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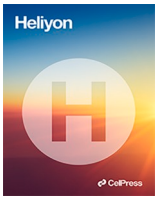

Research article

Does employee stock ownership plan have monitoring and incentive effects? --An analysis based on the perspective of corporate risk taking

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ABSTRACT

This study uses sample data of Chinese A-share listed companies from 2006 to 2022 and employs methods such as propensity score matching (PSM), difference-in-differences (DID), and instrumental variables (IV) to study the supervisory incentive effect of ESOPs from the perspective of corporate risk-taking. The results indicate that ESOPs significantly increase corporate risk-taking. The specific mechanism is that ESOPs reduce the dual agency costs between shareholders and managers, as well as between managers and employees, thereby alleviating corporate financing constraints and enhancing the level of corporate risk-taking. The enhancement of corporate risk-taking through ESOPs was also found to be of high quality. This is because ESOPs promote R&D investment that benefits the growth of corporate value and also reduce overinvestment and excessive debt that are detrimental to corporate value, thus leading to a higher quality of corporate risk-taking and stronger value effects. In addition, the design differences of ESOPs have different effects on corporate risk-taking: leverage, high discount, longer lock-up and tenure periods, and plans managed by third-party institutions have a stronger promotion effect on corporate risk-taking; employee subscription is more effective than executive subscription in promoting corporate risk-taking; in China, ESOPs do not have a "free-rider" problem, and the larger the proportion of ESOP issuance, the more participants, and the larger the scale of funds, the better the implementation effect.

1. Introduction

The employee stock ownership plan (ESOP) in China started late, and due to issues such as "benefit transfer" and "loss of state-owned assets," it has been suspended multiple times. With the advancement of China's market economy and mixed ownership, on June 20, 2014, the China Securities Regulatory Commission issued the "Guiding Opinions on the Pilot ESOP for Listed Companies," marking the beginning of a new era for ESOPs. Unlike welfare-oriented ESOPs in the United States, in China, employees in China have the right to participate in company decision-making.

Huawei is a successful example of an ESOP; however, many cases of failure have sparked academic research on ESOPs. Some scholars believe that employees with information advantages have a lower degree of information asymmetry than management [1,2].

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ESOPs bind the interests of employees and the company [3], increase employees' psychological ownership and have a "supervisory incentive" effect [4], which is beneficial for "interest coordination" [5]. Other scholars think that ESOPs do not have a "supervisory incentive" effect due to "free-riding" behavior [6,7] and "market value management" motives [8] and may lead to "conflict of interest" [9], thus lowering the level of corporate governance.

Risk-taking is an important strategic decision for companies, reflecting their selection of high-risk investment projects, which enhances their competitive advantage [10] and plays an important role in accelerating the high-quality development of the Chinese economy. However, risk-taking entails agency costs as managers may violate the interests of shareholders [11], engage in risk avoidance [12], or engage in excessive risk-taking, damaging the value of the company. Therefore, examining how ESOPs affect corporate risk-taking is of great practical significance to reveal the supervisory incentive effects of ESOPs and optimize corporate investment behavior. This study conducts the following research: first, we explore how ESOPs affect the level of corporate risk-taking; second, we explore the mechanism by which ESOPs affect corporate risk-taking; third, we explore whether ESOPs promote high-quality corporate risk-taking; and fourth, we explore the differential impact of the design heterogeneity of ESOPs.

The main contributions of this study are as follows. First, the ESOP enhances the level of corporate risk-taking and optimizes the corporate governance structure. The literature mainly focuses on the impact of executive characteristics [13,14] and the external environment [15,16] on corporate risk-taking. Few studies have examined the impact of ESOPs on corporate risk-taking levels. Second, the ESOP inhibits excessive risk-taking that harms corporate value (such as excessive investment and high debt) and enhances risk-taking, which increases corporate value (such as R&D investment), thus improving the quality of risk-taking. Existing literature merely investigates the governance effects of a single variable on excessive corporate risk-taking [17] or insufficient risk-taking [15, 18] in a one-sided manner, lacking research on adaptive governance. Thirdly, the ESOP leads to different levels of corporate risk-taking due to institutional design differences, making the research conclusions more objective compared to the existing studies that adopt a black-and-white view of "interest cohesion" [19] or "interest conflict" [20].

The remainder of this article is arranged as follows: the second section provides a theoretical analysis of how ESOP affects corporate risk-taking and proposes competitive hypotheses; the third section discusses the research design, introducing the data, variables, and models; the fourth section presents the empirical results of the basic hypotheses of this article; the fifth section conducts robustness tests; the sixth, seventh, and eighth sections further examine the mechanisms, quality, and institutional design heterogeneity of the impact of ESOP on corporate risk-taking; and the ninth section summarizes the research conclusions and discusses them.

2. Theoretical analysis and hypothesis formulation

2.1. ESOP enhances the level of corporate risk-taking

Risk-taking refers to entrepreneurs seizing opportunities hidden in uncertainty, creating value, daring to take risks, and innovating [21]. However, agency cost issues are associated with corporate risk-taking, as top executives avoid risks due to the specificity of their human capital and professional reputation [22] and abandon high-risk, high-return projects [23].

The "supervision theory" suggests that according to the "shareholder-manager-employee" principal-agent chain, shareholders are the principals, employees are the ultimate agents, and managers have dual identities as both principals and agents [24]. Owing to information asymmetry, shareholders are at an information disadvantage, the cost of supervising managers is high, and employees have information advantages, resulting in lower supervision costs, broader supervision scope, and higher supervision efficiency [2]. ESOP binds to the interests of employees and companies [3]. Employees actively participate in corporate governance [9], mitigating the principal-agent problem between shareholders and managers [25,26].

First, employee directors and supervisors are elected democratically, join the board of directors and supervisors, monitor the self-interested behavior of executives, and improve the company's governance structure. Second, employees holding shares exercise rights through the management committee, monitoring, and voting, enabling them to speak as a unit and enhancing the company's governance capabilities [27]. Third, employees participating in a company's daily management improve the quality of management's decision-making [28].

The "incentive theory" believes that the ESOP is the capitalization of labor factors (such as technology, knowledge, experience, management abilities, etc.) [29]. Through shareholding, workers have residual claim rights and control rights over their labor output. Companies can motivate employees to work hard by arranging property rights, reducing principals' supervision and management costs, and improving operational performance. This improves the cost and returns expectations of owners, making previously unfeasible projects feasible, thus changing decision-makers' decision-making behavior [30,31], which mitigates the principal-agent problem between managers and employees.

First, ESOP is a form of equity-based incentive [3] that increases employees' psychological ownership and loyalty to a company [32]. Second, it is a form of structural compensation incentive. Companies innovate successfully, and employees' wealth soars; if innovation fails, the loss is limited, resulting in asymmetric incentives that enhance the efficiency of employee innovation [33]. Third, it is a form of deferred incentive. Stock options require a certain holding period, and employees pay more attention to long-term IC investments in intellectual capital [34]. Finally, this is a form of collective incentive. Employees supervise and cooperate, demonstrating stronger team spirit [35].

The financing constraint theory suggests that the level of corporate risk-taking is constrained by the resources required for corporate investment [36]. High-risk investments are highly dependent on resources [36,37]. Financing constraints can lead to low investment efficiency and even investment failure [38]. Non-public ESOP offerings can alleviate financing constraints [26] and enhance corporate risk-taking.

Specifically, ESOPs are a form of equity financing that, on the one hand, can replace employees' monetary compensation, reducing corporate cash outflows, and, on the other hand, can increase corporate cash inflows [39]. Second, ESOPs can lower the cost of corporate debt financing because their implementation sends a positive signal of performance to the outside world [19], thus reducing the risk premium and borrowing rates demanded by creditors [40]. ESOPs also exhibit resource effects. Based on the "supervising incentive effect" and "resource effect" of ESOPs, the following hypothesis is suggested.

H1. ESOP enhances the level of corporate risk-taking.

2.2. ESOP inhibits the level of corporate risk-taking

2.2.1. The market value management attribute of ESOP

ESOPs can receive positive market reactions from investors [41,42]. According to the signaling theory, employees have an informational advantage in a company's internal affairs. Voluntary stock ownership signifies a high level of future development endorsement, and the implementation of ESOPs can drive stock prices up [43,44]. Investor irrationality further enhances the market's response to ESOPs [45]. Empirical research has proven that ESOPs have a positive market response [3,46] and function in management [47,48]. According to regulatory requirements, ESOPs are proposed by the board of directors and approved at general shareholders' meetings. The required shares are obtained through private placements or from the secondary market with a short lock-up period and low unlocking conditions, making it easier for ESOPs to become tools for market-value management because of their lower operating costs.

2.2.2. Motivation for the market value management of ESOP

China's equity is relatively concentrated, and corporate governance is imperfect, leading to agency costs between major shareholders and minority shareholders, shareholders and managers, and managers and employees. Companies are more likely to choose ESOPs to engage in market value management to help employees realize their stock holdings upon listing [49] rather than actively assuming risks to promote corporate innovation.

From the perspective of major shareholders, as equity is relatively concentrated in China, they have strong decision-making power in public companies. The separation of control and cash flow rights increases the self-interested behavior of major shareholders. Through ESOPs, major shareholders can conduct market value management, create timing to reduce their holdings and reduce the economic costs of timing behaviors and legal risks [8]. The major shareholders' large voting rights make it easy for ESOPs to be approved at general shareholder meetings. After the implementation of ESOPs, major shareholders have the motivation to maintain stock prices, as the leveraging of ESOPs in China typically involves the guarantee of major shareholders, and a decrease in stock prices would bring about significant financial risks for major shareholders, increasing their motivation for market value management [49,50] and reducing their enthusiasm for engaging in high-risk investments.

From a management perspective, market capitalization is an important indicator for shareholders when evaluating management performance [51]. An increase in stock prices increases the probability of manager promotions, while a decrease in stock prices reduces managers' market value [52]. Second, managers are motivated to cater to employees for market capitalization management. Unlike the ESOP in the United States, Chinese ESOP involves company governance. Based on the principal-agent theory [53] and the "enjoy a peaceful life" motivation [54], managers may sacrifice shareholder interests to cater to employees' short-term stock price preferences, reduce conflicts, carry out market capitalization management, and have a low willingness to assume risks, at most, engaging in strategic innovation.

From the perspective of employees, firstly, there is the "free-riding" behavior. The theoretical basis of the ESOP is income-sharing. However, the inconsistency between employees' individual and collective efforts hinders the sharing of capital incentive effects [6]. In addition, invisible personal efforts such as technological innovation lead to the "free-riding" problem [7]. Second, employees' short-term realization motivation holds stock. China's ESOP is equivalent to a restricted stock with a short lock-up period and high stock price fluctuation risks. Employees who participate in stock ownership plans dislike risks and are more concerned with short-term stock price returns [55]. Innovation activities related to long-term stock returns do not conform to the risk preferences and short-term realization motivations of employees holding stock [5], and employees have a low willingness to assume risk. Based on this, we propose the following hypothesis.

H2. ESOP inhibits the level of corporate risk-taking.

3. Study design

3.1. Data sources and processing

3.1.1. Data source

ESOP was restarted in 2014. To ensure that the sample period was consistent before and after the implementation, we selected Chinese A-share listed companies from 2006 to 2022 as the research sample. The samples were processed as follows: 1. Remove the sample companies in which the ESOP was not approved by the shareholders' meetings or stopped mid-implementation. 2. For companies that implement multiple ESOP phases in the same year, only the first phase is retained, and the year of ESOP implementation is judged based on the "continuation period (years)" in the implementation plan. 3. Excluding the financial industry and ST companies. 4. Excludes samples with missing major variables. 5. All continuous variables are winsorized at the 1 % and 99 % levels. The ESOP data

come from the WIND database, and other financial data are obtained from the CSMAR database. After the above processing, 38,184 annual samples were obtained during the sample period, including 2495 annual samples from the ESOP implementation years.

3.1.2. Data processing

The implementation of ESOPs is not a random phenomenon but is influenced by factors related to enterprise characteristics. Directly studying the entire sample may lead to sample selection bias. To alleviate this problem, this selects a series of characteristic variables from the year before the implementation of the ESOP as covariates and uses the propensity score matching (PSM) method with "one-to-one, without replacement" nearest neighbor matching to match a group of enterprises that have the most similar characteristics but did not implement the ESOP (control group) with those that did (experimental group). After matching, 11 annual implementation samples that did not meet the common support assumption were eliminated, and the remaining 2495 annual implementation samples were obtained. Finally, 4990 company annual samples (2495 for each of the experimental and control groups) were obtained. The absolute value of the matched standard error (%bias) was less than the critical value of 10 %, effectively alleviating the sample selection bias.

3.2. Model design and variable definition

Model (1) tests the effect of ESOPs on the corporate risk-taking construct:

$$Risk_{i,t} = \beta_0 + \beta_1 ESOP_{i,t} + Control_{i,t} + Year_i + Industry_t + \varepsilon_{i,t} \tag{1}$$

Risk is the explanatory variable in model (1), which indicates the level of firm risk-taking; commonly used measures include earnings volatility [56], stock return volatility [12], and the debt ratio [57]. The debt ratio is more reflective of financial risk and is not a comprehensive measure of corporate risk-taking. In this study, earnings volatility is used to measure the level of corporate risk-taking and vote earnings volatility is used for robustness testing, calculated as follows:

$$Aj\_Roa_{i,t} = \frac{EBIT\_NET_{i,t}}{ASSET_{i,t}} - \frac{1}{X}\frac{EBIT\_NET_{i,t}}{ASSET_{i,t}} \tag{2}$$

$$Risk1 = \sqrt{\frac{1}{T-1}\sum_{t=1}^{T}\left(Aj\_Roa_{i,t} - \frac{1}{T-1}\sum_{t=1}^{T}Aj\_Roa_{i,t}\right)^2}\,\Big|\, T = 5 \tag{3}$$

$$Risk2 = Max\left(Aj\_Roa_{i,t}\right) - Min\left(Aj\_Roa_{i,t}\right)\big|\, T = 5 \tag{4}$$

First, we calculated the industry and annual adjusted company profit level *Aj_Roa* using Model (2), which is the ratio of earnings before interest, taxes, depreciation, and amortization (*EBIT_NET*) to total assets (*ASSET*) minus the industry average. We then calculate the standard deviation and range of the adjusted *Aj_Roa* as risk-taking proxy measures using Model (3) and (4), respectively. Referring to Ref. [58]; we set the rolling period T to five (from year t to t+4).

ESOP is an explanatory variable representing ESOP. If the listed company implements or is in the process of implementing (within the existence period) an ESOP in the current year, the value is 1; otherwise, it is 0.

Control variables include: firm size (*Size*), the natural logarithm of total assets; financial leverage (*Lev*), total liabilities divided by total assets; capital intensity (*Inten*), fixed assets divided by total assets; growth (*Growth*), the natural logarithm of operating revenue; cash holdings (*Cash*), cash and cash equivalents divided by total assets; equity concentration (*Sh_first*), the proportion of shares held by

Table 1
Descriptive statistics.

VarName	Obs	Mean	SD	Median	Min	Max
Risk1	4990	5.662	12.979	3.097	0.000	327.978
Risk2	4990	13.132	29.778	7.095	0.000	744.145
ESOP	4990	0.500	0.500	0.500	0.000	1.000
Size	4990	22.003	1.255	21.845	19.183	26.102
Lev	4990	0.431	0.207	0.423	0.052	1.007
Inten	4990	0.214	0.157	0.183	0.002	0.710
Growth	4990	21.322	1.416	21.202	17.379	25.535
Cash	4990	0.185	0.130	0.150	0.010	0.689
Sh_first	4990	0.351	0.157	0.340	0.000	0.757
Board	4990	2.152	0.171	2.197	1.792	2.708
Cap	4990	18.449	1.787	18.527	12.040	23.116
Idr	4990	37.268	5.113	33.330	25.000	57.140
Dual	4990	0.274	0.446	0.000	0.000	1.000
Pay	4990	14.236	1.698	14.413	0.000	16.504
Share	4990	0.122	0.190	0.002	0.000	0.700
Age	4990	1.992	0.952	2.197	0.000	3.332

the largest shareholder; board size (*Board*), the natural logarithm of the number of directors; capital expenditure (*Cap*), the natural logarithm of cash paid for operating leases, fixed assets, intangible assets, and other long-term assets minus cash received from disposal of fixed assets, intangible assets, and other long-term assets; board independence (*Idr*), the proportion of independent directors to the total number of directors; dual roles (*Dual*), taking 1 if the same person serves as both chairman and CEO, otherwise taking 0; executive monetary compensation incentives (*Pay*), the natural logarithm of the sum of the top three directors' compensation and the top three executives' compensation; executive stock incentives (*Share*), the proportion of shares owned by management to the total number of shares; firm age (*Age*), the natural logarithm of the number of years since the company went public plus 1. Additionally, this study controls for year- and industry-fixed effects.

4. Analysis of the empirical results

4.1. Descriptive statistics

Table 1 reports descriptive statistics of the matched sample. The median (mean) of Risk1 (Risk2) is 3.097 (7.095) and 5.662 (13.132), respectively, indicating that the risk exposure of most companies is below the average level. The maximum values are 327.978 (744.145), the minimum values are both 0 and the standard deviations are 12.979 (29.778), suggesting significant variations in risk exposure levels among different companies. The mean of ESOP is 0.5, indicating an equal split between the experimental and control groups. The mean of Share-based incentive is 0.122, with a median of 0.002, indicating that the majority of companies have relatively low share-based incentives, to some extent illustrating the necessity of implementing ESOPs.

4.2. Main effects test

Table 2 presents the test results for the main effect of ESOPs (ESOPs) on corporate risk-taking. In columns (1) and (2), the regression results for the full sample before matching show that the coefficients for *ESOP* are 1.8815 and 4.2152, respectively, and both are significantly positive at the 1 % level. This indicates that ESOPs can enhance corporate risk-taking. In Columns (3) and (4), the regression results for the matched sample still show significantly positive coefficients for *ESOP* at the 1 % level, with values of 2.3921 and 5.7160, respectively. This suggests that even after controlling for sample selection bias, the promotional effect of ESOPs on the level of corporate risk-taking remains significant, thus confirming H1.

5. Robustness test

Some scholars argue that the motives behind ESOPs include alleviating financing constraints, reducing agency costs, and increasing stock prices, all of which have wealth effects [24]. On the other hand, other scholars suggest that the motives behind ESOPs are aimed at saving cash, resisting takeovers, earnings management, controlling shareholder reduction, and market value management, which may harm corporate value [47]. Different motives lead to different risk-taking behaviors and effects of ESOPs; thus, a reverse causal endogeneity issue may exist between ESOPs and corporate risk-taking. To address this concern, this study employs the following robustness checks.

5.1. Instrumental variable method

Based on [47]; the average proportion of employee shareholdings in other industries in the same year and province was selected as the instrumental variable (ESOP_iv) for ESOP. There are two reasons for this. First, similar regions have certain similarities in terms of equity incentive policies and granting practices, which can have mutual influences when implementing ESOP [33]. Second, the level of corporate risk-taking in different industries often differs significantly due to different industrial policies and market competition, making ESOP in other industries unrelated to the level of risk-taking in this company, thus satisfying the assumptions of instrumental variable selection for relevance and exogeneity.

Table 3 presents the results of the instrumental variable regression. The first-stage regression results in column (1) show that the instrumental variable *ESOP_iv* is significantly correlated with the explanatory variable *ESOP*. This indicates that the implementation of ESOP in other industries in the same year and province can have a significant impact on the implementation of ESOP in the studied company, thus validating the rationality of the instrumental variable selection. From the second-stage regression results for *Risk1* in column (2) and *Risk2* in column (3), it can be seen that the coefficients for *ESOP* are both significantly positive at the 1 % level, which is consistent with the results of the main effect test. This suggests that the implementation of the ESOP does not have a reverse causal endogeneity issue in terms of increasing the level of corporate risk-taking.

Table 2
ESOP and corporate risk-taking level.

	(1)	(2)	(3)	(4)
	Risk1	Risk2	Risk1	Risk2
ESOP	1.8815***	4.2152***	2.3921***	5.7160***
	(3.4425)	(3.6005)	(2.8995)	(3.2711)
Size	−2.1694***	−4.8873***	−3.7680***	−8.3337***
	(-6.7083)	(-6.6901)	(-3.9246)	(-4.1366)
Lev	5.7105***	11.6688***	2.8079	1.9602
	(6.2580)	(5.7100)	(1.0100)	(0.3309)
Inten	2.9086**	5.8528**	2.1566	8.7523
	(2.4407)	(2.2238)	(0.5603)	(1.0395)
Growth	−0.5217**	−1.7195***	1.0733	2.9416**
	(-2.0908)	(-3.0852)	(1.5399)	(2.0469)
Cash	3.7705***	5.3423*	5.0711	7.7039
	(2.8209)	(1.8207)	(1.1333)	(0.8548)
Sh_first	−0.0156	−0.0386*	−0.0985***	−0.2012***
	(-1.5853)	(-1.7782)	(-3.2595)	(-3.1423)
Board	−5.0615***	−11.5219***	−3.9197	−11.3734
	(-4.7136)	(-4.7813)	(-1.1145)	(-1.5041)
Cap	0.7307***	1.6204***	1.4747***	3.0072***
	(5.2792)	(5.1597)	(3.8052)	(3.5891)
Idr	−0.0108	−0.0797	0.0475	−0.0777
	(-0.3152)	(-1.0530)	(0.4210)	(-0.3601)
Dual	1.9220***	4.2697***	1.3755	3.2886*
	(5.4485)	(5.5420)	(1.6071)	(1.8453)
Pay	−0.0345	−0.0074	−0.6053	−1.5493
	(-0.2149)	(-0.0210)	(-0.8136)	(-0.8966)
Share	0.0868***	0.2038***	0.0366	0.0923*
	(8.6010)	(9.2569)	(1.5065)	(1.7421)
Age	1.7633***	5.5715***	−0.2270	−0.2944
	(7.9051)	(11.7206)	(-0.2574)	(-0.1564)
_cons	151.0462***	369.4122***	171.8668***	413.3813***
	(34.1955)	(36.9873)	(8.1818)	(8.8372)
Year	YES	YES	YES	YES
Industry	YES	YES	YES	YES
Firm	YES	YES	YES	YES
r2	0.4250	0.4836	0.3530	0.4219
F	1743.0943	1760.0302	188.3208	190.9555
N	38184	38184	4990	4990

Note: Regressions are all estimated using robust standard errors, t-values in parentheses; *,**,*** indicate significant at the 10 %, 5 %, and 1 % levels, respectively.

Table 3
Instrumental variable method.

	(1)	(2)	(3)
	ESOP	Risk1	Risk2
ESOP_iv	0.0882***		
	(4.3066)		
ESOP		15.9738***	39.2867***
		(5.8559)	(6.1411)
Controls	YES	YES	YES
Year	YES	YES	YES
Industry	YES	YES	YES
Firm	YES	YES	YES
r2	0.0658	0.0991	0.1425
F	50.0722	33.1685	30.2505
N	4990	4990	4990

Note: Regressions are all estimated using robust standard errors, t-values in parentheses; *,**,*** indicate significant at the 10 %, 5 %, and 1 % levels, respectively.

5.2. Dynamic effects test

The dynamic impact of ESOP on corporate risk-taking was examined three years before and three years after the implementation of the plan. To eliminate sample discontinuity noise caused by multiple periods of ESOP implementation in some companies, this section considers the first implementation of the ESOP as the criterion (i.e., 1 for the first implementation, otherwise 0), generates interaction

terms between ESOP implementation and year dummies for the three years before and after implementation (*ESOP_pre_3, ESOP_pre_2, ESOP_pre_1, Current, ESOP_aft_1, ESOP_aft_2, ESOP_aft_3*),[1] and regresses these interaction terms as explanatory variables to observe changes in corporate risk-taking. Table 4, columns (1) and (2) report the results of the ESOP dynamic effects test. The coefficients for the three years before the ESOP implementation (*ESOP_pre_3, ESOP_pre_2, ESOP_pre_1*) are not significant, whereas the coefficients for the current period (current) and the three years after implementation (*ESOP_aft_1, ESOP_aft_2, ESOP_aft_3*) are significantly positive at the 1 % or 5 % level. This indicates that the level of corporate risk-taking significantly increases after the implementation of the ESOP, which is consistent with the main effects conclusion.

5.3. Double difference method (DID and PSM + DID)

Once again, taking the first implementation of the ESOP in a company as the benchmark (i.e., set to 1 when the company first implements the ESOP and 0 otherwise), a double difference Model (5) is constructed to test the net effect of the ESOP policy on corporate risk-taking.

$$Risk_{i,t} = \beta_0 + \beta_1 Treat_{i,t} * Post_{i,t} + Control_{i,t} + Year_i + Industry_t + \varepsilon_{i,t} \quad (5)$$

Treat is an event dummy variable, which takes the value of 1 when the ESOP is first implemented, otherwise, it takes the value of 0. *Post* is a time dummy variable that takes the value of 0 before the first implementation of the ESOP by the company and 1 thereafter. The coefficient of the interaction term *Treat*Post* is of particular interest. If the coefficient of *Treat*Post* is significantly positive, it indicates that ESOP significantly promotes corporate risk-taking. Table 4, columns (3) and (4) report the results of the full-sample difference-in-differences regression, with all *Treat*Post* coefficients being significantly positive at the 1 % level, suggesting that ESOP significantly increases corporate risk-taking. Furthermore, to mitigate any potential selection bias in the full sample, a double-difference-in-differences regression (PSM + DID) was conducted based on the propensity score matching results from the main effects test. Table 4, columns (5) and (6) report the results of the PSM + DID regression, with all *Treat*Post* coefficients still significantly positive at the 1 % level, indicating the robustness of the results in terms of the elevated level of corporate risk-taking due to the ESOP.

5.4. Changing key variable metrics

Replace the performance indicators of profit volatility (*Risk1* and *Risk2*) with stock return volatility (*Risk3* and *Risk4*), which is the standard deviation (*Risk3*) and range (*Risk4*) of annual individual stock returns adjusted by the industry. Reexamination of Model (1). Table 5, columns (1) and (2) present the regression results for the entire sample, where the *ESOP* coefficient is significant at the 1 % level and positive. Table 5, columns (3) and (4) present the regression results for the matched sample, where the *ESOP* coefficient remains significant at the 1 % level and positive. This indicates that measuring the level of risk-taking using market performance indicators still validates hypothesis H1.

6. Mechanism analysis

According to the theoretical analysis above, the supervisory, incentive, and financing effects of ESOP can reduce the dual-agent costs between shareholders and managers and between managers and employees. This helps alleviate financing constraints and promotes corporate risk taking. To verify these mechanisms, we adopted the three-step mediation method proposed by Refs. [59,60]. Because the basic regression results of the first step, in which the independent variable (*ESOP*) affects the dependent variable (*Risk*), have already been verified, they are not repeated here. In this section, we constructed Models (6) and (7) to test the second step of the mediation effect (the impact of the independent variable on the mediator variable) and the third step (the impact of the mediator variable on the dependent variable).

$$M_{i,t} = \lambda_0 + \lambda_1 ESOP_{i,t} + Control_{i,t} + Year_i + Industry_t + \varepsilon_{i,t} \quad (6)$$

$$Risk_{i,t} = \lambda_0 + \lambda_1 ESOP_{i,t} + \lambda_2 M_{i,t} + Control_{i,t} + Year_i + Industry_t + \varepsilon_{i,t} \quad (7)$$

M is the intermediary variable, which includes the proxy cost variable and financing constraint variable: 1) The agency cost variable is based on the approach of Wang et al. (2021) [61]; using the management expense ratio, free cash flow, total asset turnover ratio, and unit employee growth to measure. The management expense ratio and free cash flow reflect the agency costs between shareholders and managers. The total asset turnover ratio and unit employee growth reflect the agency costs of employee decision execution. The higher the management expense ratio, the more severe the executives' comfortable consumption and risk avoidance. The higher the free cash flow, the more likely executives are to engage in overinvestment [62] to pursue personal interests. Negative employee work attitudes reduce asset operating efficiency, weaken executive risk-taking willingness, and reduce the company's ability to bear risks. The unit employee growth reflects the value of individual employees. The higher the unit employee growth, the stronger the investment in human capital and the higher the work efficiency and effort level [63]. Management expense ratio (*MF*) =

[1] *ESOP_pre_3, ESOP_pre_2, ESOP_pre_1, Current, ESOP_aft_1, ESOP_aft_2, ESOP_aft_3* denote dummy variable interaction terms, meaning 1 for the first three years, first two years, first year, current year, next year, next two years, and last three years of employee stock ownership plan implementation, otherwise 0.

Table 4
Dynamic effects, double difference model, PSM + DID.

	Dynamic effect		DID		PSM + DID	
	(1)	(2)	(3)	(4)	(5)	(6)
	Risk1	Risk2	Risk1	Risk2	Risk1	Risk2
ESOP_pre_3	−2.3050	−7.1729				
	(-0.5243)	(-0.9103)				
ESOP_pre_2	−0.4932	−1.0937				
	(-0.1414)	(-0.1697)				
ESOP_pre_1	4.3795	7.2758				
	(1.0372)	(0.9957)				
Current	5.5743***	7.2198***				
	(3.0986)	(2.8294)				
ESOP_aft_1	3.6859**	5.0429**				
	(2.2774)	(2.0670)				
ESOP_aft_2	3.9382**	6.1759**				
	(2.4094)	(2.4821)				
ESOP_aft_3	4.9404**	6.9480**				
	(2.3739)	(2.1578)				
Treat*Post			2.9047***	7.1396***	2.7361***	7.1196***
			(2.8369)	(3.1629)	(2.8140)	(2.9659)
Controls	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES
Industry	YES	YES	YES	YES	YES	YES
Firm	YES	YES	YES	YES	YES	YES
r2	0.1539	0.3608	0.4250	0.4836	0.3525	0.4216
F	122.6166	124.5464	1769.6482	1779.3649	48.6390	65.1973
N	4990	4990	38184	38184	4990	4990

Note: Regressions are all estimated using robust standard errors, t-values in parentheses; *,**,*** indicate significant at the 10 %, 5 %, and 1 % levels, respectively.

Table 5
Changing key variable metrics.

	(1)	(2)	(3)	(4)
	Risk3	Risk4	Risk3	Risk4
ESOP	4.4101***	5.8947***	0.4261***	0.9795***
	(3.9126)	(3.7508)	(2.8931)	(3.8105)
Controls	YES	YES	YES	YES
Year	YES	YES	YES	YES
Industry	YES	YES	YES	YES
Firm	YES	YES	YES	YES
r2	0.1531	0.3601	0.1001	0.0929
F	141.1556	140.1304	11.7921	11.4478
N	38184	38184	4990	4990

Note: Regressions are all estimated using robust standard errors, t-values in parentheses; *,**,*** indicate significant at the 10 %, 5 %, and 1 % levels, respectively.

management expenses/operating income; free cash flow (*FCF*) = operating cash flow–maintenance investment–expected investment, where maintenance investment refers to the depreciation of fixed assets, amortization of intangible assets, and amortization of long-term deferred expenses. The expected investment is calculated based on Richardson's (2006) [62] investment model: total asset turnover ratio (*TO*) = operating income/total assets; unit employee growth (*EMG*) = (market value of shareholders' equity - book value of shareholders' equity)/number of employees. 2) The financing constraint (*FC*) is calculated according to the financing constraint model of Hadlock and Pierce (2010) and Gu Leilei et al. (2020).

According to the principle of the mediation effect, if the independent variable *ESOP* is significant in Model (6) and the coefficients of the mediator variables (*MF*, *FCF*, *TO*, *EMG*, *FC*) are also significant in Model (7), then the mediation effect is established.

6.1. Channels for reducing two-tier agency costs

Table 6 presents the test results of the dual-agent cost-mediation mechanism. Columns (1), (4), (7), and (10) report the regression results of Model (6), examining the effects of ESOP on the intermediary variables of management fee ratio (*MF*), free cash flow (*FCF*), total asset turnover (*TO*), and employee growth (*EMG*). Columns (2), (3), (5), (6), (8), (9), and (11), (12) report the regression results of Model (7), examining the effects of the intermediary variables on the level of corporate risk. From the results in Columns (1), (4), (7), and (10), it can be concluded that the coefficients of *ESOP* are significantly negative, negative, positive, and positive at the 1 % level,

Table 6
Tests of the channels to reduce dual agency cost.

	Costs of Shareholder-Manager Agency						Costs of Manager-Employee Agency					
	In-job consumption intermediary effect			Free cash flow intermediary effect			Total asset turnover intermediary effect			Unit employee growth intermediary effect		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	MF	Risk1	Risk2	FCF	Risk1	Risk2	TO	Risk1	Risk2	EMG	Risk1	Risk2
ESOP	−0.0001***	2.3641***	5.6844***	−0.0242***	2.8991***	7.1983***	0.0271***	2.3041***	5.5570***	0.1909***	2.9291***	6.8676***
	(-3.0498)	(2.9218)	(3.3138)	(-3.7923)	(3.1936)	(3.7238)	(3.2942)	(2.7897)	(3.1732)	(3.6849)	(3.0651)	(3.3923)
MF		−12.5552***	−24.0348***									
		(-4.5003)	(-4.3525)									
FCF					−1.2223***	−3.2351***						
					(-2.6382)	(-3.2728)						
TO								3.2453***	5.8904***			
								(3.2857)	(3.9331)			
EMG											0.0000***	0.0000***
											(8.6584)	(8.6157)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
r2	0.4932	0.3531	0.4220	0.6275	0.3559	0.4180	0.7512	0.3535	0.4222	0.1690	0.2156	0.3076
F	86.6438	47.4900	63.5978	141.6925	151.0177	152.9518	78.5151	183.8852	186.6737	86.1246	61.7528	73.9111
N	4990	4990	4990	4990	4990	4990	4990	4990	4990	4990	4990	4990

Note: Regressions are all estimated using robust standard errors, t-values in parentheses; *,**,*** indicate significant at the 10 %, 5 %, and 1 % levels, respectively.

indicating that ESOP reduces executive consumption, decrease the free cash flow of the firm, increase total asset turnover, and accelerate employee growth. From the results in Columns (2)–(3), (5)–(6), (8)–(9), and (11)–(12), it can be concluded that the coefficients of the intermediary variables (*MF, FCF, TO, EMG*) are significantly negative, negative, positive, and positive at the 1 % level, respectively, indicating that executive consumption, free cash flow, total asset turnover, and employee growth play a mediating role. ESOP enhances corporate risk taking by reducing executive consumption, decreasing free cash flow, increasing total asset turnover, and accelerating employee growth. This implies that ESOP improves corporate risk-taking by mitigating the dual-agent costs between shareholders and managers and between managers and employees.

6.2. Channels for easing financing constraints

Table 7 presents the empirical results of the intermediation mechanisms of financial constraints. In column (1), the regression results of Model (6) examine the impact of ESOP on the intermediate variable of financial constraints. Columns (2)–(3) show the regression results of Model (7), which tests the effect of the intermediate variable financial constraints (FC) on the level of corporate risk-taking. From the results in Column (1), the coefficient of *ESOP* is significant and negative at the 1 % level, indicating that ESOP reduces the degree of financial constraints for the firm. From the results in columns (2)–(3), the coefficients of the intermediate variable financial constraints (*FC*) are both significant and negative at the 1 % level, suggesting that the intermediate effect of the ESOP on increasing corporate risk-taking by reducing financial constraints is established. In other words, the equity financing role of ESOP and their signaling attributes can provide financial support and financing convenience for high-risk investments, contributing to the enhancement of corporate risk-taking.

7. Quality analysis

Agency problems lead executives to either avoid risk, enjoy a comfortable life, and underinvest [53] or to maximize personal interests and engage in empire-building, leading to overinvestment [62]. An increase in a company's risk-taking level may be due to the governance of executive risk aversion by enhancing corporate value (ESOPs) or the result of executive moral hazard (damaging corporate value). The quality of ESOP' enhancing corporate risk-taking levels must be tested.

Research shows that R&D investment (He et al., 2019), overinvestment (Xia et al., 2015), and high leverage [57] increase corporate risk-taking. However, overinvestment and its accompanying high leverage (Ma and Zhang, 2022) increase a company's operational and financial risks and crowd out R&D investments. This type of risk taking harms corporate value (Arrfelt et al., 2018; Liu et al., 2020), whereas R&D investment is a value-added investment that enhances a company's core competitiveness. This type of risk-taking promotes corporate value (Liu et al., 2020). Therefore, this study chooses R&D investment, overinvestment, and high leverage to test the impact of ESOPs on corporate heterogeneous high-risk investments and constructs an interactive term *ESOP*Risk* to further test the risk-taking effect of ESOP (promoting or harming corporate value) to judge whether the increase in corporate risk-taking levels through ESOP is of high quality. We define R&D investment (*R&D*) = ln (net increase in R&D investment), the leverage rate (*Lev*) = total debt/total assets, and overinvestment (*Over_inv*), calculated using [62] investment efficiency model.

Table 8 presents the regression results for the quality tests. Columns (1) to (3) show the regression results of ESOP on heterogeneous corporate high-risk investments (dependent variables: R&D investment, overinvestment, and high leverage). The coefficients of *ESOP* are significantly positive, negative, and negative at the 1 %, 1 %, and 1 % levels, respectively, indicating that ESOPs promote R&D investment, suppress overinvestment, and are accompanied by high leverage. Columns (4)–(5) show the regression results of the risk-taking effect of the ESOP (dependent variable: corporate value). The coefficients of the interaction term between the ESOP and corporate risk-taking levels (*ESOP*Risk1, ESOP*Risk2*) are significantly positive at the 1 % level, indicating that ESOP that enhances corporate risk-taking levels promotes corporate value growth. This regression result shows that ESOP not only promotes risk-taking, which can increase corporate value (R&D investment) but also suppresses risk-taking, which harms corporate value (overinvestment

Table 7
Tests of the channels to reduce financing constraints.

	(1)	(2)	(3)
	FC	Risk1	Risk2
ESOP	−0.0182***	2.4186***	5.9109***
	(-7.0026)	(2.9000)	(3.3453)
FC		−11.8869***	−28.8505***
		(-3.5253)	(-4.0342)
Controls	YES	YES	YES
Year	YES	YES	YES
Industry	YES	YES	YES
Firm	YES	YES	YES
r2	0.7954	0.3558	0.4228
F	2616.4756	177.7016	180.4143
N	4990	4990	4990

Note: Regressions are all estimated using robust standard errors, t-values in parentheses; *,**,*** indicate significant at the 10 %, 5 %, and 1 % levels, respectively.

Table 8
Quality Inspection.

	(1)	(2)	(3)	(4)	(5)
	R&D	Over_Inv	Lev	Tobinq	Tobinq
ESOP	0.1049***	−0.0184***	−0.0178***	−0.0150	−0.0347
	(5.9398)	(-3.1762)	(-5.6619)	(-0.3751)	(-0.8672)
Risk1				0.0059***	
				(22.0483)	
ESOP*Risk1				0.0026***	
				(2.9380)	
Risk2					0.0025***
					(20.5885)
ESOP*Risk2					0.0013***
					(3.2363)
Controls	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES
Industry	YES	YES	YES	YES	YES
Firm	YES	YES	YES	YES	YES
r2	0.5954	0.6571	0.4046	0.3110	0.3060
F	234.2579	86.3246	168.4521	234.0215	221.2648.
N	4990	2259	4990	4990	4990

Note: Regressions are all estimated using robust standard errors, t-values in parentheses; *,**,*** indicate significant at the 10 %, 5 %, and 1 % levels, respectively.

and high leverage) and enhances corporate value growth. This indicates that the increase in corporate risk-taking levels is due to the governance of executive risk aversion through ESOP rather than the result of executive moral hazard. The increase in corporate risk-taking levels through ESOP is high-quality.

8. System design heterogeneity test

The institutional designs of ESOP vary in terms of funding sources, stock sources, stockholders, lock-up periods, implementation scales, and management methods. The design elements of heterogeneity may affect the implementation of ESOP.

8.1. Heterogeneity of funding sources

The funding sources of ESOP can be divided into two categories: "leveraged" and "non-leveraged.'' Non-leveraged approaches include employee compensation, self-raised funds, stock plan rewards, and shareholder contributions. The leveraged approach involves third-party financing and loans from shareholders and controllers. The leveraged ESOP creates a financial institution (creditor) priority-employee subordinated residual income extraction model. Employees cannot claim the right to extract residual income before financial institutions, but they bear all losses when stock prices fall. As subordinated residual income claimants, employees must ensure that the stock price increase exceeds the return rate of priority shares to obtain profits. In the case of leveraged ESOP, employees holding subordinated shares work harder to obtain residual income distribution and avoid losses when stock prices fall. They actively participate in governance, enhance corporate risk-taking levels, and increase stock prices. The regression test shows that non-leveraged and leveraged ESOP have different impacts on corporate risk-taking. The coefficient of non-leveraged *ESOP* is not significant, whereas that of leveraged *ESOP* is significantly positive at the 1 % level, indicating that leveraged ESOP can promote corporate risk-taking. (See Appendix 9 for the regression results.)

8.2. Heterogeneity of stock sources

The primary sources of ESOP include repurchases by listed companies, bidding transfers, and subscriptions to non-public offerings. Different stock sources offer different discounts, and purchasing at a discount can expand the marginal returns of employee-held stocks when stock prices increase. Existing research shows that the purchasing discounts of equity incentives can effectively motivate executives to enhance their level of corporate risk-taking [3]; Tu and Sun, 2020). Is there an incentive difference in the purchasing discounts for ESOP? Referring to Zhou et al. (2019) and [63] define the "low discount group" as those with repurchases by listed companies and bidding transfers and the "high discount group" as those with subscriptions to non-public offerings to examine the differential impact of purchasing discount on the level of corporate risk-taking. The regression results show that the coefficient of *ESOP* in the low-discount group is not significant, while the coefficient of *ESOP* in the high-discount group is significant and positive at the 1 % level, indicating that higher purchasing discounts are more conducive to the incentive effect of ESOP and promote corporate risk-taking. (See Appendix 10 for the regression results.)

8.3. Heterogeneity of stockholders

According to "Guiding Opinions," both executives and non-executive employees can participate in ESOP. Who has a more or more significant impact on corporate risk-taking: non-executive employees or executives? Definitions: Executive ownership ratio (*ESOP_GG_hold*) = executive's subscribed shares/total shares; employee ownership ratio (*ESOP_YG_hold*) = employee's subscribed shares/total shares. This study examines the differential impacts of different stockholder ratios on corporate risk-taking levels. The regression results show that the coefficients of the executive ownership ratio (*ESOP_GG_hold*) are 0.3096 and 0.7818, which are significant at the 5 % level. The coefficients of the employee ownership ratio (*ESOP_YG_hold*) are 22.8378 and 44.1145, which are significant at the 1 % level. This indicates that both executive and employee subscriptions increase corporate risk-taking levels. However, both the coefficient and significance level show that employee ownership is higher than executive ownership (the coefficient difference is significant according to Fisher's permutation test, with an empirical p-value of 0.003 at the 1 % significance level). This suggests that, after employees become owners, their sense of identity increases, leading to greater effort in their work and more active supervision of managers' risk aversion and opportunistic behavior. Employee subscriptions have a stronger impact on corporate risk-taking levels than executives (See Appendix 11 for the regression results.).

8.4. Heterogeneity of lock-up and tenure periods

According to the "Guidelines," "the holding period for each ESOP should not be less than 12 months, and if implemented through non-public issuance, the holding period should not be less than 36 months." This study finds significant differences in the "unlocking period" and "tenure in years" tenure in the years of the ESOP in the sample companies. Oehmichen et al. (2018) point out, based on the sharing economy theory and psychological ownership theory, that employees' ability to hold company stocks is only a prerequisite for the effectiveness of ESOPs as incentives. To truly achieve the motivational effect of ESOPs, it is necessary to ensure that this benefit-sharing mechanism and employees' psychological ownership persist for a sufficiently long period, meaning that employees must hold company stock for a long period. How do the lengths of the lock-up and tenure periods of ESOPs affect corporate risk-taking? To investigate this, we construct continuous indicators, the lock-up period indicator *ESOP_long* = ln (lock-up period+1), and the tenure period indicator *ESOP_years* = ln (tenure in years+1), and regressively examine the impact of different lock-up and tenure periods of ESOPs on the level of corporate risk-taking. The results show that the coefficients of *ESOP_long* and *ESOP_years* are both significantly positive at the 1 % level, indicating that the longer the lock-up and tenure periods, the better the monitoring and incentive effects of ESOPs (See Appendix 12 for the regression results.).

8.5. Heterogeneity in implementation scale

ESOPs were originally intended to motivate employees and owners to create wealth. However, studies on ESOPs in the United States have found that they may suffer from equalitarianism, leading to opportunistic behavior by employees and negative impacts on company performance and value creation [35,39]. Based on this viewpoint, combined with the imperfect market supervision in China, the Chinese ESOPs may also experience free-riding behavior. However [39], point out that free-riding behavior occurs among employees in the United States because there are too many participants, making it difficult to establish effective mutual scrutiny mechanisms among employees. If a scale limit is imposed, the cost of mutual supervision among employees can be reduced, and the enthusiasm and efficiency of monitoring can be enhanced, thus avoiding free-riding behavior and maximizing the incentive effect of ESOPs. There are significant differences in the scale of implementation of ESOP between China and the United States. In the United States, all employees are required to participate mandatorily (100 %), whereas in China, participation is voluntary, and the average participation rate among employees is only 13 %. In terms of the proportion of shares held, most ESOPs in the United States hold more than 6.7 % of the total share of capital, whereas in China, this proportion is only 1.24 %. This indicates that in terms of both the number of shareholders and the proportion of shares held, the scale of ESOPs in China is much smaller than that in the United States. Therefore, it can be inferred that a smaller scale of ESOPs in China may lead to the absence of free-riding behavior and a more effective incentive effect. Drawing on Song et al. (2020), we measured the implementation scale of ESOPs using the number of participants (*ESOP_people*), size of funds (*ESOP_money*), and proportion of ESOPs (*ESOP_hold*). Specifically, we define *ESOP_people* = ln (number of participants + 1), *ESOP_money* = ln (size of funds + 1), and *ESOP_hold* = total shares in the ESOP/total share capital. We examine the heterogeneous impact of the implementation scale of ESOPs on corporate risk-taking. The linear relationship test shows that the coefficients of *ESOP_people*, *ESOP_money*, and *ESOP_hold* are all significantly positive at the 1 % level, indicating that the larger the number of participants in ESOPs, the larger the size of funds, and the higher the issuance proportion, the more beneficial it is for promoting corporate risk-taking. Furthermore, by including the square terms of the implementation scale to test the problem of free riding, the nonlinear relationship test shows that the coefficients of the square terms ($ESOP\_people^2$, $ESOP\_money^2$, $ESOP\_hold^2$) are all insignificant, indicating that there is no free-riding problem in the implementation of ESOPs in China (See Appendix 13 for the regression results.).

8.6. Heterogeneity in management styles

According to the "Guidelines," listed companies can establish an employee stock ownership plan management committee to manage the company's ESOPs on their own, or they can entrust them to a third-party institution with asset management qualifications. This difference in management methods directly affects the effectiveness of employees in exercising shareholder rights. For ESOPs managed

by a company, employees primarily exercise shareholder rights through the election of representatives by the ESOP management committee. Major shareholders appoint most directors and members of the management committee, often the chairperson, CEO, internal directors, or members of the senior management team. For example, in the announcement of the "Xin Zhi Renci" (stock code 603869) ESOP in 2023, the three members of the ESOP management committee elected were Wang Xi (director), Zhang Yanfeng (member), and Zhang Ping (member). Wang Xi serves as an internal director and executive vice president, whereas Zhang Yanfeng is the deputy general manager, CFO, and board secretary. In the announcement of the "Kai Zhong" (stock code 603037) ESOP for 2023, three members of the ESOP management committee were elected: Yang Jiangang (director), Li Jianxing (member), and Tang Danni (member). Yang Jiangang is the chairman of the company, and Li Jianxing is a shareholder-representative supervisor. Both firms hold shares. It can be seen that the ESOP management committee (the employee's voice mechanism) of self-managed ESOPs is effectively controlled by major shareholders or management, lacking independence, and it may be difficult for employee shareholders to play a supervisory role in corporate governance. In contrast, ESOPs managed by third-party asset management institutions not only have strong independence but also have more professional personnel and expertise. They are more efficient and professional in supervising management decisions and protecting employee shareholders' interests.

To examine whether the management method affects the implementation effect of ESOPs, we further divide the samples into "entrusted third-party management group" and "self-management group" for group tests. The regression results show that the coefficients of *ESOP* in the entrusted third-party management group are all significantly positive at the 1 % level, whereas in the self-management group, the coefficients of *ESOP* are not significant. This indicates that ESOPs managed by third-party institutions have better monitoring and incentive effects than self-managed ESOPs. Third-party institutions have greater independence and professionalism in participating in corporate governance, whereas major shareholders and managers effectively control self-managed ESOPs. They may not represent the voices of employees in board decisions and cannot effectively supervise the opportunistic behavior of major shareholders and managers (See Appendix 14 for the regression results.).

9. Conclusions and discussion

This article used sample data from 2006 to 2022 of China's A-share listed companies to study the level, quality, and effect of employee stock ownership plans (ESOPs) on corporate risk-taking. Our findings are as follows: (1) The implementation of ESOPs enhances corporate risk-taking. Specifically, ESOPs reduce executive perks and free cash flow, improve asset operation efficiency, alleviate financing constraints, and increase risk taking. (2) The improvement in corporate risk-taking by ESOPs is of high quality, which manifests in increasing R&D investment (which enhances corporate value) and reducing overinvestment and high leverage (which damages corporate value). (3) There are differences in the implementation effects of ESOPs in terms of system design: leveraged, high-discount, longer lock-up and duration, and entrusted third-party management ESOPs have a stronger promoting effect on corporate risk-taking. Employee purchases, higher participation rates, and larger funds can improve the effectiveness of implementation.

The findings of this study provide a reference for governments, corporations, and investors. They provide theoretical and empirical support for the implementation of ESOPs by governments and offer insights for corporations to improve the institutional design of ESOPs. Furthermore, they provide a framework for companies to enhance their risk-taking abilities through the implementation of ESOPs, particularly in the current economic downturn, when the capacity to bear risks becomes more crucial. This will be the focus of our future research.

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CRediT authorship contribution statement

Quan Zhou: Writing – original draft. **Heyang Han:** Writing – original draft. **Junhua Han:** Writing – review & editing, Writing – original draft.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Annexes.

Table 9
Heterogeneity test of funding sources

	Unleveraged		Leveraged	
	(1)	(2)	(3)	(4)
	Risk1	Risk2	Risk1	Risk2
ESOP	0.2044	0.3428	3.6683***	6.0618***
	(0.6709)	(0.4602)	(3.1280)	(3.3099)
Controls	YES	YES	YES	YES
Year	YES	YES	YES	YES
Industry	YES	YES	YES	YES
Firm	YES	YES	YES	YES
r2	0.1687	0.1724	0.3042	0.3214
F	33.6604	33.7302	66.3248	69.2416
N	3556	3556	1434	1434

Note: Regressions are all estimated using robust standard errors, t-values in parentheses; *,**,*** indicate significant at the 10 %, 5 %, and 1 % levels, respectively.

Table 10
Heterogeneity test for stock sources

	Low Discount		High Discount	
	(1)	(2)	(3)	(4)
	Risk1	Risk2	Risk1	Risk2
ESOP	1.2090	3.2951	2.1053***	4.9990***
	(0.4720)	(0.5084)	(3.4739)	(2.7896)
Controls	YES	YES	YES	YES
Year	YES	YES	YES	YES
Industry	YES	YES	YES	YES
Firm	YES	YES	YES	YES
r2	0.1961	0.1870	0.3624	0.4296
F	17.4298	12.9245	167.4519	169.2905
N	3628	3628	1362	1362

Note: Regressions are all estimated using robust standard errors, t-values in parentheses; *,**,*** indicate significant at the 10 %, 5 %, and 1 % levels, respectively.

Table 11
Heterogeneity test for stockholders

	Executive Subscription		Employee Subscription	
	(1)	(2)	(3)	(4)
	Risk1	Risk2	Risk1	Risk2
ESOP_GG	0.3096**	0.7818**		
	(2.2988)	(2.3425)		
ESOP_YG			22.8378***	46.1145***
			(2.7619)	(2.6268)
Controls	YES	YES	YES	YES
Year	YES	YES	YES	YES
Industry	YES	YES	YES	YES
Firm	YES	YES	YES	YES
r2	0.3527	0.4211	0.3527	0.4211
F	48.3730	64.6856	48.3840	64.6826
N	4990	4990	4990	4990

Note: Regressions are all estimated using robust standard errors, t-values in parentheses; *,**,*** indicate significant at the 10 %, 5 %, and 1 % levels, respectively.

Table 12
Heterogeneity test for lock-up and tenure periods

	lock-up period		tenure period	
	(1)	(2)	(3)	(4)
	Risk1	Risk2	Risk1	Risk2
ESOP_long	1.7104***	4.2460***		
	(2.7445)	(3.1907)		
ESOP_years			4.1183***	5.4472***
			(3.5675)	(3.3851)
Controls	YES	YES	YES	YES
Year	YES	YES	YES	YES
Industry	YES	YES	YES	YES
Firm	YES	YES	YES	YES
r2	0.3524	0.4214	0.1525	0.3597
F	187.8459	190.4399	143.0958	140.3169
N	4990	4990	4990	4990

Note: Regressions are all estimated using robust standard errors, t-values in parentheses; *,**,*** indicate significant at the 10 %, 5 %, and 1 % levels, respectively.

Table 13
Heterogeneity test for implementation scale

	linear relationship test						free-rider test					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Risk1	Risk2	Risk1	Risk2	Risk1	Risk2	Risk1	Risk2	Risk1	Risk2	Risk1	Risk2
ESOP_people	0.5270***	1.2576***					0.2014	0.7202				
	(3.4383)	(3.8720)					(0.3699)	(0.6312)				
$ESOP\_people^2$							0.0537	0.0886				
							(0.6268)	(0.4979)				
ESOP_money			0.3061***	0.7194***					−0.2416*	−0.5067		
			(3.3009)	(3.6338)					(-1.7654)	(-1.5655)		
$ESOP\_money^2$									0.0291	0.0620		
									(1.1417)	(1.2245)		
ESOP_Hold					0.4606***	1.0551***					−0.5003	−0.7729
					(3.7839)	(4.1145)					(-1.3720)	(-1.0565)
$ESOP\_Hold^2$											0.1284	0.2442
											(0.8219)	(0.7349)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
r2	0.3555	0.4242	0.3509	0.4194	0.3539	0.4228	0.3555	0.4243	0.1907	0.1970	0.3550	0.4235
F	183.8206	185.9023	184.6631	187.2201	187.7880	190.6208	179.9315	182.0463	43.1923	43.1983	183.8398	187.1952
N	4990	4990	4990	4990	4990	4990	4990	4990	4990	4990	4990	4990

Note: Regressions are all estimated using robust standard errors, t-values in parentheses; *,**,*** indicate significant at the 10 %, 5 %, and 1 % levels, respectively.

Table 14
Heterogeneity test for management style

	Third-party managed		Self-managed	
	(1)	(2)	(3)	(4)
	Risk1	Risk2	Risk1	Risk2
ESOP	0.7314***	2.4206***	1.6429	3.5063
	(3.6553)	(4.0137)	(0.2329)	(0.2413)
Controls	YES	YES	YES	YES
Year	YES	YES	YES	YES
Industry	YES	YES	YES	YES
Firm	YES	YES	YES	YES
r2	0.3295	0.4006	0.4391	0.5055
F	29.7763	40.5419	26.1871	34.2731
N	3268	3268	1722	1722

Note: Regressions are all estimated using robust standard errors, t-values in parentheses; *,**,*** indicate significant at the 10 %, 5 %, and 1 % levels, respectively.

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