

## Article

# The Contract Design of Employee Stock Ownership Plan and Enterprise Innovation Investment: Evidence from China

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**Abstract:** Enterprise innovation is a key driver of national economic growth. How to stimulate employees' innovation vitality to improve the company's innovation input and output has always been a hot topic. Employee Stock Ownership Plan (ESOP) is one of the effective means to stimulate employees' innovation vitality by linking employee wealth with firm value. The purpose of this paper is to examine the effect of ESOP implementation and contract design on enterprise innovation investment in the context of the recent booming development of ESOP in China. First, we use a treatment effect model to examine the impact of ESOP implementation on innovation investment, taking firms that implement ESOPs as the treatment group and firms that do not implement ESOPs as the control group. Second, we use multivariate regression models to test the impact of ESOP contract design (including fund source, stock source, lockup period, duration, shareholding scale, executive subscription ratio, participation degree, and management mode) on innovation investment using the treatment group. The results indicate that the implementation of ESOP is helpful in increasing enterprise innovation investment, and the impact of ESOP on innovation investment varies significantly with the design of incentive contracts.

**Keywords:** employee stock ownership plan; enterprise innovation; innovation investment; contract design



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## 1. Introduction

Innovation is essential to ensure a country's long-term economic growth and competitive advantage. If a country cannot continuously improve productivity and develop internationally competitive industries through innovation, its economic development will be severely tested [1]. Enterprises are the core body of the innovation system, and enterprise innovation is the key driver of economic growth. In recent years, China has invested a lot of resources in the technological innovation of enterprises and introduced many policies to promote and support the independent innovation of enterprises, but there is still a big gap between the level of innovation input and output and that of western developed countries [2]. The main body of enterprise innovation is the employees. How to stimulate the innovation vitality of employees to improve the innovation input and output of enterprises has become a hot issue.

Employee Stock Ownership Plan (ESOP) refers to the institutional arrangement whereby the listed company enables employees to acquire and hold the company's shares for a long time by legal means according to the employees' will, and the share rights and interests are allocated to the employees as agreed [3]. ESOP originated in the United States in the 1950s and has been rapidly developed and promoted in western developed countries, which has greatly eased labor relations and reduced income inequality to some extent [4]. China's ESOP originated in the early 1980s in the form of share certificates issued to employees of state-owned enterprises. For more than 30 years, ESOP was not widely implemented in China due to immature objective conditions such as the market

environment and regulatory policies [5]. It was only on 20 June 2014 that the China Securities Regulatory Commission (CSRC) issued the “Guidance on the Pilot Implementation of the Employee Stock Ownership Plan for Listed Companies” (hereinafter referred to as the Guidance), marking a new development period of China’s ESOP. The issuance of the Guidance triggered a boom in the implementation of ESOPs in China’s listed companies. According to the Wind database, between 1 July 2014 and 31 December 2020, 851 Chinese listed companies announced the implementation of ESOPs, involving a total of 1258 ESOPs.

ESOP connects employee wealth with enterprise value, helps to fully mobilize employees’ enthusiasm, and establishes a long-term incentive and restraint mechanism of profit sharing and risk sharing, which is one of the effective means to stimulate employees’ innovation vitality [6]. In the United States and other western developed countries, few scholars pay attention to the incentive effect of ESOP on enterprise innovation because ESOP is usually embedded in pension plans. In China, with the rapid development of ESOP in recent years and the increasing importance of innovation in national economic development, many scholars have paid attention to the incentive effect of ESOP on enterprise innovation, and have consistently found that China-style ESOP has an innovation-promoting effect [7–10]. However, these studies mainly focus on the effect of ESOP on innovation output, while few studies focus on the effect of ESOP on innovation input. In addition, these studies focus on the impact of ESOP implementation on corporate innovation but lack a systematic discussion of how different ESOP contract designs affect corporate innovation.

ESOP provides incentives not only to ordinary employees but also to senior executives. By reading the ESOP drafts disclosed by Chinese listed companies, we found that more than 90 percent of ESOPs involve senior executives. Therefore, ESOP may affect enterprise innovation investment through two mechanisms. First, the implementation of ESOP will have an incentive effect on both senior executives and ordinary employees, and the equity incentive for senior executives will directly affect enterprise innovation investment decisions [11]. Second, when ordinary employees have the status of shareholders, they will participate in corporate governance and monitor the decision-making process of senior executives, which will indirectly affect the innovation investment decision of enterprises [12]. In addition, the Guidance regulated the contractual elements of ESOP such as the source of funds, the source of stocks, the size of shareholding, the duration of shareholding, and the management mode. The information disclosure guidelines formulated by the Shanghai and Shenzhen stock exchanges also require listed companies to disclose the above contractual elements in the draft ESOPs. This provides a good opportunity to further explore the influence of different ESOP contract designs on innovation investment.

This paper first uses a treatment effect model to test the influence of ESOP implementation on innovation investment based on the incentive and governance effects of ESOP. Then, this paper further adopts multivariate regression models to examine the impact of ESOP contract design on innovation investment from eight dimensions of fund source, stock source, lockup period, duration, shareholding scale, executive subscription ratio, participation degree, and management mode. The ESOPs implemented by Chinese A-share listed companies on the Shanghai and Shenzhen stock exchanges during the period from 2014 to 2020 are used as the research sample of this study. Based on the previous literature on the determinants of enterprise innovation, we use the absolute and relative levels of R&D expenditures to measure the level of innovation investment. Meanwhile, we control for corporate characteristics, governance structure, year-fixed effects, industry-fixed effects, and province-fixed effects in the models. Additionally, we address the endogeneity issues by lagging the explanatory variables, using the propensity score matching (PSM) procedure, and replacing the ordinary least squares (OLS) estimation with the fixed effects (FE) estimation and the generalized method of moments (GMM).

The results show that companies with ESOPs have a higher level of innovation investment than companies without ESOPs, indicating that ESOP implementation is helpful in increasing enterprise innovation investment. The results also suggest that the contract design of ESOP is also correlated with innovation investment. Specifically, the participation

degree, lockup period, and duration of ESOP are positively correlated with innovation investment, while the shareholding scale of ESOP has an inverted U-shaped relationship with innovation investment, and the executive subscription ratio in ESOP has a U-shaped relationship with innovation investment. Furthermore, companies implementing ESOPs with employee's own funds have a lower level of innovation investment than those with other fund sources, while companies implementing ESOPs by subscribing to non-publicly offered shares have a higher level of innovation investment than those with other stock sources, and companies implementing ESOPs with the entrustment management mode have a higher level of innovation investment than those with the self-management mode.

This paper contributes to the literature on the relationship between ESOP and enterprise innovation in two ways. First, we provide a better understanding of the effect of ESOP on enterprise innovation. While most prior studies focus on the effect of ESOP on innovation output (i.e., patent filings and citations), we investigate the effect of ESOP on innovation input (i.e., R&D investment). Given that ESOP is designed to motivate all employees in China, including senior executives and ordinary employees, we argue that ESOP will affect innovation investment through the incentive role of senior executives (i.e., incentive effect) and the monitoring role of ordinary employees (governance effect). Consistent with our expectations, we find that ESOP implementation is positively correlated with innovation investment. Combining our findings with existing research findings, the implementation of ESOP not only affects enterprise innovation output but also affects enterprise innovation input.

Second, we systematically explore the effect of ESOP contract design on innovation investment. Previous studies focus on discussing how ESOP implementation affects enterprise innovation, but most of them ignore the heterogeneity of ESOPs. Although several studies have discussed the effect of ESOP contract design, they have only considered some contractual elements, such as fund source, stock source, and lockup period, without considering other important contractual elements, including duration, participation degree, and management mode. In this paper, we consider eight contractual elements of ESOP, including fund source, stock source, lockup period, duration, shareholding scale, executive subscription ratio, participation degree, and management mode, to systematically examine the effect of incentive contract design on innovation investment. Consistent with our predictions, the results suggest that the eight contractual elements of ESOP are all significantly correlated with innovation investment. In addition, given a high correlation between the lockup period and duration, we design a new proxy for the duration (i.e., the difference between duration and lockup period) and provide evidence on the incremental effect of the duration after controlling for the lockup period.

The remainder of the paper is organized as follows. Section 2 introduces the institutional background and reviews prior studies. Section 3 analyzes related theories and develops the hypotheses. Section 4 introduces the research design and Section 5 presents the results. Section 6 provides the conclusions and discussions.

## 2. Institutional Background and Literature Review

### 2.1. Institutional Background

ESOP originated from the two-factor theory proposed by the American economist Louis Kelso in 1958. According to the two-factor theory, wealth is jointly created by the two key factors of labor and capital, and the contribution of the capital factor to production will be greater than that of the labor factor in the process of industrialization [13]. For workers whose main income is labor income, this trend will eventually lead to serious injustice in social distribution. Therefore, Kelso advocated that employees should buy the company's shares to realize the effective combination of capital and labor factors, thus forming the rudiment of the employee stock ownership system. Promoted by Kelso, ESOP was officially recognized by the United States and developed rapidly in the following 40 years. The reason lies in the fact that the United States government provided appropriate support systems for the development of ESOP, such as the enactment of relevant legislation, preferential

financing policies, and preferential tax policies [14]. In addition, the success of American ESOP has also been recognized by other western countries. Great Britain, Germany, and France have also established and developed their employee stock ownership systems.

Different from western developed countries, the employee shareholding system of Chinese enterprises started in the mid-1980s, and it is an equity system arrangement that has been continuously developed in the process of state-owned enterprises' corporate system and joint-stock transformation [5]. At that time, China was in the pilot stage of transforming the operation mechanism of enterprises and carrying out shareholding reform, and many small state-owned enterprises and collective enterprises made various attempts at shareholding. In the 1990s, under the influence of the employee shareholding system in the western developed countries, a bold attempt at employee stock ownership was made throughout the country, and internal employee stock ownership flourished. However, due to the lack of owners and imperfect system design, a few people took advantage of the internal employee stock ownership, resulting in serious losses of state-owned assets and emergency suspensions of internal employee stock ownership several times [15]. Until 20 June 2014, the CSRC issued the Guidance, which regulated the scope of participants, the stock source, the fund source, the shareholding scale, the shareholding period, the management mode, and the information disclosure requirements of ESOPs. It marks the standard implementation stage of China's ESOP. Since the issuance of the Guidance, many listed companies have launched their ESOPs, and China's ESOP has boomed again. According to the Wind database, from 1 July 2014 to 31 December 2020, 1258 ESOP drafts were announced, involving a total of 851 listed companies.

## 2.2. Literature Review

This paper reviews the literature on ESOP from two aspects of implementation motivations and implementation consequences, especially the literature on the relationship between ESOP and enterprise innovation.

### 2.2.1. The Motivations for ESOP Implementation

As for the implementation motivations of ESOP, the existing literature summarizes them into two categories: incentive motivation and non-incentive motivation [16]. Incentive motivation means that the implementation of ESOP aims to alleviate the conflict of interest between employees and shareholders, which can improve employees' work enthusiasm and the company's performance [17]. However, the proposal of non-incentive motivation is based on the combination of system and political background. It is believed that companies adopt ESOPs to obtain tax preferences, to ease financing constraints, or to resist hostile takeovers [18,19].

Accounting scholars have conducted a large number of empirical studies on the incentive motivations and non-incentive motivations of ESOP. First, there is both supporting and disconfirming evidence in the tests of incentive motivations. For example, Core and Guay [20] find that companies use equity incentives to attract and retain certain types of employees and encourage employees to create value for the company. However, Ittner et al. [18] and Oyer and Schacfer [21] find that employee attraction and retention do a good job of explaining the implementation motivations of employee equity incentives, but the theoretical explanation of employee incentives is not supported. Chen [22] finds that the explanatory power of employee attraction and retention is stronger for equity incentive implementation, while the explanatory power of employee incentives is weaker. Second, among the tests of non-incentive motivations, easing financing constraints have been supported by a large number of studies [20,22,23], while obtaining tax preferences or resisting hostile takeovers is supported only in the United States context [24,25].

Recently, Chinese scholars have also found other motivations for listed companies to implement ESOPs. Sun et al. [23] find that companies implement ESOPs to signal their future development prospects to investors. Zhang et al. [26] provide evidence that companies implement ESOPs to improve the competitiveness of employee compensation. Several stud-

ies also provide evidence of the opportunistic motivations for ESOP implementation, such as market value management [27], reduction in shareholding by major shareholders [28], and pledging of controlling shareholder's equity [29,30].

#### 2.2.2. The Consequences of ESOP Implementation

Many previous studies have discussed the consequences of implementing ESOP from many aspects, especially from the perspective of shareholder wealth and financial performance. We review these studies as follows.

(1) Market consequences. Most of the previous studies suggest that the announcement of ESOP has a positive wealth effect, and the wealth effect depends on the motivation for ESOP implementation [25,31,32]. Since the issuance of the Guidance, scholars in China have begun to test the announcement effects of ESOP in the new era, and consistently find that the announcement of ESOP can bring a positive short-term wealth effect to shareholders, and the wealth effect varies with the different designs of ESOP [33–38]. In addition, several studies provide other market consequences of ESOP, such as increasing stock liquidity [39] and reducing stock volatility, equity capital cost, and stock crash risk [40–42].

(2) Performance consequences. Most of the early studies find a positive impact of ESOP on corporate performance [43–45], while some studies find no correlation between ESOP and corporate performance [46], and a few studies find a negative impact of ESOP on corporate performance [47]. In recent years, based on ESOP in the new era in China, scholars have reexamined the relationship between ESOP and corporate performance and also found contradictory conclusions. Shi [48] finds that ESOP has a positive effect on corporate financial performance, while Shen et al. [49] find that the implementation of ESOP in state-owned enterprises does not significantly improve corporate governance and business performance due to the lack of management incentives. Ren et al. [50] find that ESOP adopters outperform non-ESOP adopters both before and after adoption, but the relative performance does not increase after adoption.

(3) Other consequences. Recent papers have examined other consequences of employee stock ownership. Chen et al. [51] find that employee stock ownership is negatively associated with private loan spreads and restrictive loan covenants. Feng et al. [52] provide evidence that ESOP implementation has a significant inhibitory effect on corporate financialization. Zhou et al. [53] suggest that the ESOPs of Chinese listed companies increase employees' motivation to engage in corporate social responsibility (CSR) activities, and ultimately contribute to CSR.

#### 2.2.3. The Relationship between ESOP and Enterprise Innovation

In the United States, ESOP is a qualified retirement plan, which means that employees can only sell their shares after retirement and cannot actively participate in management because they cannot realize profits earlier. Thus, US scholars rarely pay attention to the effect of ESOP on enterprise innovation. In China, with the recent rapid development of ESOP and the increasing role of innovation in economic growth, a large number of studies discuss the relationship between ESOP and enterprise innovation. However, these studies focus on the impact of ESOP on innovation output and consistently find that the implementation of ESOP has a positive effect on innovation output [7–10]. These studies also suggest that the promotion effect of ESOP on innovation output varies with the employee characteristics, corporate characteristics, or program characteristics [54–57].

However, few studies have discussed the impact of ESOP on innovation input. Chen and Huang [58] take listed information technology companies in Taiwan as a research sample and find that employee-owned companies have higher R&D expenditures than non-employee-owned companies, and in employee-owned companies, the employee-owned ratio is positively correlated with R&D expenditures. Luo and Wang [59] test the relationship between R&D spending and the executive subscription ratio in ESOP. They find that the company's total R&D expenditure and expensed R&D expenditure both have a U-shaped relationship with the executive subscription ratio in ESOP.



In summary, there are two shortcomings in the literature on the relationship between ESOP and enterprise innovation. First, existing studies mainly focus on the impact of ESOP on innovation output but pay little attention to the impact of ESOP on innovation input. In an innovation activity, senior executives are responsible for formulating innovation plans, investing in R&D expenditures, and organizing R&D personnel, while non-executive employees, represented by R&D personnel, are the users of R&D resources and the implementers of innovation plans [54]. Therefore, the incentive effect of ESOP on senior executives is mainly reflected in the innovation input, while the incentive effect of ESOP on ordinary employees is mainly reflected in the innovation output. Since the participants of ESOPs usually include both senior executives and ordinary employees, the implementation of ESOP will have an incentive effect on both senior executives and ordinary employees, which may have an impact on both innovation input and output. Thus, it is not comprehensive to discuss only the incentive effect of ESOP on innovation output. Second, existing studies have only sporadically focused on one or more contract features of ESOP, but lack a comprehensive discussion on how different contract designs of ESOP affect innovation input.

Based on the above analysis, this paper takes ESOPs in the new era of China as our research sample and specifically discusses the impact of ESOP implementation and contract design on innovation input.

### 3. Theory Analysis and Hypothesis Development

#### 3.1. The Implementation of ESOP and Innovation Investment

Huang et al. [15] argue that ESOP is an institutional arrangement with both incentive and governance effects. According to the agency theory, the incentive effect of ESOP refers to ESOP promoting benefit sharing and risk sharing between employees and shareholders, which can effectively alleviate agency conflicts between employees and shareholders [60]. According to the corporate governance literature, the governance effect of ESOP refers to ESOP that encourages employees to participate in corporate governance as shareholders and properly monitor the daily management behavior of executives [12]. Therefore, we argue that the implementation of ESOP will affect innovation investment through incentive and governance mechanisms.

First, we argue that ESOP can directly promote the increase in innovation investment by stimulating senior executives who participate in the ESOP. ESOPs implemented by listed companies make executives who participate in the plans have a dual identity of the company's employees and owners, and closely relate the rise and fall of the company with their interests, which can form an incentive mechanism of benefit sharing and risk sharing in enterprise innovation activities [61]. This will encourage executives to attach importance to corporate innovation, formulate innovation strategies and implement innovation incentive policies, thus increasing enterprise innovation investment [11].

Second, we expect that ESOP can indirectly promote the increase in innovation investment by monitoring the behavior of controlling shareholders and management. ESOPs implemented by listed companies not only enable employees to participate in the company's operational decisions as shareholders but also enable them to conduct daily and continuous supervision over the behaviors of controlling shareholders and management [12], which can effectively reduce the company's agency costs and ultimately promote the increase in innovation investment. Different from the direct purchase and holding of a company's shares by individual employees, ESOP participates in corporate governance as a whole and has the advantages of participation motivation, information, and organization, which can promote ordinary employees to supervise the behaviors of controlling shareholders and executives [62].

Thus, this paper proposes the following hypothesis:

**Hypothesis 1 (H1).** *The implementation of ESOP is helpful in increasing enterprise innovation investment.*

### 3.2. The Contract Design of ESOP and Innovation Investment

Prior studies suggest that the incentive and governance effects of ESOP vary with the contract design of the plan [33–38]. Therefore, this paper further analyzes the impact of ESOP contractual elements on innovation investment. According to the Guidance, the contractual elements of an ESOP usually include the fund source, stock source, lockup period, duration, shareholding scale, executive subscription ratio, participation degree, and management mode [3].

#### 3.2.1. The Impact of ESOP Fund and Stock Sources on Innovation Investment

According to the Guidance, ESOP can be funded by: (1) legal compensation of employees; (2) other means permitted by laws and administrative regulations [3]. In practice, in addition to employees' own funds, listed companies also solve the funds required for ESOPs by withdrawing incentive funds, borrowing from actual controllers or controlling shareholders, third-party financing, and other ways. Compared with other sources of funding, when employees participate in ESOPs with their own funds, they will bear higher risks, because the decline of the company's stock price will directly damage the personal wealth of employees. At this time, employees tend to be risk-averse and are more likely to prevent management from engaging in risky innovation activities. Consistent with this argument, Shang et al. [55] find that companies implementing ESOPs with employees' own funds have a lower level of innovation output than those with other fund sources. Thus, we expect that ESOPs implemented with employees' own funds will be detrimental to innovation investment.

According to the Guidance, listed companies may resolve the stock sources of ESOP in the following ways: (1) repurchase of the company's shares; (2) secondary market purchase; (3) subscription of non-publicly offered shares; (4) voluntary donation by shareholders; and (5) other means permitted by laws and administrative regulations [3]. Additionally, the Guidance requires that the holding period of each ESOP should not be less than 12 months, and the holding period of ESOPs with non-publicly offered shares should not be less than 36 months. Therefore, compared with other sources of equity, ESOPs implemented through private offerings usually have a longer holding period, which is more in line with the original intention of long-term incentive design and will have a stronger incentive effect on executives and employees. Consistent with these arguments, Liu et al. [63] provide evidence that companies implementing ESOPs by subscribing to privately offered shares have higher levels of innovation output than those purchasing shares in the secondary market. Thus, we expect that ESOPs implemented through private offering subscriptions will have a positive impact on innovation investment.

Based on the above analysis, the following hypothesis is proposed:

**Hypothesis 2 (H2).** *Companies that implement ESOPs with employees' own funds have a lower level of innovation investment than those with other fund sources, while companies that implement ESOPs by subscribing to non-publicly offered shares have a higher level of innovation investment than those with other stock sources.*

#### 3.2.2. The Impact of ESOP Lockup Period and Duration on Innovation Investment

According to the Guidance, the lockup period of ESOP refers to the minimum holding period of ESOP, starting from the time when the company announced the transfer of the underlying shares to the current shareholding plan [3]. During the lockup period, ESOP participants are not allowed to sell the underlying shares, so the lockup period binds the interests of executives and employees with shareholders, which effectively reduces the conflicts of interest among shareholders, executives, and employees. Zhou et al. [7] and Meng et al. [8] both find a positive correlation between the lockup period of ESOP and innovation output. Therefore, we expect that the longer the lockup period of ESOP, the longer the incentive objects will be linked to the interests of shareholders, thus enhancing the incentive effect of ESOP and promoting the increase in innovation investment.

According to the Guidance, the duration refers to the period of ESOP from its establishment to the completion of implementation, usually starting from the date when the draft ESOP is approved by the general meeting of shareholders [3]. The duration of ESOP includes not only the lockup period but also the period of purchase of shares before the lockup period and the period of sale of shares after the lockup period. In addition to the interest bundling effect generated by the lockup period, the extension of the share purchase period provides more opportunities for the holder to complete the purchase of the underlying shares at a lower price, while the extension of the share sale period provides more opportunities for the holder to complete the sale of the underlying shares at a higher price. Xiao et al. [36] find that the announcement effect of ESOP increases with its duration, indicating that investors are more optimistic about ESOPs with longer duration. Therefore, we expect that the longer the duration of ESOP, the better it will be for the holders to choose the timing of stock purchase and sale, so as to enhance the incentive effect of ESOP and promote the increase in innovation investment.

Based on the above analysis, the following hypothesis is proposed:

**Hypothesis 3 (H3).** *The lockup period and duration of ESOP are positively correlated with the level of innovation investment.*

### 3.2.3. The Impact of the Shareholding Scale and Executive Subscription Ratio of ESOP on Innovation Investment

According to the Guidance, the shareholding scale refers to the percentage of the total number of shares held by the plan to the total share capital of the company [3]. Prior studies find evidence for both a bright and a dark side to employee stock ownership: on the bright side, employee stock ownership may reduce agency costs by increasing employees' incentives to act in shareholders' interests; on the dark side, employee stock ownership may increase agency costs by increasing managerial entrenchment [64]. Consistent with these arguments, Campa and Kern [65] find a U-shaped relationship between employee stock ownership and the cost of equity. Therefore, we expect that the shareholding scale of ESOP will have an inverted U-shaped relationship with innovation investment. Specifically, when the shareholding scale is lower, the incentive effect of ESOP will dominate its entrenchment effect, and thus innovation investment will increase with the shareholding scale; when the shareholding scale is higher, the entrenchment effect of ESOP will dominate its incentive effect, and thus innovation investment will decrease with the shareholding scale.

The executive subscription ratio refers to the percentage of the number of shares subscribed by executives to the total number of shares held by the plan. When the executive subscription ratio is lower, executives do not have a strong sense of ownership and believe that their shareholdings are insignificant and do not have a decisive influence on the company, so the innovation motivation is insufficient. At this time, the innovation investment will decrease with the increase in the executive subscription ratio. On the contrary, when the executive subscription ratio is higher, executives realize that they are also shareholders and have a stronger sense of ownership. They believe that the interests of the company are closely related to their interests. At this point, innovation investment will increase with the increase in the executive subscription ratio. Consistent with these arguments, Luo and Wang [59] find a U-shaped relationship between the executive subscription ratio and R&D expenditure. Thus, we also expect that the executive subscription ratio of ESOP has a U-shaped relationship with innovation investment.

Based on the above analysis, the following hypothesis is proposed:

**Hypothesis 4 (H4).** *There is an inverted U-shaped relationship between the shareholding scale of ESOP and innovation investment, while there is a U-shaped relationship between the executive subscription ratio in ESOP and innovation investment.*



### 3.2.4. The Impact of the Participation Degree and Management Mode of ESOP on Innovation Investment

The participation degree refers to the percentage of the number of employees participating in the ESOP to the total number of employees in the company. The higher the participation degree, the larger the number of employees who are motivated, the stronger the improvement effect on corporate governance, and the stronger the promotion effect on innovation investment. Zhou et al. [7] find that the more people participate in the employee stock ownership plan, the higher the level of innovation output of the enterprise. Thus, we expect the participation degree of ESOP to have a positive impact on innovation investment.

According to the Guidance, listed companies can manage their own ESOPs or entrust the management of their own ESOPs to third parties with asset management qualifications [3]. Compared with the self-management mode, the entrusted management mode helps to reduce the conflicts of interest in the establishment, share trading, and exercise of voting rights of ESOP, which can enhance the incentive and governance effects of ESOP [50]. In addition, compared with the company's internal personnel, asset management qualified institutions tend to have more professional management knowledge and more rich management experience, can make better decisions on the timing of share purchase and sale, to improve the holding gains of ESOP and strengthen the incentive and governance effects of ESOP. Therefore, we argue that ESOPs with entrusted management mode have a positive impact on innovation investment.

Based on the above analysis, the following hypotheses are proposed:

**Hypothesis 5 (H5).** *The participation degree of ESOP is positively correlated with the level of innovation investment.*

**Hypothesis 6 (H6).** *Compared with the self-management mode, companies implementing ESOPs with entrusted management mode have a higher level of innovation investment.*

## 4. Methodology

### 4.1. Data and Sample

In this paper, listed companies that successfully implemented ESOPs during the period from 1 July 2014 to 31 December 2020 were selected as the treatment group, and listed companies that never implemented ESOPs during this period were selected as the control group. The successfully implemented ESOPs refer to the ESOPs that have completed the purchase of the underlying shares during the target period. Based on this standard, this paper excluded ESOPs whose implementation progress during the target period was “termination of implementation”, “failed to pass the deliberation of the shareholders’ meeting”, “board planning stage”, or “passed the deliberation of shareholders’ meeting”. In addition, the following observations were also excluded: (1) companies offering B-shares; (2) companies in the finance industry; (3) companies with special treatment; (4) observations missing variable data. The screening process resulted in a sample of 15,793 firm-year observations. To eliminate the influence of extreme values on the empirical results, all continuous variables were winsorized at the 1 percentile at both tails of their distributions.

The data on innovation investment and the implementation and contractual elements of ESOPs were obtained from the Wind database, and the data on company characteristics and governance structure were obtained from the CSMAR database. In this paper, the date of the approval of the ESOP proposal by the shareholders’ meeting is taken as the symbol of the formal implementation of ESOP, and this date is taken as the starting year of ESOP implementation. In addition, to further confirm whether an ESOP is completed each year, we checked whether companies that successfully implemented ESOPs disclosed an announcement on the completion of share sales, and determined the ending year of ESOP implementation based on the announcement date. According to the beginning and ending years of ESOP implementation, this paper further divides the research sample

into four categories: companies that have never implemented ESOPs (never-implement sample), companies that are implementing ESOPs (implementing sample), companies that will implement ESOPs (will-implement sample) and companies that have completed the implementation of ESOPs (completed-implement sample). Table 1 shows the annual distributions of the four sample categories.

**Table 1.** Composition of the research sample in each year.

Year	Never-Implement Sample		Implementing Sample		Will-Implement Sample		Completed-Implement Sample	
2014	924	69.42%	28	2.10%	379	28.47%	0	0.00%
2015	1302	70.53%	278	15.06%	266	14.41%	0	0.00%
2016	1467	71.84%	373	18.27%	202	9.89%	0	0.00%
2017	1671	73.10%	468	20.47%	129	5.64%	18	0.79%
2018	2023	75.91%	477	17.90%	95	3.56%	70	2.63%
2019	2100	76.64%	482	17.59%	55	2.01%	103	3.76%
2020	2248	77.97%	445	15.44%	0	0.00%	190	6.59%
Total	11,735	74.31%	2551	16.15%	1126	7.13%	381	2.41%

As can be seen from Table 1, in terms of the whole sample, during the sample period, the proportions of the never-implement sample, implementing sample, will-implement sample, and completed-implement sample are 74.31 percent, 16.15 percent, 7.13 percent, and 2.41 percent, respectively. In terms of the annual change trends, the proportion of never-implement sample shows a trend of increasing year by year, while the proportion of implementing sample shows a trend of first increasing and then decreasing, but the proportion of will-implement-sample shows a trend of decreasing year by year. In 2017, 18 companies completed their implementation of ESOPs, and the proportion of completed-implement sample shows a trend of increase from 2017 to 2020.

Considering that there may be a lag effect on the influence of ESOP on innovation investment, this article further eliminated the completed-implement sample (381 observations) to eliminate the interference of the lag effect. Therefore, the final sample includes never-implement firms, will-implement firms, and implementing firms, consisting of 15,412 firm-year observations.

#### 4.2. Variables

##### 4.2.1. Dependent Variables

The dependent variable of this paper is enterprise innovation investment. Existing studies typically use R&D expenditures to proxy for innovation investment. Following Luo and Wang [59], and Tian and Meng [66], we measure the level of innovation investment in terms of absolute scale and relative scale. First, similar to Hou and Zhou [11], and Tian and Meng [66], since some companies do not have or disclose R&D expenditures, we use the natural logarithm of R&D expenditures plus one to measure the absolute scale of innovation investment (lnRD). Second, in the accounting and finance literature, two R&D ratios are most commonly used to measure the relative scale of innovation investment: the ratio of R&D expenditures to sales and the ratio of R&D expenditures to total assets. Consistent with Chen and Huang [58], and Tian and Meng [66], since the ratio of R&D expenditures to sales cannot be calculated when companies have zero sales, we use the ratio of R&D expenditures to total assets (RD\_assets) to measure the relative scale of innovation investment in our main regression analysis. We also use the ratio of R&D expenditures to sales (RD\_sales) in the robustness tests.

##### 4.2.2. Independent Variables

The independent variables of this paper are ESOP implementation and ESOP contract elements. First, based on prior studies (e.g., Zhou et al. [7], Meng et al. [8], Li and Ding [9], and Ding [10]), this paper designs a binary dummy variable (ESOP\_dummy) to represent

the implementation of ESOP, that is, its value is 1 when the company is implementing ESOP in the current year, and otherwise its value is 0. Second, according to the Guidance, this paper focuses on the following contractual elements of ESOP: (1) fund source (ESOP\_fund); (2) stock source (ESOP\_stock); (3) lockup period (ESOP\_lockup); (4) duration (ESOP\_duration); (5) shareholding scale (ESOP\_share); (6) executive subscription ratio (ESOP\_exepurchase); (7) participation degree (ESOP\_participation); (8) management mode (ESOP\_management). The specific definitions of each contractual element are shown in Table 2.

**Table 2.** Definitions of dependent and independent variables.

Symbol	Definition
lnRD	It represents the absolute scale of innovation investment, which is equal to the natural logarithm of R&D expenditures plus one.
RD_assets	It represents the relative scale of innovation investment, which is equal to R&D expenditures in the current year divided by total assets at the end of the year.
ESOP_dummy	It represents the implementation of ESOP, which is equal to 1 when the firm is implementing ESOP in the current year and is otherwise equal to 0.
ESOP_fund	It represents the fund source of ESOP, which is equal to 1 when the firm implements ESOP with employees' own funds and is otherwise equal to 0.
ESOP_stock	It represents the stock source of ESOP, which is equal to 1 when the firm implements ESOP by subscribing for non-public offering shares and is otherwise equal to 0.
ESOP_lockup	It represents the lockup period of ESOP, which refers to the minimum shareholding period of the ESOP, starting from the time when the listed company announces the transfer of the underlying shares to the current shareholding plan.
ESOP_duration	It represents the duration of ESOP, which is the number of years from the date on which the ESOP draft was approved by the general meeting of shareholders to the date on which the sales of ESOP shares were completed.
ESOP_share	It represents the shareholding scale of ESOP, which is the number of shares held by the ESOP divided by the company's total number of shares.
ESOP_exepurchase	It represents the executive subscription ratio in ESOP, which is the percentage of shares purchased by the firm's executives in ESOP.
ESOP_participation	It represents the participation degree of ESOP, which is the number of employees involved in ESOP divided by the total number of employees.
ESOP_management	It represents the management mode of ESOP, which is equal to 1 when the ESOP is managed by a third-party institution with asset management qualifications and is otherwise equal to 0.

#### 4.2.3. Control Variables

Drawing on prior studies on the determinants of enterprise innovation (e.g., Hou and Zhou [11], Chen and Huang [58], Luo and Wang [59]), this paper controls for a number of corporate characteristics and governance variables, as well as some fixed effects in the model. First, in terms of corporate characteristics, similar to Chang et al. [67], we control for firm size (Size), leverage (Lev), operating profitability (ROA), sales growth (Growth), cash holdings (Cash), capital intensity (Tangible) and firm age (Firm\_age). Second, in terms of corporate governance, following Zhou et al. [7] and Jiang and Yu [54], we control for ownership concentration (Shr1), institutional investors (Institution), board independence (Independence), dual structure (Dual), executive compensation (Exe\_comp), employee compensation (Emp\_comp) and executive shareholdings (Exe\_share). Finally, drawing on Meng et al. [8] and Jiang and Yu [54], we also control for year-fixed effects, industry-fixed effects, and province-fixed effects. The specific definitions of each control variable are presented in Table 3.

**Table 3.** Definitions of control variables.

Symbol	Definition
Size	It represents firm size, which is the natural logarithm of total assets at the end of the year.
Lev	It represents financial leverage, which is equal to the total liability divided by total assets at the end of the year.
ROA	It represents operating profitability, which is the net income in the current year divided by the total assets at the end of the year.
Growth	It represents sales growth, which is the difference between the current year's revenue and last year's revenue divided by last year's revenue.
Cash	It represents cash holdings, which is equal to the monetary funds divided by total assets at the end of the year.
Tangible	It represents capital intensity, which is equal to the fixed assets divided by total assets at the end of the year.
Firm_age	It represents firm age, which is the number of years from the establishment of the firm to the current fiscal year.
Shr1	It represents ownership concentration, which is equal to the number of shares held by the largest shareholder divided by the total shares of the firm.
Institution	It represents institutional investors, which is equal to the number of shares held by institutional investors divided by the total shares of the firm.
Independence	It represents board independence, which is equal to the number of independent directors divided by the total number of board directors.
Dual	It represents a dual structure, which is equal to 1 when the chairman of the board serves concurrently as general manager and is otherwise equal to 0.
Exe_comp	It represents executive compensation, which is the natural logarithm of the total compensation of the top three executives.
Emp_comp	It represents employee compensation, which is the natural logarithm of the total employee compensation divided by the total number of employees.
Exe_share	It represents executive shareholdings, which is equal to the number of shares held by executives divided by the total shares of the firm.
Year	It represents year-fixed effects, which are represented by 6 year dummies. The year 2014 is used as the baseline in setting year dummies.
Industry	It represents industry-fixed effects, which are represented by 16 industry dummies. We classify sample firms into 17 industry categories (the finance industry is excluded in our sample) according to the "Guidance on Industry Classification of Listed Companies" issued by the China Securities Regulatory Commission in 2012.
Province	It represents province-fixed effects, which are represented by 33 province dummies. China has 34 provincial-level administrative regions, including 23 provinces, 5 autonomous regions, 4 municipalities directly under the Central Government, and 2 special administrative regions. Based on this, we classify sample firms into 34 province categories and set 33 province dummies.

#### 4.3. Models

To test the impact of ESOP implementation on enterprise innovation investment, this paper constructs the following treatment effect model:

$$\begin{aligned}
 \ln RD / RD\_assets = & \alpha_0 + \alpha_1 ESOP\_dummy + \alpha_2 Size + \alpha_3 Lev + \alpha_4 ROA \\
 & + \alpha_5 Growth + \alpha_6 Cash + \alpha_7 Tangible + \alpha_8 Firm\_age \\
 & + \alpha_9 Shr1 + \alpha_{10} Institution + \alpha_{11} Independence + \alpha_{12} Dual \\
 & + \alpha_{13} Exe\_comp + \alpha_{14} Emp\_comp + \alpha_{15} Exe\_share \\
 & + \sum Year + \sum Industry + \sum Province + \varepsilon
 \end{aligned} \tag{1}$$

In Model (1), the dependent variable is innovation investment, which is measured by the absolute scale ( $\ln RD$ ) and the relative scale ( $RD\_assets$ ) of R&D expenditures. The independent variable is the implementation of ESOP, which is represented by a dummy variable  $ESOP\_dummy$ . We control for corporate characteristics (i.e., firm size, leverage, operating profitability, sales growth, cash holdings, capital intensity, and firm age), governance structure (i.e., ownership concentration, institutional investors, board independence, dual

structure, executive compensation, employee compensation, and executive shareholdings) and fixed effects of year, industry, and province in the model. To estimate the treatment effect of ESOP implementation, we use companies that implement ESOPs and companies that do not implement ESOPs as the treatment and control groups, respectively. The coefficient on the ESOP\_dummy measures the average treatment effect of ESOP implementation. If it is significantly positive, Hypothesis 1 is supported.

To further test the influence of ESOP contract design on enterprise innovation investment, this paper constructs the following multivariate regression model:

$$\begin{aligned} \ln RD / RD\_assets = & \beta_0 + \beta_1 ESOP\_contract + \beta_2 Size + \beta_3 Lev + \beta_4 ROA \\ & + \beta_5 Growth + \beta_6 Cash + \beta_7 Tangible + \beta_8 Firm\_age \\ & + \beta_9 Shr1 + \beta_{10} Institution + \beta_{11} Independence + \beta_{12} Dual \\ & + \beta_{13} Exe\_comp + \beta_{14} Emp\_comp + \beta_{15} Exe\_share \\ & + \sum Year + \sum Industry + \sum Province + \varepsilon \end{aligned} \quad (2)$$

In Model (2), the independent variable ESOP\_contract represents ESOP contract elements, including fund source (ESOP\_fund), stock source (ESOP\_stock), lockup period (ESOP\_lockup), duration (ESOP\_duration), participation degree (ESOP\_participation), and management mode (ESOP\_management). The dependent and control variables in Model (2) are the same as in Model (1). This paper uses companies that implement ESOPs to estimate Model (2) and tests Hypothesis 2, 3, 5, and 6 according to the estimated coefficients of each contract element. Since there are large differences among the missing values of each contract element and there are high correlations between parts of contract elements, each contract element is added separately to Model (2).

To test the non-linear relationships of the shareholding scale and executive subscription ratio of ESOP with innovation investment (i.e., Hypothesis 4), this paper constructs the following regression models:

$$\begin{aligned} \ln RD / RD\_assets = & \beta_0 + \beta_1 ESOP\_share + \beta_2 ESOP\_share^2 + \beta_3 Size \\ & + \beta_4 Lev + \beta_5 ROA + \beta_6 Growth + \beta_7 Cash + \beta_8 Tangible \\ & + \beta_9 Firm\_age + \beta_{10} Shr1 + \beta_{11} Institution + \beta_{12} Independence \\ & + \beta_{13} Dual + \beta_{14} Exe\_comp + \beta_{15} Emp\_comp + \beta_{16} Exe\_share \\ & + \sum Year + \sum Industry + \sum Province + \varepsilon \end{aligned} \quad (3)$$

$$\begin{aligned} \ln RD / RD\_assets = & \beta_0 + \beta_1 ESOP\_exepurchase + \beta_2 ESOP\_exepurchase^2 \\ & + \beta_3 Size + \beta_4 Lev + \beta_5 ROA + \beta_6 Growth + \beta_7 Cash + \beta_8 Tangible \\ & + \beta_9 Firm\_age + \beta_{10} Shr1 + \beta_{11} Institution + \beta_{12} Independence \\ & + \beta_{13} Dual + \beta_{14} Exe\_comp + \beta_{15} Emp\_comp + \beta_{16} Exe\_share \\ & + \sum Year + \sum Industry + \sum Province + \varepsilon \end{aligned} \quad (4)$$

The independent variables of Model (3) are the shareholding scale (ESOP\_share) and its square term, and the independent variables of Model (4) are the executive subscription ratio (ESOP\_exepurchase) and its square term. The dependent and control variables in Model (3) and Model (4) are the same as in Model (1). This paper also uses companies that implement ESOPs to estimate Model (3) and Model (4) and tests Hypothesis 4 according to the estimated coefficients of the shareholding scale, executive subscription ratio, and their square terms.

## 5. Results

### 5.1. Descriptive Analysis

Table 4 reports the descriptive statistics of the research variables. From the perspective of dependent and independent variables in Model (1), the mean values of  $\ln RD$  and  $RD\_assets$ , two proxy variables of innovation investment, are 17.932 and 0.023, respectively, indicating that the average level of R&D expenditure of sample companies is about 61.34 million yuan ( $e^{17.932} - 1$ ), and the average proportion of R&D expenditure in total



assets at the end of the year is 2.3 percent. The mean value of ESOP\_dummy is 0.166, indicating that 16.6 percent of the sample companies are implementing ESOPs.

**Table 4.** Descriptive statistics of the research variables.

Variable	N	Mean	Median	S.D.	Min	Max
lnRD	15,412	17.932	17.915	1.460	13.499	21.788
RD_assets	15,412	0.023	0.020	0.020	0.000	0.108
ESOP_dummy	15,412	0.166	0.000	0.372	0.000	1.000
ESOP_stock	2551	0.220	0.000	0.414	0.000	1.000
ESOP_fund	2551	0.698	1.000	0.459	0.000	1.000
ESOP_lockup	2545	1.524	1.000	0.864	1.000	5.000
ESOP_duration	2479	2.972	3.000	1.132	1.000	10.000
ESOP_share	2507	1.669	1.310	1.443	0.015	9.270
ESOP_exepurchase	2342	28.236	24.250	22.338	0.000	100.000
ESOP_participation	2383	0.129	0.077	0.159	0.001	0.884
ESOP_management	2542	0.770	1.000	0.421	0.000	1.000
Lev	15,412	0.407	0.397	0.195	0.059	0.964
ROA	15,412	0.035	0.038	0.073	−0.427	0.200
Growth	15,412	0.174	0.104	0.438	−0.681	3.383
Cash	15,412	0.173	0.144	0.115	0.003	0.617
Tangible	15,412	0.204	0.176	0.145	0.001	0.691
Firm_age	15,412	18.541	18.229	5.416	7.195	33.074
Shr1	15,412	0.333	0.311	0.143	0.084	0.743
Institution	15,412	0.407	0.422	0.248	0.002	0.926
Independence	15,412	0.376	0.364	0.053	0.333	0.571
Dual	15,412	0.308	0.000	0.462	0.000	1.000
Exe_comp	15,412	14.596	14.552	0.661	12.996	16.606
Emp_comp	15,412	11.644	11.598	0.447	10.610	13.174
Exe_share	15,412	0.162	0.038	0.204	0.000	0.688

From the perspective of contract design variables in Models (2), (3), (4), 22 percent of sample companies implement ESOPs by subscribing to non-publicly offered shares, 69.8 percent of sample companies implement ESOPs with employees' own funds, and 77 percent of companies entrust third-party institutions to manage their ESOPs. The average lockup period of ESOP is 1.524 years, with the shortest being 1 year and the longest being 5 years. The average duration of ESOP is 2.972 years, the shortest is 1 year, and the longest is 10 years. The mean value of participation degree is 0.129, the minimum value is 0.001, and the maximum value is 0.884, indicating that the willingness of employees to participate in ESOPs is currently lower in China, and the degree of employee participation in ESOPs vary widely among different companies. The average subscription proportion of executives in ESOP is 28.236 percent, accounting for about one-third of the total shares of ESOP, while the minimum value is 0 and the maximum value is 100 percent. The extreme value reflects that some ESOPs are designed to benefit only senior executives or ordinary employees, indicating that ESOPs are used either as a simple incentive tool for senior executives or as a simple measure to benefit employees. The shareholding scale is 1.669 percent on average, which is a relatively low percentage of total shares of the company, with a maximum of 9.27 percent, in line with the requirement in the Guidance that the cumulative number of shares involved in the ESOP should not exceed 10 percent of the company's total shares.

In terms of corporate characteristic variables, for the sample companies of this study, the average asset–liability ratio is 40.7 percent, the average return on assets is 3.5 percent, the average growth rate of operating income is 17.4 percent, the average proportion of cash holdings to total assets is 20.4 percent, the average proportion of fixed assets to total assets is 20.4 percent, and the average age of the sample firms is 18.541 years. In terms of corporate governance variables, the average shareholdings of the largest shareholder, institutional investors, and senior executives of sample companies are 33.3 percent, 40.7 percent, and 16.2 percent, respectively. In sample companies, the average proportion of independent directors to the total number of directors on the board is 37.6 percent, the average total compensation of the top three executives is about 2.18 million yuan ( $e^{14.596}$ ), and the average

annual salary of employees is about 114,000 yuan ( $e^{11.644}$ ). In addition, the chairman of 30.8% of the sample companies also served as general manager.

Table 5 shows the comparisons between the treatment group (companies that implement ESOPs in the current year) and the control group (companies that do not implement ESOPs in the current year). From the perspective of innovation investment, the absolute and relative scales of innovation investment of companies implementing ESOPs are both significantly larger than companies not implementing ESOPs, consistent with the prediction of Hypothesis 1. From the perspective of corporate characteristic variables, compared with companies that do not implement ESOPs, companies that implement ESOPs have larger sizes, higher debt levels, and growth rates, but are younger and have a lower proportion of cash holdings and fixed assets. From the perspective of corporate governance variables, compared with companies that do not implement ESOPs, companies that implement ESOPs have higher board independence, executive compensation, dual structure, and executive shareholding ratio, but lower ownership concentration and institutional shareholding ratio. The above results indicate that there are significant differences in corporate characteristics and governance structure between companies with and without ESOP implementation, so it is necessary to control for the influence of corporate characteristics and governance structure when discussing the impact of ESOP implementation on innovation investment.

**Table 5.** Comparisons between the treatment group and the control group.

Variable	(1) ESOP_dummy = 0		(2) ESOP_dummy = 1		(2) – (1) Mean Difference
	N	Mean	N	Mean	
lnRD	12,861	17.854	2551	18.321	0.467 ***
RD_assets	12,861	0.023	2551	0.025	0.002 ***
Size	12,861	22.165	2551	22.466	0.301 ***
Lev	12,861	0.405	2551	0.416	0.011 ***
ROA	12,861	0.035	2551	0.035	0.000
Growth	12,861	0.169	2551	0.199	0.030 ***
Cash	12,861	0.175	2551	0.159	−0.016 ***
Tangible	12,861	0.209	2551	0.178	−0.031 ***
Firm_age	12,861	18.596	2551	18.261	−0.335 ***
Shr1	12,861	0.338	2551	0.308	−0.030 ***
Institution	12,861	0.414	2551	0.372	−0.043 ***
Independence	12,861	0.376	2551	0.378	0.002 **
Dual	12,861	0.300	2551	0.348	0.048 ***
Exe_comp	12,861	14.572	2551	14.713	0.141 ***
Emp_comp	12,861	11.643	2551	11.644	0.001
Exe_share	12,861	0.157	2551	0.185	0.028 ***

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

## 5.2. Correlation Analysis

Table 6 reports the Pearson correlation coefficients between the main variables. It shows that the implementation of ESOP is significantly positively correlated with the absolute and relative scale of innovation investment at the 1 percent level, which preliminarily supports Hypothesis 1. In addition, there are significant correlations between all the control variables and the two proxy variables of innovation investment, which to some extent confirms the rationality of the selection of control variables in this paper.

Table 6 also shows that among the eight contractual elements of ESOP, seven elements are significantly correlated with the absolute scale of innovation investment, but only four elements are significantly correlated with the relative scale of innovation investment. In addition, there is a certain correlation among all contractual elements. Specifically, stock source, lockup period, and duration are highly correlated (the correlation coefficients are 0.907, 0.608, and 0.519, respectively), so these three contractual elements should not be added to the regression model at the same time.

**Table 6.** Pearson correlations between the main variables.

Variable	lnRD	RD_assets	Esop_dummy	ESOP_stock	ESOP_fund	ESOP_lockup	ESOP_duration	ESOP_share	ESOP_exepurchase	ESOP_participation	ESOP_management
RD_assets	0.484 ***	1									
ESOP_dummy	0.119 ***	0.032 ***	1								
ESOP_stock	0.066 ***	0.002	-	1							
ESOP_fund	-0.110 ***	-0.080 ***	-	0.219 ***	1						
ESOP_lockup	0.077 ***	0.023	-	0.907 ***	0.165 ***	1					
ESOP_duration	0.140 ***	0.039 *	-	0.519 ***	-0.038 *	0.608 ***	1				
ESOP_share	-0.005	-0.037 *	-	0.162 ***	0.101 ***	0.145 ***	0.066 ***	1			
ESOP_exepurchase	-0.141 ***	-0.078 ***	-	-0.008	0.060 ***	-0.047 **	-0.089 ***	0.039 *	1		
ESOP_participation	-0.174 ***	-0.021	-	0.034 *	0.048 **	0.013	-0.040 *	0.066 ***	-0.202 ***	1	
ESOP_management	0.039 **	0.028	-	-0.102 ***	0.094 ***	-0.125 ***	-0.254 ***	0.124 ***	-0.008	0.062 ***	1
Size	0.534 ***	-0.232 ***	0.088 ***	0.106 ***	-0.032	0.116 ***	0.177 ***	-0.007	-0.150 ***	-0.185 ***	0.037 *
Lev	0.192 ***	-0.202 ***	0.022 ***	0.025	0.094 ***	0.014	0.010	0.089 ***	-0.023	-0.137 ***	0.105 ***
ROA	0.101 ***	0.105 ***	0.001	-0.019	-0.055 ***	0.008	0.064 ***	-0.034 *	-0.059 ***	-0.062 ***	-0.077 ***
Growth	0.052 ***	0.022 ***	0.025 ***	0.052 ***	0.016	0.054 ***	0.023	0.033 *	-0.039 *	-0.042 **	0.003
Cash	0.003	0.196 ***	-0.051 ***	-0.002	-0.051 ***	0.025	0.008	-0.053 ***	-0.043 **	0.029	-0.004
Tangible	-0.049 ***	-0.189 ***	-0.079 ***	0.003	-0.003	0.008	-0.010	0.028	-0.016	-0.050 **	-0.079 ***
Firm_age	0.010	-0.106 ***	-0.023 ***	0.068 ***	0.089 ***	0.076 ***	0.038 *	0.055 ***	-0.005	0.051 **	0.030
Shr1	0.016 *	-0.118 ***	-0.079 ***	-0.072 ***	-0.124 ***	-0.058 ***	-0.017	-0.040 **	-0.031	0.052 **	-0.035 *
Institution	0.152 ***	-0.158 ***	-0.064 ***	0.085 ***	0.026	0.085 ***	0.072 ***	-0.015	0.053 ***	-0.124 ***	0.014
Independence	0.011	0.041 ***	0.017 **	-0.095 ***	-0.112 ***	-0.046 **	-0.023	-0.048 **	-0.091 ***	0.060 ***	0.068 ***
Dual	-0.038 ***	0.119 ***	0.039 ***	-0.050 **	-0.085 ***	-0.042 **	0.009	0.010	-0.028	0.015	-0.023
Exe_share	-0.088 ***	0.196 ***	0.051 ***	-0.098 ***	-0.078 ***	-0.091 ***	-0.074 ***	0.015	-0.157 ***	0.075 ***	-0.038 *
Exe_comp	0.402 ***	0.136 ***	0.079 ***	-0.005	-0.106 ***	0.023	0.100 ***	-0.039 *	-0.043 **	-0.186 ***	-0.020
Emp_comp	0.242 ***	0.200 ***	0.001	0.020	-0.006	0.042 **	0.091 ***	-0.039 *	-0.020	0.121 ***	0.010

Note. The symbols \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% levels, respectively. The correlation coefficients between control variables are not included in the table because of space limitation.

Table 7 reports the variance inflation factors (VIFs) of research variables in Model (1) and Model (2). It shows that all the VIFs of the variables in Model (1) are less than 5, indicating that Model (1) does not have a multicollinearity problem. Table 7 also shows that when all the contract design variables are included in Model (2), the VIFs of ESOP\_lockup and ESOP\_stock are 6.63 and 5.83, respectively (both of which are higher than 5), indicating that adding these two variables to the model at the same time may lead to serious multicollinearity problem. On the contrary, When ESOP\_lockup (ESOP\_stock) is excluded in Model (2), the VIF of ESOP\_stock (ESOP\_lockup) reduces to 1.71 (1.50). Therefore, to address the multicollinearity problem, we separately add ESOP\_lockup or ESOP\_stock to Model (2) in the regression analysis.

**Table 7.** The variance inflation factors (VIFs) of research variables in Model (1) and Model (2).

Variable	Model (1)	Model (2)		
ESOP_dummy	1.04			
ESOP_stock		5.83	1.50	
ESOP_fund		1.12	1.12	1.10
ESOP_lockup		6.63		1.71
ESOP_duration		1.78	1.57	1.77
ESOP_share		1.07	1.06	1.07
ESOP_exepurchase		1.19	1.19	1.19
ESOP_participation		1.24	1.23	1.23
ESOP_management		1.17	1.17	1.17
Size	2.07	2.46	2.46	2.46
Lev	1.72	1.77	1.77	1.77
ROA	1.36	1.30	1.30	1.29
Growth	1.09	1.11	1.11	1.11
Cash	1.26	1.21	1.20	1.21
Tangible	1.25	1.31	1.30	1.30
Firm_age	1.10	1.11	1.11	1.11
Shr1	1.61	1.63	1.63	1.63
Institution	3.23	3.06	3.06	3.06
Independence	1.04	1.14	1.12	1.12
Dual	1.10	1.11	1.11	1.11
Exe_comp	1.45	1.68	1.68	1.68
Emp_comp	1.28	1.43	1.43	1.43
Exe_share	2.52	2.38	2.38	2.37
Mean VIF	1.54	1.94	1.50	1.52

### 5.3. Regression Analysis

#### 5.3.1. The Impact of ESOP Implementation on Innovation Investment

To test the impact of ESOP implementation on innovation investment, this paper uses the whole sample and adopts firm clustering robust standard errors to estimate Model (1). The results are reported in Table 8. In terms of the goodness of fit, ESOP implementation, corporate characteristics, and governance structure explain 56.9 percent variation in the absolute scale of innovation investment (lnRD) and 34.1 percent variation in the relative scale of innovation investment (RD\_assets), respectively, indicating that Model (1) has a high explanatory power. In terms of the coefficients of the independent variables, the implementation of ESOP is significantly and positively correlated with the absolute and relative scales of innovation investment at the level of 1 percent and 5 percent, respectively, indicating that the implementation of ESOP can promote the increase in innovation investment of enterprises, which supports Hypothesis 1. By exerting its incentive and governance effects, ESOP effectively alleviates financing constraints and agency problems in innovation investment and then promotes the increase in innovation investment. The result is consistent with the finding of Chen and Huang [58], but their sample is limited to information-technology firms.

**Table 8.** Regression results: The impact of ESOP implementation on innovation investment.

Variable	Model (1): lnRD			Model (1): RD_assets		
	Coefficient	t-Value	p-Value	Coefficient	t-Value	p-Value
ESOP_dummy	0.091 ***	4.64	≤0.01	0.001 **	2.33	0.020
Size	0.743 ***	75.83	≤0.01	−0.003 ***	−22.22	≤0.01
Lev	−0.084	−1.46	0.145	0.004 ***	4.16	≤0.01
ROA	0.623 ***	4.46	≤0.01	0.017 ***	6.28	≤0.01
Growth	0.064 ***	2.98	0.003	0.0002	0.75	0.454
Cash	0.181 **	2.36	0.018	0.008 ***	5.11	≤0.01
Tangible	−0.159 **	−2.09	0.037	−0.004 ***	−3.44	0.001
Firm_age	−0.013 ***	−8.52	≤0.01	−0.0002 ***	−7.64	≤0.01
Shr1	−0.168 **	−2.44	0.015	−0.067 ***	−5.96	≤0.01
Institution	−0.053	−0.96	0.336	0.049 ***	5.18	≤0.01
Independence	−0.075	−0.50	0.615	0.003	1.25	0.213
Dual	0.021	1.33	0.185	0.001 ***	2.88	0.004
Exe_share	0.198 ***	3.52	≤0.01	0.066 ***	6.31	≤0.01
Exe_comp	0.253 ***	15.43	≤0.01	0.004 ***	16.78	≤0.01
Emp_comp	0.342 ***	14.02	≤0.01	0.009 ***	22.23	≤0.01
Constant	−6.792 ***	−19.91	≤0.01	−0.078 ***	−14.11	≤0.01
Industry FE		controlled			controlled	
Year FE		controlled			controlled	
District FE		controlled			controlled	
Adj. R-sq		0.569			0.341	
N		15,412			15,412	
F-value		295.86 ***			111.63 ***	

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

In addition, the regression results of the firm characteristic variables show that the increase in operating profitability and cash ratio can significantly increase both the absolute and relative scale of innovation investment, while the increase in firm age and tangible asset ratio can significantly reduce both the absolute and relative scales of innovation investment. The increase in leverage significantly increases the relative scale of innovation investment, while the acceleration of growth rate significantly increases the absolute scale of innovation investment.

The regression results of the governance variables show that the increase in ownership concentration significantly reduces both the absolute and relative scale of innovation investment, while the increase in institutional shareholdings and the existence of dual structure significantly increase the relative scale of innovation investment. The increase in executive shareholdings, executive compensation, or employee compensation significantly increases both the absolute and relative scale of innovation investment.

### 5.3.2. The Impact of ESOP Contract Design on Innovation Investment

To further test the influence of ESOP contract design on innovation investment, this paper takes companies implementing ESOPs as a regression sample and adopts firm clustering robust standard errors to estimate Model (2).

Table 9 reports the regression results of the impact of fund and stock sources of ESOP on innovation investment. Columns (1) and (2) are the regressions of innovation investment on the stock source or fund source, and column (3) is the regression of innovation investment on the stock source and fund source. The results show that the fund source of ESOP is significantly and negatively correlated with innovation investment, indicating that companies implementing ESOPs with employees' own funds have a lower level of innovation investment than those with other fund sources. The results also show that the stock source of ESOP is significantly and positively correlated with innovation investment, indicating that companies implementing ESOPs by subscribing to non-publicly offered shares have a higher level of innovation investment than those with other stock sources. In summary, the results of Table 9 support Hypothesis 2. Contrary to our findings, Zhou et al. [7] find a positive impact of fund source on innovation output and fail to find a relationship between



stock source and innovation output. This suggests that the fund and stock sources of ESOP may have different impacts on innovation input and output.

**Table 9.** The impact of the fund and stock sources of ESOP on innovation investment.

Variable	(1) Stock Source		(2) Fund Source		(3) Combination	
	lnRD	RD_assets	lnRD	RD_assets	lnRD	RD_assets
ESOP_stock	0.118 (3.030) ***	0.002 (2.738) ***			0.138 (3.520) ***	0.003 (3.225) ***
ESOP_fund			−0.068 (−1.838) *	−0.001 (−1.676) *	−0.094 (−2.503) **	−0.002 (−2.268) **
Size	0.708 (30.708) ***	−0.003 (−7.953) ***	0.712 (31.590) ***	−0.003 (−7.923) ***	0.703 (30.840) ***	−0.004 (−8.285) ***
Lev	0.158 (1.136)	0.003 (1.248)	0.164 (1.185)	0.003 (1.300)	0.186 (1.347)	0.004 (1.463)
ROA	0.612 (2.531) **	0.012 (1.898) *	0.603 (2.471) **	0.012 (1.878) *	0.626 (2.593) ***	0.012 (1.948) *
Growth	0.034 (0.673)	0.002 (2.339) **	0.041 (0.797)	0.002 (2.468) **	0.035 (0.694)	0.002 (2.362) **
Cash	0.126 (0.677)	0.007 (1.895) *	0.097 (0.522)	0.007 (1.754) *	0.109 (0.585)	0.007 (1.808) *
Tangible	0.573 (3.033) ***	0.009 (3.016) ***	0.584 (3.066) ***	0.009 (3.070) ***	0.579 (3.057) ***	0.009 (3.047) ***
Firm_age	−0.014 (−4.113) ***	−0.000 (−2.212) **	−0.013 (−3.828) ***	−0.000 (−1.948) *	−0.014 (−3.992) ***	−0.000 (−2.100) **
Shr1	−0.126 (−0.386)	−0.003 (−0.478)	−0.105 (−0.830)	−0.003 (−0.885)	−0.105 (−0.689)	−0.002 (−0.759)
Institution	−0.526 (−4.151) ***	−0.006 (−2.937) ***	−0.534 (−3.980) ***	−0.006 (−2.747) ***	−0.534 (−4.039) ***	−0.006 (−2.808) ***
Independence	−0.450 (−1.444)	0.009 (1.430)	−0.539 (−1.719) *	0.008 (1.190)	−0.486 (−1.553)	0.009 (1.331)
Dual	0.095 (2.691) ***	0.002 (2.312) **	0.092 (2.591) ***	0.002 (2.211) **	0.092 (2.592) ***	0.002 (2.210) **
Exe_share	−0.104 (−0.708)	0.000 (0.014)	−0.105 (−0.721)	0.000 (0.001)	−0.105 (−0.726)	0.000 (−0.004)
Exe_comp	0.274 (7.611) ***	0.005 (8.005) ***	0.262 (7.286) ***	0.005 (7.653) ***	0.268 (7.451) ***	0.005 (7.807) ***
Emp_comp	0.286 (5.183) ***	0.009 (8.630) ***	0.295 (5.346) ***	0.009 (8.754) ***	0.288 (5.220) ***	0.009 (8.656) ***
Constant	−6.147 (−7.652) ***	−0.101 (−6.662) ***	−5.999 (−7.546) ***	−0.098 (−6.406) ***	−5.868 (−7.355) ***	−0.096 (−6.270) ***
Industry FE	controlled	controlled	controlled	controlled	controlled	controlled
Year FE	controlled	controlled	controlled	controlled	controlled	controlled
District FE	controlled	controlled	controlled	controlled	controlled	controlled
F-value	137.56 ***	36.41 ***	140.75 ***	35.34 ***	136.32 ***	35.88 ***
Adj. R-sq	0.608	0.399	0.607	0.398	0.609	0.400
N	2551	2551	2551	2551	2551	2551

Note. The symbols \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% levels, respectively. The numbers inside the brackets are t values, and the numbers outside the brackets are coefficients.

Table 10 reports the regression results of the impact of the lockup period and duration of ESOP on innovation investment. Column (1) and column (2) are the regressions of innovation investment on the lockup period or duration. Considering that duration includes a lockup period and they are highly correlated, to test the incremental impact of the duration on innovation investment, this paper first takes the difference between duration and lockup period as a new proxy for the duration (ESOP\_duration1) and then includes both the lockup period and the new proxy for duration in the model for regression estimation. The results are shown in column (3). It suggests that both the lockup period and duration of ESOP are significantly and positively correlated with innovation investment and that after excluding the effect of the lockup period, the duration is still significantly and positively correlated with innovation investment, indicating that the longer the lockup period or duration of ESOP, the higher the level of innovation investment, supporting Hypothesis 3. Similar to our finding on the effect of the lockup period, Zhou et al. [7] and Meng et al. [8] both find a positive impact of the lockup period on innovation output. However, they do not consider the effect of duration.

**Table 10.** The impact of the lockup period and duration of ESOP on innovation investment.

Variable	(1) Lockup Period		(2) Duration		(3) Combination	
	lnRD	RD_assets	lnRD	RD_assets	lnRD	RD_assets
ESOP_lockup	0.055 (2.827) ***	0.001 (3.226) ***			0.051 (2.392) **	0.001 (2.873) ***
ESOP_duration			0.050 (2.990) ***	0.001 (3.148) ***		
ESOP_duration1					0.049 (2.384) **	0.001 (1.990) **
Size	0.702 (30.364) ***	−0.004 (−8.231) ***	0.693 (29.573) ***	−0.004 (−8.444) ***	0.693 (29.513) ***	−0.004 (−8.460) ***
Lev	0.149 (1.075)	0.003 (1.211)	0.178 (1.275)	0.004 (1.456)	0.178 (1.275)	0.004 (1.457)
ROA	0.580 (2.411) **	0.012 (1.825) *	0.579 (2.339) **	0.011 (1.754) *	0.580 (2.348) **	0.012 (1.773) *
Growth	0.034 (0.669)	0.002 (2.309) **	0.033 (0.626)	0.002 (2.200) **	0.033 (0.623)	0.002 (2.159) **
Cash	0.107 (0.577)	0.007 (1.814) *	0.126 (0.665)	0.008 (2.024) **	0.126 (0.665)	0.008 (2.011) **
Tangible	0.587 (3.105) ***	0.009 (3.080) ***	0.695 (3.596) ***	0.012 (3.918) ***	0.695 (3.588) ***	0.012 (3.884) ***
Firm_age	−0.015 (−4.325) ***	−0.0002 (−2.430) **	−0.015 (−4.289) ***	−0.0002 (−2.571) **	−0.015 (−4.285) ***	−0.0002 (−2.610) ***
Shr1	−0.052 (−0.348)	−0.001 (−0.416)	−0.086 (−0.568)	−0.002 (−0.676)	−0.086 (−0.564)	−0.002 (−0.642)
Institution	−0.523 (−3.964) ***	−0.006 (−2.746) ***	−0.514 (−3.800) ***	−0.006 (−2.464) **	−0.514 (−3.799) ***	−0.006 (−2.481) **
Independence	−0.462 (−1.483)	0.009 (1.412)	−0.433 (−1.380)	0.009 (1.435)	−0.433 (−1.380)	0.009 (1.442)
Dual	0.098 (2.777) ***	0.002 (2.395) **	0.097 (2.683) ***	0.002 (2.330) **	0.097 (2.671) ***	0.002 (2.352) **
Exe_share	−0.093 (−0.642)	0.0002 (0.080)	−0.061 (−0.413)	0.001 (0.325)	−0.061 (−0.413)	0.001 (0.323)
Exe_comp	0.271 (7.535) ***	0.005 (7.967) ***	0.266 (7.230) ***	0.005 (7.580) ***	0.267 (7.193) ***	0.005 (7.581) ***
Emp_comp	0.294 (5.332) ***	0.009 (8.734) ***	0.289 (5.172) ***	0.009 (8.567) ***	0.289 (5.167) ***	0.009 (8.555) ***
Constant	−6.116 (−7.612) ***	−0.100 (−6.610) ***	−5.895 (−7.065) ***	−0.094 (−6.112) ***	−5.896 (−7.069) ***	−0.094 (−6.137) ***
Industry FE	controlled	controlled	controlled	controlled	controlled	controlled
Year FE	controlled	controlled	controlled	controlled	controlled	controlled
District FE	controlled	controlled	controlled	controlled	controlled	controlled
F-value	140.90 ***	35.91 ***	152.81 ***	37.79 ***	150.60 ***	35.88 ***
Adj. R-sq	0.606	0.402	0.603	0.404	0.603	0.404
N	2545	2545	2479	2479	2479	2479

Note. The symbols \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% levels, respectively. The numbers inside the brackets are t values, and the numbers outside the brackets are coefficients.

Table 11 reports regression the results of the impact of the shareholding scale and executive subscription ratio on innovation investment. The first and second columns present the estimation results of Model (2), the third and fourth columns report the estimation results of Model (3), and the fifth and sixth columns present the estimation results of Model (4). The results of Model (2) show that before considering a non-linear relationship, the shareholding scale has an insignificant impact on innovation investment, but the executive subscription ratio has a significant and negative impact on innovation investment. However, the results of Model (3) and Model (4) show that after considering a non-linear relationship, the shareholding scale has an inverted U-shaped impact on innovation investment, but the executive subscription ratio has a U-shaped impact on innovation investment, which supports Hypothesis 4.

**Table 11.** The impact of the shareholding scale and executive subscription ratio of ESOP on innovation investment.

Variable	Model (2)		Model (3)		Model (4)	
	lnRD	RD_assets	lnRD	RD_assets	lnRD	RD_assets
ESOP_share	0.007 (0.568)	−0.0002 (−1.175)	0.054 (1.838) *	0.001 (1.112)		
ESOP_share <sup>2</sup>			−0.008 (−1.951) *	−0.0002 (−2.307) **		
ESOP_exepurchase	−0.003 (−3.769) ***	−0.0001 (−5.737) ***			−0.014 (−5.726) ***	−0.0003 (−6.397) ***
ESOP_exepurchase <sup>2</sup>					0.0001 (4.750) ***	0.000003 (5.000) ***
Size	0.688 (29.071) ***	−0.004 (−8.539) ***	0.714 (30.584) ***	−0.003 (−7.678) ***	0.677 (28.687) ***	−0.004 (−8.968) ***
Lev	0.032 (0.230)	0.002 (0.767)	0.148 (1.054)	0.003 (1.204)	0.064 (0.462)	0.003 (1.035)
ROA	0.554 (2.182) **	0.011 (1.710) *	0.607 (2.480) **	0.012 (1.924) *	0.488 (1.946) *	0.009 (1.441)
Growth	0.030 (0.580)	0.002 (2.231) **	0.038 (0.761)	0.002 (2.499) **	0.038 (0.738)	0.002 (2.409) **
Cash	0.100 (0.518)	0.006 (1.539)	0.126 (0.677)	0.008 (1.938) *	0.089 (0.467)	0.006 (1.480)
Tangible	0.500 (2.453) **	0.008 (2.440) **	0.562 (2.943) ***	0.009 (3.007) ***	0.569 (2.794) ***	0.010 (2.946) ***
Firm_age	−0.014 (−3.946) ***	−0.000 (−2.221) **	−0.015 (−4.341) ***	−0.000 (−2.271) **	−0.013 (−3.618) ***	−0.000 (−2.074) **
Shr1	−0.000 (−0.016)	−0.000 (−0.273)	−0.000 (−0.227)	−0.000 (−0.561)	−0.001 (−0.599)	−0.000 (−0.636)
Institution	−0.006 (−4.366) ***	−0.000 (−3.231) ***	−0.006 (−4.336) ***	−0.000 (−3.119) ***	−0.005 (−3.854) ***	−0.000 (−2.578) **
Independence	−0.199 (−0.624)	0.006 (0.947)	−0.428 (−1.378)	0.009 (1.396)	−0.327 (−1.021)	0.005 (0.733)
Dual	0.068 (1.815) *	0.001 (1.863) *	0.088 (2.471) **	0.001 (1.820) *	0.080 (2.126) **	0.002 (2.381) **
Exe_share	−0.004 (−2.340) **	−0.000 (−1.380)	−0.002 (−1.112)	−0.000 (−0.189)	−0.003 (−2.226) **	−0.000 (−1.389)
Exe_comp	0.279 (7.232) ***	0.006 (8.427) ***	0.278 (7.682) ***	0.005 (8.089) ***	0.267 (6.984) ***	0.006 (8.111) ***
Emp_comp	0.280 (4.784) ***	0.009 (8.236) ***	0.298 (5.417) ***	0.009 (8.615) ***	0.266 (4.545) ***	0.009 (8.362) ***
Constant	−5.217 (−6.357) ***	−0.088 (−5.467) ***	−6.462 (−7.753) ***	−0.101 (−6.475) ***	−4.461 (−5.351) ***	−0.077 (−4.791) ***
Industry FE	controlled	controlled	controlled	controlled	controlled	controlled
Year FE	controlled	controlled	controlled	controlled	controlled	controlled
District FE	controlled	controlled	controlled	controlled	controlled	controlled
F-value	94.97 ***	77.04 ***	122.20 ***	36.33 ***	99.70 ***	78.20 ***
Adj. R-sq	0.606	0.420	0.603	0.402	0.607	0.421
N	2304	2304	2507	2507	2342	2342

Note. The symbols \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% levels, respectively. The numbers inside the brackets are t values, and the numbers outside the brackets are coefficients.

It suggests that when the shareholding scale is at a lower level or the executive subscription ratio is at a higher level, ESOP can effectively alleviate agency conflicts among shareholders, executives, and employees; when the shareholding scale is at a higher level or the executive subscription ratio is at lower level, ESOP can be used as a tool for executives to improve their entrenchment. Consistent with our finding on the effect of executive subscription ratio, Luo and Wang [59] also find a U-shaped relationship between the executive subscription ratio and R&D expenditure. However, they do not explore the effect of other contractual elements of ESOP on R&D spending.

Table 12 reports the regression results of the impact of the participation degree and management mode on innovation investment. Column (1) and column (3) are the regressions of innovation investment on the participation degree or management mode, and column (2) are the regression results after controlling for employee size in testing the effect of the participation degree. It suggests that after eliminating the negative correlation between the participation degree and innovation investment caused by employee size, the participation degree of ESOP is significantly and positively correlated with innovation investment, indicating that the higher the participation degree of ESOP, the higher the level of innovation investment, supporting Hypothesis 5. It also indicates that companies implementing ESOPs with entrusted management mode have a higher level of innovation investment than those with self-management mode, supporting Hypothesis 6.

**Table 12.** The impact of the participation degree and management mode of ESOP on innovation investment.

Variable	(1) Participation Degree		(2) Control Employee Size		(3) Management Mode	
	lnRD	RD_assets	lnRD	RD_assets	lnRD	RD_assets
ESOP_participation	−0.310 (−2.255) **	−0.007 (−2.779) ***	0.190 (1.405)	0.005 (2.059) **		
ESOP_management					0.087 (2.025) **	0.002 (2.223) **
Employee_size			0.496 (13.500) ***	0.011 (17.053) ***		
Size	0.705 (29.700) ***	−0.004 (−7.945) ***	0.348 (10.447) ***	−0.012 (−18.838) ***	0.709 (31.181) ***	−0.003 (−7.953) ***
Lev	0.085 (0.578)	0.003 (1.147)	0.054 (0.400)	0.002 (0.944)	0.115 (0.832)	0.002 (0.912)
ROA	0.704 (2.947) ***	0.014 (2.100) **	0.461 (2.056) **	0.008 (1.382)	0.593 (2.447) **	0.012 (1.847) *
Growth	0.049 (0.921)	0.002 (2.423) **	0.056 (1.011)	0.002 (2.529) **	0.042 (0.825)	0.002 (2.495) **
Cash	0.031 (0.161)	0.005 (1.160)	−0.245 (−1.349)	−0.002 (−0.440)	0.105 (0.567)	0.007 (1.801) *
Tangible	0.644 (3.325) ***	0.011 (3.510) ***	0.101 (0.580)	−0.002 (−0.594)	0.617 (3.262) ***	0.010 (3.262) ***
Firm_age	−0.014 (−3.796) ***	−0.0001 (−1.894) *	−0.014 (−3.840) ***	−0.0001 (−1.822) *	−0.015 (−4.253) ***	−0.0002 (−2.316) **
Shr1	−0.073 (−0.470)	−0.001 (−0.269)	−0.102 (−0.702)	−0.002 (−0.506)	−0.061 (−0.405)	−0.002 (−0.506)
Institution	−0.449 (−3.324) ***	−0.006 (−2.542) **	−0.570 (−4.625) ***	−0.009 (−4.182) ***	−0.512 (−3.888) ***	−0.006 (−2.649) ***
Independence	−0.355 (−1.092)	0.011 (1.582)	−0.375 (−1.205)	0.010 (1.611)	−0.534 (−1.694) *	0.008 (1.177)
Dual	0.093 (2.524) **	0.002 (1.994) **	0.079 (2.296) **	0.001 (1.716) *	0.099 (2.774) ***	0.002 (2.408) **
Exe_share	−0.084 (−0.555)	0.001 (0.329)	−0.204 (−1.443)	−0.002 (−0.734)	−0.079 (−0.539)	0.001 (0.191)
Exe_comp	0.234 (6.153) ***	0.005 (6.675) ***	0.113 (2.828) ***	0.002 (2.750) ***	0.265 (7.370) ***	0.005 (7.781) ***
Emp_comp	0.346 (5.908) ***	0.010 (9.147) ***	0.732 (11.308) ***	0.019 (15.133) ***	0.299 (5.451) ***	0.009 (8.881) ***
Constant	−6.207 (−7.462) ***	−0.102 (−6.528) ***	−4.750 (−5.983) ***	−0.068 (−4.759) ***	−6.173 (−7.726) ***	−0.101 (−6.697) ***
Industry FE	controlled	controlled	controlled	controlled	controlled	controlled
Year FE	controlled	controlled	controlled	controlled	controlled	controlled
District FE	controlled	controlled	controlled	controlled	controlled	controlled
F-value	152.78 ***	38.45 ***	122.95 ***	37.73 ***	143.48 ***	35.88 ***
Adj. R-sq	0.612	0.416	0.653	0.502	0.606	0.401
N	2383	2383	2383	2383	2542	2542

Note. The symbols \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% levels, respectively. The numbers inside the brackets are t values, and the numbers outside the brackets are coefficients.

Similar to our findings on the effect of participation degree, Zhou et al. [7] find that the number of employees participating in ESOP has a positive impact on innovation output. However, they do not control for the employee size in their tests. In addition, our results provide empirical evidence consistent with Pei and Ding's [62] argument that the entrusted management model can reduce the conflicts of interest of the main body in ESOP to a certain extent.

Table 13 summarizes the test results of the hypotheses in this paper. It shows that all the six hypotheses proposed in the paper are supported by our empirical results, indicating that the implementation of ESOP has a promoting effect on enterprise innovation investment and that the contract design of ESOP matters in innovation investment.

**Table 13.** Test results of the hypotheses in the paper.

Hypothesis	Variable	Expectation	Result	Support /Reject
H1	ESOP_dummy	positive	positive	support
H2	ESOP_fund	negative	negative	support
	ESOP_stock	positive	positive	support
H3	ESOP_lockup	positive	positive	support
	ESOP_duration	positive	positive	support
H4	ESOP_share	inverted U-shaped	inverted U-shaped	support
	ESOP_exepurchase	U-shaped	U-shaped	support
H5	ESOP_participation	positive	positive	support
H6	ESOP_management	positive	positive	support

#### 5.4. Robustness Tests

##### 5.4.1. Propensity Score Matching

The implementation of ESOP is an endogenous decision, and there may be sample self-selection bias, that is, the differences in innovation investment between companies that implement ESOPs and companies that do not implement ESOPs are not caused by the implementation itself, but by the characteristic differences in the two types of companies. To address the endogeneity problem caused by sample self-selection bias, this paper uses the propensity score matching (PSM) method to control for the characteristic differences in the two types of companies.

In the first step, with ESOP implementation as the explained variable and the control variables in Model (1) as the explanatory variables, the logit model is used to estimate the probability of ESOP implementation for each sample, and the probability is taken as the propensity score. In the second step, the 1:1 nearest lead matching is used to match each implementing sample with a never-implement sample with the closest propensity score. In the third step, a balance test is performed on the matching results (see Table 14). The results show that before matching, there are significant differences between the implementing sample and the non-implementing sample ESOPs in terms of company characteristics and governance variables, but after matching, there are no significant differences between the two types of samples, indicating that the matching result is satisfactory. Finally, regression estimation is performed on Model (1) based on the matched samples and the results are shown in the first and second columns of Table 15. The results show that after controlling for sample self-selection bias, ESOP implementation is still significantly and positively correlated with the absolute and relative scale of innovation investment, which further supports Hypothesis 1.

**Table 14.** The balancing test results of PSM.

Variable	Unmatched Matched	Mean		t-Test	
		Treated	Control	t-Value	p-Value
Size	U	22.466	22.174	10.51	0.000
	M	22.466	22.493	−0.75	0.455
Lev	U	0.416	0.406	2.32	0.020
	M	0.416	0.418	−0.23	0.820
ROA	U	0.035	0.034	0.75	0.456
	M	0.035	0.035	0.17	0.868
Growth	U	0.199	0.164	3.57	0.000
	M	0.199	0.209	−0.84	0.403
Cash	U	0.159	0.175	−6.22	0.000
	M	0.159	0.157	0.75	0.455
Tangible	U	0.178	0.211	−10.31	0.000
	M	0.178	0.179	−0.21	0.830



Table 14. Cont.

Variable	Unmatched Matched	Mean		<i>t</i> -Test	
		Treated	Control	<i>t</i> -Value	<i>p</i> -Value
Firm_age	U	18.261	18.824	−4.77	0.000
	M	18.261	18.067	1.31	0.191
Shr1	U	0.308	0.339	−10.12	0.000
	M	0.308	0.311	−0.98	0.329
Institution	U	0.372	0.419	−8.74	0.000
	M	0.372	0.384	−1.87	0.062
Independence	U	0.378	0.376	2.08	0.038
	M	0.378	0.380	−1.07	0.286
Dual	U	0.348	0.297	5.12	0.000
	M	0.348	0.337	0.88	0.376
Exe_share	U	0.185	0.153	7.37	0.000
	M	0.185	0.180	0.92	0.359
Exe_comp	U	14.713	14.58	9.27	0.000
	M	14.713	14.727	−0.73	0.465
Emp_comp	U	11.644	11.66	−1.63	0.104
	M	11.644	11.645	−0.01	0.991

Table 15. Results of robustness tests.

Variable	Regression Based on PSM Samples		The Forward Processing of Dependent Variables		Replace the Proxy for the Relative Scale of Innovation Investment	
	lnRD <sub>t</sub>	RD_assets <sub>t</sub>	lnRD <sub>t+1</sub>	RD_assets <sub>t+1</sub>	RD_sales <sub>t</sub>	RD_employees <sub>t</sub>
ESOP_dummy	0.090 (3.340) ***	0.001 (1.954) *	0.094 (4.304) ***	0.001 (2.095) **	0.002 (2.118) **	0.075 (3.829) ***
Size	0.749 (45.333) ***	−0.003 (11.315) ***	0.731 (63.842) ***	−0.003 (−17.289) ***	−0.004 (−10.440) ***	0.021 (2.142) **
Lev	−0.004 (0.037)	0.003 (1.541)	0.025 (0.359)	0.004 (3.835) ***	−0.041 (−18.147) ***	−0.473 (−8.462) ***
ROA	0.443 (2.240) **	0.013 (2.790) **	1.565 (9.346) ***	0.021 (7.052) ***	−0.082 (−10.883) ***	0.090 (0.679)
Growth	0.039 (1.191)	0.001 (1.394)	0.134 (5.747) ***	0.0005 (1.281)	−0.002 (−2.680) ***	0.126 (5.696) ***
Cash	0.350 (2.382) **	0.013 (4.109) **	0.223 (2.366) **	0.008 (4.623) ***	0.017 (4.561) **	−0.178 (−2.353) **
Tangible	0.352 (2.395) **	0.003 (1.447)	−0.154 (−1.774) *	−0.005 (−3.964) ***	−0.020 (−8.188) ***	−0.793 (−10.567) ***
Firm_age	−0.011 (4.215) ***	−0.000 (3.216) ***	−0.012 (−6.601) ***	−0.0002 (−5.610) ***	−0.001 (−10.836) ***	−0.017 (−10.957) ***
Shr1	−0.140 (1.169)	−0.004 (1.971) **	−0.234 (−2.916) ***	−0.007 (−5.241) ***	−0.028 (−10.906) ***	−0.411 (−6.049) ***
Institution	−0.263 (2.777) **	−0.000 (0.106)	−0.013 (−0.198)	0.003 (2.920) ***	0.007 (3.346) **	−0.375 (−6.834) ***
Independence	−0.429 (1.695) *	0.009 (1.804) *	0.081 (0.463)	0.005 (1.759) *	0.018 (3.143) **	−0.061 (−0.413)
Dual	0.055 (1.982) **	0.001 (2.491) **	0.027 (1.409)	0.001 (1.823) *	0.006 (7.934) ***	0.063 (3.938) ***
Exe_share	0.026 (0.257)	0.002 (1.128)	0.194 (2.889) ***	0.004 (3.472) ***	0.018 (7.359) ***	0.061 (1.051)
Exe_comp	0.235 (8.520) ***	0.004 (9.456) ***	0.263 (13.887) ***	0.004 (14.808) ***	0.005 (8.927) ***	−0.015 (−0.916)
Emp_comp	0.381 (9.032) ***	0.010 (13.371) ***	0.268 (9.726) ***	0.007 (15.810) ***	0.020 (20.479) ***	1.150 (46.727) ***
Constant	−7.524 (12.866) ***	−0.105 (9.887) **	−5.919 (−14.945) ***	−0.069 (−10.809) ***	−0.165 (−12.841) ***	−3.302 (−9.651) ***
Industry FE	controlled	controlled	controlled	controlled	controlled	controlled
Year FE	controlled	controlled	controlled	controlled	controlled	controlled
District FE	controlled	controlled	controlled	controlled	controlled	controlled
F-value	101.53 ***	39.53 ***	201.84 ***	157.15 ***	126.71 ***	166.17 ***
Adj. R-sq	0.600	0.352	0.566	0.319	0.363	0.428
N	4754	4754	11,271	11,271	15,412	15,412

Note. The symbols \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% levels, respectively. The numbers inside the brackets are *t* values, and the numbers outside the brackets are coefficients.

#### 5.4.2. The Forward Processing of Dependent Variables

To address the endogenous problems caused by the reciprocal causation between the dependent variable and independent variable, and to consider the lagged effect of ESOP implementation on innovation investment, this article uses innovation investment

in the next year to replace innovation investment in the current year as the dependent variables to re-estimate Model (1). The results are shown in the third and fourth columns of Table 15. After the forward processing of the dependent variables (equivalent to the backward processing of the independent variables), the implementation of ESOP is still significantly and positively correlated with the absolute and relative scale of innovation investment, indicating that the implementation of ESOP significantly increases the level of innovation investment, which further supports Hypothesis 1.

#### 5.4.3. Replacing the Proxy for the Relative Scale of Innovation Investment

Considering that some studies also adopt the ratio of R&D expenditures to sales (RD\_sales) or R&D expenditures to the total number of employees (RD\_employees) to measure the relative scale of innovation investment [68,69], this paper further adopts these two ratios to measure the relative scale of innovation investment. On this basis, RD\_sales and RD\_employees are taken as the dependent variables to perform regression estimation on Model (1), respectively. The results are shown in the fifth and sixth columns of Table 15. After replacing the proxy variable of the relative scale of innovation investment, the implementation of ESOP is still significantly and positively correlated with the relative scale of innovation investment, which further supports Hypothesis 1.

#### 5.4.4. Replacing the Estimation Method

In the main regression analysis, we used ordinary least squares (OLS) to estimate Model (1). However, OLS estimators may be biased when the model residuals are correlated with the explanatory variables (i.e., endogeneity) or if there is a heteroscedasticity or autocorrelation problem. Thus, we substitute the estimation method of Model (1) to test the robustness of our results. First, to address the endogeneity problem caused by missing variables that do not change over time, we use the individual fixed effects (FE) method to re-estimate Model (1). The results are shown in the second and third columns of Table 16. They suggest that after controlling for firm fixed effects, the implementation of ESOP is still significantly and positively correlated with the absolute and relative scale of innovation investment. Second, to relax the assumptions of homoscedasticity and non-autocorrelation, we use the generalized method of moments (GMM) to re-estimate Model (1). The results are shown in the third and fourth columns of Table 16. It indicates that after accounting for the presence of heteroscedasticity and autocorrelation, the implementation of ESOP is still significantly and positively correlated with innovation investment. Overall, the results of Table 16 enhance the robustness of our findings.

**Table 16.** Regression results of fixed effects estimations and generalized method of moments.

Variable	Estimation Results by FE		Estimation Results by GMM	
	lnRD	RD_assets	lnRD	RD_assets
ESOP_dummy	0.062 (2.347) **	0.001 (2.561) **	0.168 (7.210) ***	0.002 (3.970) ***
Size	0.728 (22.783) ***	−0.006 (−11.123) ***	0.632 (55.56) ***	−0.004 (−27.58) ***
Lev	−0.400 (−4.615) ***	−0.001 (−0.345)	−0.365 (−5.660) ***	−0.001 (−0.940)
ROA	−0.130 (−1.270)	−0.006 (−2.616) ***	0.791 (5.590) ***	0.015 (5.530) ***
Growth	0.023 (1.627)	0.001 (3.159) ***	0.032 (1.290)	0.000 (0.670)
Cash	−0.095 (−1.324)	−0.004 (−3.329) ***	0.486 (5.570) ***	0.014 (8.500) ***
Tangible	0.671 (4.461) ***	0.009 (4.471) ***	−0.365 (−3.920) ***	−0.005 (−5.000) ***

Table 16. Cont.

Variable	Estimation Results by FE		Estimation Results by GMM	
	lnRD	RD_assets	lnRD	RD_assets
Firm_age	−0.031 (−0.729)	−0.001 (−0.554)	−0.022 (−12.010) ***	−0.0003 (−10.750) ***
Shr1	−0.002 (−1.313)	−0.0001 (−1.132)	−0.056 (−6.720) ***	−0.0001 (−9.990) ***
Institution	0.001 (0.760)	0.000 (1.810) *	−0.003 (−6.720) ***	0.000 (2.36) **
Independence	0.087 (0.476)	−0.004 (−1.466)	0.325 (1.890) *	0.006 (2.400) **
Dual	0.001 (0.061)	0.000 (0.907)	0.079 (4.240) ***	0.002 (4.760) ***
Exe_share	0.004 (4.393) ***	0.000 (1.559)	0.004 (5.680) ***	0.0001 (7.780) ***
Exe_comp	0.129 (5.250) ***	0.003 (8.931) ***	0.365 (19.780) ***	0.005 (20.270) ***
Emp_comp	0.173 (4.483) ***	0.004 (6.620) ***	0.206 (7.560) ***	0.009 (23.21) ***
Constant	−1.785 (−1.743) *	0.064 (3.227) ***	−3.264 (−8.990) ***	−0.059 (−11.840) ***
Year FE	controlled	controlled	controlled	controlled
Firm FE	controlled	controlled	uncontrolled	uncontrolled
N	15,412	15,412	15,412	15,412

Note. The symbols \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% levels, respectively. The numbers inside the brackets are t values, and the numbers outside the brackets are coefficients.

## 6. Discussion and Conclusions

Based on the incentive and governance effects of ESOP, this paper investigates whether the implementation and contract design of ESOP affects enterprise innovation investment. Chinese listed companies that successfully implement ESOPs in the period from 2014 to 2020 are used as the research sample. This paper first uses a treatment effect model to examine the impact of ESOP implementation on innovation investment by using the whole sample (companies with and without ESOPs), and then adopts multivariate regression models to test the impact of ESOP contract design on innovation investment by using the research sample (companies with ESOPs).

The results suggest that the implementation of ESOP helps to increase enterprise innovation investment, which is consistent with the expectation that ESOP can alleviate agency problems in innovation investment through its incentive and governance effects. We further find that the contract design of ESOP also affects enterprise innovation investment: (1) the participation degree, lockup period, and duration of ESOP are positively correlated with innovation investment; (2) the executive subscription ratio in ESOP has a U-shaped impact on innovation investment, while the shareholding scale of ESOP has an inversely U-shaped impact on innovation investment; (3) companies implementing ESOPs with employees' own funds have a lower level of innovation investment than those with other fund sources, while companies implementing ESOPs by subscribing to private offering shares have a higher level of innovation investment than those with other stock sources, and companies implementing ESOPs with entrusted management mode have a higher level of innovation investment than those with self-management mode.

This paper contributes to the literature on the relationship between ESOP and enterprise innovation in two ways. First, existing studies (e.g., Zhou et al. [7], Meng et al. [8], Li and Ding [9]) mostly focus on the effect of ESOP on innovation output and consistently find that ESOP implementation has a promotion effect on innovation output (i.e., patent filings and citations). We extend these studies by providing evidence that ESOP implementation also has a promotion effect on innovation input (i.e., R&D expenditures). Second, although several studies (e.g., Chen and Huang [58], Luo and Wang [59]) have

paid attention to the effect of ESOP contract design on innovation input, they consider only one aspect of contract design. For example, Chen and Huang [58] consider only the incentive magnitude (measured by stock bonus per employee) of ESOP, and Luo and Wang [59] consider only the executive subscription ratio in ESOP. We complement their studies by considering eight dimensions of contract design of ESOP (i.e., fund source, stock source, lockup period, duration, shareholding scale, executive subscription ratio, participation degree, and management mode) and examining their impacts on innovation investment. We find that all eight dimensions of the contract design of ESOP significantly impact innovation investment.

This paper also has practical implications for managers and regulators. First, whether to implement ESOP is usually determined by corporate managers and they have discretion over the contract design of ESOP. Our findings suggest that in order to fully activate corporate employees and promote innovation investment activities, corporate managers should actively promote the implementation of ESOP and design the ESOP appropriately. For example, to fully realize the incentive and governance effects of ESOP, corporate managers should increase the participation degree of ordinary employees, adopt diversified fund sources, develop a longer lockup period or duration, and entrust asset management agencies to manage the firm's ESOP. Second, the CSRC and the stock exchanges are the regulators of ESOP in China. Since CSRC issued the Guidance in 2014, China's ESOP has developed rapidly in recent years. However, there are many oddities in the contract design of ESOPs, such as the "half-price ESOP" launched by Green Electric and the "zero-price ESOP" launched by some listed companies. Therefore, regulators should pay more attention to the contract design of ESOPs and make comment letters to companies whose ESOPs have abnormal contract designs.

This study is subject to certain limitations. First, this paper only considers the basic contract elements whose data can be obtained directly from the Wind database but does not consider the innovative contract elements (e.g., performance appraisal terms, installment unlock terms, and major shareholder guarantee terms) whose data require manual collection from ESOP drafts disclosed by listed companies. With the rapid development of ESOP in China, innovative contract elements have become common in recent years. Therefore, one avenue for future research is to examine the effect of the innovative contract elements of ESOP on enterprise innovation. This future research will extend our findings on the effect of ESOP contract design on innovation investment. Second, given the length of this paper, we do not further examine the possible interactions among contractual elements in testing the effect of contractual elements on innovation investment. Thus, a second avenue for future research is to investigate the interactive effects of contractual elements on innovation investment. This future research will further our understanding of the effects of contractual elements on innovation investment.

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