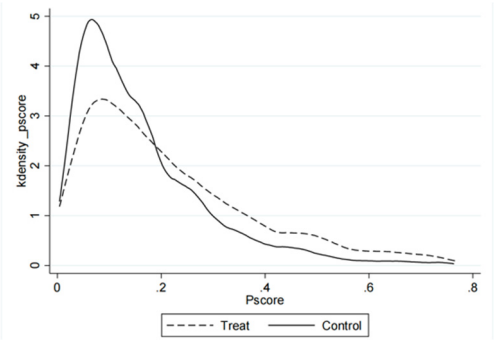

Figure 3. Density plot after matching

4.3.2. Adjust the Sample for Continuous Panel Data

Table 5. Robustness test: Adjust the sample for continuous panel data

	Model 1	Model 2
Variables	ABRD	ABRD
Size	-0.021***	-0.024***
	(-3.15)	(-3.13)
Lev	0.018	0.021
	(0.59)	(0.72)
Age	-0.044*	-0.046*
	(-1.69)	(-1.79)
ROA	1.495***	1.487**
	(2.61)	(2.57)
Fixed	-0.264***	-0.268***
	(-5.37)	(-5.41)
Loss	0.216***	0.215***
	(7.41)	(7.27)
Dual	0.033***	0.034***
	(4.44)	(4.52)
Big4	0.031**	0.025**
	(2.16)	(1.97)
Mshare	-0.031	-0.026
	(-0.51)	(-0.43)
Top1	0.016	0.018
	(0.65)	(0.72)
Coz		**-0.050*****
		(-3.04)
Constant	1.022***	1.080***
	(8.26)	(8.65)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Adjusted-R^2	0.093	0.135
Observations	21955	21955

Note: t-statistics in parentheses. ***p <0.01, **p <0.05, *p < 0.1

While only retaining samples with more than five consecutive years of observations could reduce 1117 firm-year observations, multiple years of consecutive observations

would better reflect trends in the corporate R&D manipulation and make the sample more representative over the time series. As shown in Table 5, the coefficient of *Coz* in Model 2 is significantly negative (β =-0.050, p < .01), indicating a negative relationship between the common institutional ownership and corporate R&D manipulation. To sum up, the findings of this paper are not affected by changes in the research period and sample size and have a certain degree of robustness.

4.4. Further Analysis

According to the theoretical analysis above, when co-institutional investors hold shares in multiple firms, they can improve communication among firms in the linked network and facilitate the exchange and sharing of information (Gao et al., 2019). As the shareholding ratio of common institutional ownership increases, its influence and voice in corporate governance will also be enhanced. This paper further examines the impact of the degree of linkage (*Coz2*) and shareholding (*Coz3*) of common institutional ownership on corporate R&D manipulation.

As shown in Table 6, the coefficient of *Coz2* in Model 1 is significantly negative (β = -0.069, p < .01). In Model 2, the coefficient of *Coz3* is also significantly negative (β = -0.108, p < .01). By further segmenting common institutional ownership, the paper finds that the higher the degree of common institutional ownership and the larger the shareholding, the more it helps to inhibit corporate R&D manipulation behaviour.

Table 6. Further analysis

	Model 1	Model 1
Variables	ABRD	ABRD
Size	-0.027***	-0.026***
	(-3.30)	(-3.33)
Lev	0.039*	0.037*
	(1.84)	(1.72)
Age	-0.048*	-0.048*
	(-1.80)	(-1.80)
ROA	1.527***	1.537***
	(2.88)	(2.92)
Fixed	-0.284***	-0.283***
	(-6.04)	(-6.04)
Loss	0.219***	0.220***
	(8.23)	(8.35)
Dual	0.036***	0.036***
	(6.54)	(6.74)
Big4	0.033**	0.035**
	(2.22)	(2.26)
Mshare	-0.017	-0.019
	(-0.28)	(-0.31)
Top1	0.018	0.010
	(0.70)	(0.38)
Coz2	**-0.069*** **	
	(-3.45)	
Coz3		**-0.108*** **
		(-2.68)
Constant	1.139***	1.115***
	(9.29)	(9.12)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Adjusted-R^2	0.094	0.094
Observations	23072	23072

Note: t-statistics in parentheses. ***p <0.01, **p <0.05, *p < 0.1

4.5. Heterogeneity Analysis

As an informal system, the synergistic governance of common institutional ownership depends not only on the common institutional investors themselves but also influenced by the firms. Based on this, this paper further examines the nature of high-tech firms and business lifecycle on the effect of common institutional ownership on corporate R&D manipulation.

4.5.1. The Nature of High-Tech Firms

A high-tech enterprise is a resident enterprise that carries out continuous research and development and transformation of technological achievements within the scope of the "*the State Oriented Key High-tech field*", forming the core independent intellectual property rights of the enterprise and carrying out business activities on this basis (Shi et al., 2021). In China, high-tech enterprises are entitled to a preferential corporate income tax rate of 15%, compared to the standard corporate income tax rate of 25%. On the whole, they are knowledge-intensive and technology-intensive economic entities (Liu et al., 2021).

In Model 1, the coefficient of *Coz* is significantly negative (β = -0.055, p < .05). Compared to the non-high-tech firms, the synergistic governance effect of common institutional ownership is more pronounced in high-tech firms.

As an important carrier of technological innovation in China's national economy, high-tech enterprises have a greater demand for R&D resources, and the support measures provided by the government often make them the winners of various policy dividends (Liu et al., 2021). However, when it comes to non-high-tech firms, they may have a lower willingness to conduct R&D investment. Therefore, the synergistic governance effect of common institutional ownership is less pronounced in non-high-tech firms.

4.5.2. Business Lifecycle

Firms are living organizations with a life cycle similar to that of an organism from birth to death (Koh et al., 2015). Early research has found that, in addition to age, there are significant differences in size, profitability, investment strategy, willingness to innovate and research and development capabilities at different life cycle stages, as well as in the critical constraints on firm development.

Referring to Koh et al. (2015) and other scholars, this paper uses four variables, namely sales revenue growth rate, retained earnings rate, capital expenditure rate, and firm age, to calculate a composite score to measure the life cycle of a firm, and classifies the different life cycles of a firm according to the criteria that about 1/4 of the highest scoring firms are growth stage firms, about 1/4 of the lowest scoring firms are decline stage firms, and the middle 1/2 are mature stage firms.

In Models 3 and 4, the coefficient of *Coz* is significantly negative (β = -0.078, p < .01; β = -0.031, p < .05), which means compared to the decline stage firms, the synergistic governance effect of common institutional ownership is more pronounced in growth stage and maturity stage firms.

Perhaps the reason for this is that during a period of decline, when the company's market share is shrinking, the resources available to it are diminishing, the organization is rigid, and the people within the company have meager expectations for the future and therefore have little interest in R&D manipulation. However, during the growth and maturity stage of a company, the company is in the development stage and is still exposed to many external threats and uncertainties. The R&D manipulation by firms can give them more benefits and therefore increase this disobedient behaviour (Shea & Hawn, 2019). Thus, the synergistic governance effect of common institutional ownership is less pronounced in decline-stage firms.

Table 7. Heterogeneity analysis

	Model 1	Model 2	Model 3	Model 4	Model 5
	The nature of high-tech firms		Business lifecycle		
	High-tech	Non-high-tech	Growth	Mature	Decline
Variables	ABRD	ABRD	ABRD	ABRD	ABRD
Size	-0.030**	-0.021***	-0.027***	-0.041***	-0.050***
	(-2.20)	(-3.66)	(-3.76)	(-13.39)	(-3.33)
Lev	0.182***	-0.019	-0.014	-0.022**	0.031
	(3.19)	(-0.52)	(-0.41)	(-2.15)	(0.61)
Age	-0.083***	0.007	-0.020	0.031	-0.096**
	(-3.13)	(0.35)	(-0.47)	(0.53)	(-2.33)
ROA	1.386***	2.015***	1.763**	-0.036	0.708
	(3.25)	(16.08)	(2.43)	(-1.63)	(1.31)
Fixed	-0.395***	-0.192***	-0.405***	1.832***	-0.286***
	(-3.69)	(-4.87)	(-5.86)	(5.49)	(-5.52)
Loss	0.226***	0.233***	0.242***	-0.192***	0.153***
	(5.95)	(9.84)	(4.84)	(-5.04)	(2.94)
Dual	0.040***	0.021	0.057***	0.232**	0.006
	(3.66)	(1.44)	(7.02)	(10.25)	(0.35)
Big4	0.035	0.026	0.008	0.019	0.112***
	(1.05)	(1.21)	(0.39)	(1.47)	(2.65)
Mshare	-0.117*	0.146***	-0.003	-0.072	0.019
	(-1.85)	(3.34)	(-0.05)	(-0.93)	(0.38)
Top1	0.001	0.053	0.060	0.042*	-0.062
	(0.03)	(1.36)	(1.32)	(1.76)	(-1.11)
Coz	**-0.055****	0.038	**-0.078*****	**-0.031****	-0.044
	(-2.50)	(1.16)	**(-3.39)**	**(-2.23)**	(-1.56)
Constant	0.579*	0.902***	1.248***	1.064***	1.417***
	(1.82)	(6.27)	(4.89)	(4.98)	(4.04)
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Adjusted-R^2	0.065	0.121	0.094	0.108	0.110
Observations	10747	11220	9953	8506	4465

Note: t-statistics in parentheses. ***p <0.01, **p <0.05, *p < 0.1

5. Conclusion and Discussion

5.1. Research Conclusion

The highly asymmetric nature of R&D activities provides a "breeding ground" for R&D manipulation by enterprises (Clausen & Pohjola, 2013; Le Bas et al., 2015). At the same time, manipulation of R&D for improper purposes by inflating or adjusting R&D investment occurs due to various incentives such as tax policy bonuses, profit smoothing, reducing tax liabilities and satisfying managers' self-interest (Chen et al., 2016). The available evidence supports the attribute of R&D manipulation in the Chinese context as a strategic innovation behaviour by inflating R&D expenses to meet national policy preferences or market reputation (Sun, 2021). Therefore, it is crucial to seek solutions to control this dishonest behaviour accurately. In recent years, the phenomenon of common institutional ownership has become increasingly widespread in the capital markets and has had a significant impact on the strategic decisions of companies. Using data from Chinese listed firms from 2009 to 2021, we empirically examine the negative relationship between common institutional ownership and corporate R&D manipulation. The study found that common institutional ownership can inhibit corporate R&D manipulation. The higher the degree of their linkage and the greater the shareholding, the more pronounced the synergistic effect. The findings remained valid after testing using propensity score matching (PSM) and changing the sample period. Heterogeneity analysis shows that the inhibiting effect of common institutional ownership on corporate R&D manipulation is more pronounced in high-tech firms and firms which stay in the growth and maturity stage.

5.2. Theoretical Contributions

Our study contributes to the existing research from the following aspects. First, this paper contributes to research on corporate R&D manipulation. The positive effect of innovation incentives depends on the government's ability to select from among the many applicants those enterprises that need policy support and guidance (Sasaki, 2017). In fact, industrial policy is essentially an incomplete contract between the government and enterprises, which is reflected in the fact that neither the government nor the enterprises can anticipate all the possible future scenarios and the lack of a third party who can ensure the effective implementation of the contract (Melnyk et al., 2014), i.e., externality and non-contractability. R&D activities are characterized by high uncertainty and complexity, further increasing the information asymmetry between external and corporate R&D activities and expanding companies' scope for R&D manipulation (Poonawala & Nagar, 2018). In other words, the problem of adverse selection arising from the advantage of information becomes an essential factor for some enterprises to defeat the original purpose of the government's innovation incentive policy. Some studies found an internal drive to manipulate R&D investment for tax incentive reduction and expectation adjustment (Overland & Samani, 2021; Liu, et al., 2021). Overall, it is essential to understand and explore the motivations for corporate R&D manipulation to help drive the implementation of "genuine innovation" towards a virtuous cycle. This paper seeks to contribute to the study of how to effectively respond to corporate R&D manipulation by identifying the common institutional ownership from the perspective of external governance mechanisms.

Second, this paper enriches the research on the economic consequences of common institutional ownership. The

corporate governance role of common institutional ownership has recently attracted much attention from academics and industry (Schmalz, 2018; Gao et al., 2019; Koch et al., 2021). However, there is no unanimous conclusion on the corporate governance role of common institutional ownership. There are two main types of views: "synergistic governance" and "collusive fraud": some studies suggest that common institutional ownership has synergistic governance effects and can improve M&A performance (Brooks et al., 2018), as well as curbing corporate surplus management (Ramalingegowda et al., 2020). Some studies have also taken the opposite view, arguing that common institutional ownership engages in collusive fraud with the firms it is linked to, distorting the market price mechanism and making the market less competitive (Azar et al., 2018). We argue that the "collaborative governance" or "collusive fraud" effect of common institutional ownership may be related to the firm's business activities, level of governance, and resource allocation. This paper finds that common institutional ownership can inhibit corporate R&D manipulation behaviour. Besides, the inhibiting effect of common institutional ownership on corporate R&D manipulation is more pronounced in high-tech firms and firms that stay in the growth and maturity stage.

5.3. Practical Implications

In 2008, Ministry of Science and Technology, the Ministry of Finance and the State Administration of Taxation of China issued the "*Administrative Measures for the Recognition of High-tech Enterprises*" to increase the R&D intensity of enterprises through tax relief and other preferential policies (Liu et al., 2021). Governments at all levels have also promoted technological innovation and R&D by enterprises by formulating and introducing implementation measures for R&D funding subsidies and work plans for cultivating high-tech enterprises (Shi et al., 2021). Although these R&D subsidies can effectively promote enterprises' R&D investment, reduce their risks and costs, guide their continuous investment and promote substantive innovation, they can also have a substitution effect on private R&D activities and make enterprises dependent on them, leading some enterprises, especially those facing financing constraints, to engage in R&D manipulation to obtain the corresponding preferential policies.

The empirical results of this paper show that common institutional ownership can inhibit corporate R&D manipulation behaviour and that the higher the degree of their linkage and the greater the shareholding, the more pronounced the synergistic effect. Therefore, government regulators should encourage and guide co-institutional investors to play a collaborative governance role, improve relevant policies and regulations to motivate co-institutional investors, enhance the depth and breadth of common institutional ownership in corporate management, and further leverage its unique advantages as an "industry pivot" and "information intermediary".

Besides, heterogeneity analysis shows that the inhibiting effect of common institutional ownership on corporate R&D manipulation is more pronounced in high-tech firms and firms which stay in the growth and maturity stage. The government should improve the effectiveness of policy identification and provide effective policy support to high-tech enterprises. The government should further strengthen the identification mechanism for high-tech enterprises and enhance the quality of audits to reduce information asymmetry between government agencies and enterprises and reduce the possibility of R&D manipulation. At the same time, the government should increase the penalties to avoid opportunistic behaviour of enterprises after weighing up the situation, to create a favourable innovation environment for enterprises.

5.4. Limitations and Future Research

Inevitably, there are some limitations to this paper which require further in-depth study in the future: (1) Based on the availability of data, this paper constructs the indicator of common institutional ownership through public data of listed firms without considering the case of common institutional shareholding of non-listed firms, and the construction of the indicator of common institutional ownership can be further improved in the future; (2) Our research context is limited to China, with relatively weak market-based institutions (Jamali & Karam, 2018). Hence, the conclusions in our study may not be universal and generalizable to other research contexts where the institutional environment is more well-developed (e.g., the United States, European countries, etc.). Future research could expand the sample to other research contexts and examine whether our findings will be variant in different research contexts; (3) This study is based on the statistical analysis of a large sample to investigate how common institutional ownership affects corporate R&D manipulation behaviour. In the future, we may consider using fuzzy set qualitative comparative analysis (fsQCA), rooting theory and other research methods to further study the relationship between common institutional ownership and corporate R&D manipulation in the context of specific industries or typical cases.

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Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflict of Interest Statement

None.

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