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Employee stock ownership plans and firm productivity in China

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Abstract
A growing number of Chinese firms motivate their employees through employee stock ownership plans (ESOPs). Using a sample of listed firms in China, this paper examines the impact of ESOPs on firms' total factor productivity (TFP), as well as the mechanisms of ESOPs. The empirical results show that ESOPs have a positive impact on firm TFP. The mechanism tests convey that ESOPs increase firm TFP by promoting research and development (R&D) investment and mitigating agency costs. These results are robust after accounting for endogeneity and using alternative metrics of TFP. In addition, we find that the positive effect of ESOPs on firm TFP is more pronounced in non-state-owned firms and firms with a less severe free-riding problem. Furthermore, the effect on firm TFP is positively associated with the subscription proportion of non-executive employees in ESOPs. Overall, the results of this study underscore the important role of employee ownership in firms' productivity improvement.

JEL Codes: D24, G30, J33

Keywords
Employee stock ownership plan, firm productivity, ownership structure, China, labour policy

Introduction

Beginning in the United States, ESOPs are widely adopted by enterprises in developed countries, and have also recently appeared in many emerging markets, including China. ESOPs, also known as employee stock purchase plans, allow employees to obtain stock shares, either through compensation or via subscription plans offered by their employers.

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Proponents of ESOPs argue that employee equity ownership improves firm performance by improving corporate governance (Faleye et al., 2006), attracting and retaining employees (Chen et al., 2020), cultivating job satisfaction and organisational commitment (Dong et al., 2002), and enhancing peer monitoring (Jones and Kato, 1995) and interest alignment (Jones and Kato, 1993; Robinson and Wilson, 2010). However, critics of ESOPs suggest that employees' ownership earnings are exposed to higher capital market risk; hence, making it difficult to stimulate employee productivity (Conyon et al., 1995). Also, as an incentive to rank-and-file employees, ESOPs are insufficient to improve firm productivity when there are too many participants to mitigate free-riding problems (Kim and Ouimet, 2014).

Existing literature presents mixed results on the link between ESOPs and firm performance. In addition, little is known about the effect of employee ownership firms in emerging countries. Although Ren et al. (2019) have provided evidence that ESOPs facilitate corporate performance in China, existing literature does not provide convincing evidence on how ESOPs in emerging countries affect productivity. This study attempts to help fill this gap in the literature. We explore how ESOPs affect a firm's total factor productivity (TFP, hereafter), and investigate the channel through which ESOPs exert influence on firms' TFP. Firm TFP is analysed, because TFP is a measure of a firm's efficiency, which in turn has been recognised as a critical factor in firms' survival and competitiveness (Lieberman and Dhawan, 2005).

In recent years, the rapid development of ESOPs in emerging capital markets has attracted widespread attention, especially in China. To standardise the implementation of ESOPs, the China Securities Regulatory Commission (CSRC) issued the 'Guiding Opinions on the Implementation of Pilot ESOPs by listed firms' (henceforth referred to as 'The Guidance') in 2014. This document sets out the basic principles of information disclosure. Since then, many listed firms have adopted ESOPs. More than 430,000 employees participated in ESOPs by the end of 2019. Remarkably, whether state-owned or private-owned, China's listed firms usually have an overly-concentrated ownership structure, in which controlling shareholders hold the majority of shares, while employees hold very few. Hence, many of China's firms suffer from agency problems and tunnelling issues (Jefferson and Su, 2006; Jiang and Kim, 2015), which reduce staff productivity. Based on these facts, studying the economic consequences of Chinese firms' ESOPs has theoretical value and practical significance. This study provides suggestions, not only for Chinese firms, but also for many emerging capital markets.

This study's primary research design is based on ESOPs for Chinese publicly traded firms. First, the empirical results suggest that the implementation of ESOPs is linked to an increase in firms' productivity, as measured by TFP. These results still hold after conducting a series of robustness checks. Second, this article further broadens the focus on the possible mechanism through which these effects may be exerted. The results suggest that ESOPs promote firms to invest in research and development (R&D) activities and alleviate agency problems. This is achieved by stimulating employees to adopt long-term interests and by binding their benefits to the firm's financial performance. Third, this study further investigates the economic consequences of ESOPs in firms with different characteristics and finds that the impact of ESOPs on firm productivity is more pronounced in non-state-owned enterprises (non-SOEs), as well as in

firms with a less severe free-riding problem measured by the number of employees. Fourth, we find that an increase in firm TFP positively associates with the subscription proportion of non-executive employees in ESOPs.

This study contributes to the existing literature by examining the role of employee ownership on firm productivity. First, it builds on previous literature on the economic functions of employee ownership. To our knowledge, no previous work systematically links ESOPs with TFP using a large-scale analysis in an emerging market. This is despite the existing evidence that employee ownership is an efficient way to improve corporate governance. We document that an essential function of employee ownership is to foster firm productivity. Also, this research discovers the effects of and the specific channels through which ESOPs affect firm productivity. Based on the findings, this study complements the research of Jones and Kato (1995), and Kim and Ouimet (2014), both of which confirmed the positive impact of ESOPs on corporate performance and innovation. Second, this paper also contributes to the existing literature on firm productivity. Corporate literature has paid close attention to ways in which to improve firm productivity (see, e.g., Ferrando and Ruggieri, 2015; Le et al., 2019; Liu and Mao, 2019; Wye and Bahri, 2021), especially through labour policy (Ellem, 2021; Wye and Bahri, 2021). We focus on the role of ESOPs in this field, in order to provide new ideas on how to improve the productivity of Chinese enterprises. Third, this paper contributes to the current literature on Chinese ESOPs (Feng et al., 2022; Ren et al., 2019). Since China now officially allows listed firms to adopt ESOPs, a growing number of Chinese firms are motivating employees through such plans, though the literature on Chinese ESOPs is scarce. Hence, this research provides insights into the economic outcomes in which Chinese enterprises' ESOPs are adopted.

The rest of this article is structured as follows: in the section 'Institutional background and hypothesis development', a review of the institutional background related to ESOPs in China is performed, and hypotheses are proposed. The section 'Research design' introduces the empirical strategy with our sample selection, variable construction, and regression model. Then, the 'Empirical results' section reports empirical findings, including the tests for the hypotheses, moderation analysis, further analysis, and robustness checks. Finally, the 'Conclusion' section presents a summary of the findings.

Institutional background and hypothesis development

Ever since ESOPs originated in the US, similar plans have been adopted by many enterprises around the world. The CSRC in China issued 'The Guidance', which formulates the main content, information disclosure, adoption procedures, and regulatory requirements. This document formally launched ESOPs for public traded firms in China. Compared to common equity incentives, ESOPs include a larger group of employees, as well as different implementation methods. According to our statistics based on all ESOPs announced by Chinese A-share firms before 2019, these ESOPs account for 1.59% of their firms' shares. For the subscribed shares in these ESOPs, 74.97% of shares were purchased by non-executive employees on average, while the remaining shares belonged to executives. The average number and proportion of employees participating in these ESOPs are 469 and 15.68%. In addition, since many Chinese SOEs do not allow their

officials to hold shares, only 9.74% of ESOPs are adopted by Chinese SOEs. As required by the CSRC, the shares subscribed by employees in ESOPs are centrally managed by an organisation elected by employees, and rights to shares are allocated to employees as agreed in the terms of subscription. However, shares cannot be sold for a designated period – on average 1.39 years. Listed firms need to release the specific progress and purchase quantity of ESOPs, and this requirement provides reliable data for empirical research. Statistics from the Wind database show that, after 'The Guidance' was issued, 1,190 ESOPs were released in the Chinese capital market. Overall, ESOPs have become a common way to motivate employees in China.

Employees are believed to be one of the most important stakeholders of a firm, and they should be involved in decision-making and strategic plans (Chang et al., 2015; Chen et al., 2020). In practice, ESOPs enable employees to become shareholders of their firm; ESOPs also link employee wealth to the market performance of firm stock. ESOPs motivate employees to greater work effort, thus enhancing a firm's financial performance. Specifically, a firm can adopt an ESOP to facilitate productivity gains (Kim and Ouimet, 2014), encourage R&D activities (Chang et al., 2015) and/or improve the firm's financial performance (Ren et al., 2019). Thus, ESOPs can boost firm TFP through different channels.

As one of the major forms of profit sharing and employee incentive, employee ownership is a compensation strategy that primarily focuses on offering shares to employees. Through these shares, employees can increase their wealth, thus more closely linking the employee to the firm's success (Aubert et al., 2017). When employees hold firm shares, the sensitivity between the employees' interests and the firm's financial performance is increased. Employees may also develop a sense of identity or loyalty to the firm (Jones and Kato, 1995). One prime motivation that underlies managerial adoption of ESOPs is to incentivise employees, and translate those positive attitudes into better performance and higher productivity. French (1987), among others (Aubert et al., 2017; Gamble et al., 2002) suggested that employee ownership can successfully motivate employees and inspire them to work harder, ultimately improving firm performance and business sustainability. Based on the above considerations and evidence, we propose the following hypothesis:

Hypothesis 1: ESOPs have a positive effect on firms' TFP.

We believe that improved attitudes can be translated into innovation involvement, that is, employee stock ownership facilitates corporate innovation activities. It has been documented that the key to progress of research and development is talented people, namely firm employees (Bradley et al., 2013). Caramelli and Briole (2007) argued that employee ownership might affect worker attitudes via improved work motivation and affective commitment. Chang et al. (2015) suggested that employee profit-sharing plans act as a group incentive scheme to enhance cooperation, information sharing, and social learning between innovators, thus promoting R&D activities. In addition, employee motivation plays a decisive role in a firm's development and growth, especially in long-term R&D activities. Since ESOPs usually last for at least 1 year and require employees to stay within their firm's employ, such plans can improve the stability of employees, in turn

ensuring the continuity of the firm's R&D activities. Theoretically, firm productivity is the Solow residual and is driven by innovation activities (Solow, 1957). Hence, this study assumes that ESOPs play a positive role in improving TFP, particularly by promoting corporate R&D activities (Syverson, 2011). To sum up, the following hypothesis is proposed:

Hypothesis 2a: ESOPs improve firms' TFP by promoting R&D investment.

Employee ownership can enhance employees' *sense* of ownership and make the interests of employees and shareholders more consistent, improving work enthusiasm and strengthening supervision over managers. According to agency cost theory, the consistency of employees' interests can reduce a firm's agency cost, which is conducive to reducing opportunistic behaviour by management and promoting firm development. Furthermore, the effect on staff stability is also associated with greater corporate productivity. Prior research supports the idea that ESOPs reduce agency costs. For instance, Chen and Huang (2006) suggested that employee ownership can alleviate the agency problem between management and shareholders; and reduce information asymmetry between employees and shareholders. Hochberg and Lindsey (2010) pointed out that stock-based compensation establishes the common goals of employees at all levels; employee teamwork is also enhanced. To sum up, the next hypothesis is proposed as follows:

Hypothesis 2b: ESOPs improve firms' TFP by mitigating agency costs.

Studies indicate that a firm's ownership nature affects business behaviour (Jefferson and Su, 2006; O'Toole et al., 2016). The magnitude of the effect on firm productivity varies across firms with different conditions. Therefore, this study provides moderation analysis of the heterogeneous impacts of ESOPs on firm TFP.

First, the effect of ESOPs on TFP is assumed to be different in state-owned enterprises (SOEs) and non-SOEs. On the one hand, when a firm is controlled by the government, its objective function is likely to be muddled with various non-economic considerations. Political inference will inevitably distort the firm's competitive strategy (Abrami et al., 2014; Shleifer and Vishny, 1997). The government has tremendous power over resource allocation and often interferes in a firm's operating activities (Hu, 2001), especially in China. Chinese state-owned enterprises have undertaken more social responsibility, for example, they work to solve unemployment issues and maintain social stability, rather than only aiming at for-profit earnings (Bai et al., 2006). On the other hand, agency theory suggests that a firm's state ownership damages the interests of non-state minority shareholders; such firms are associated with lower governance quality (Borisova et al., 2012). Among Chinese SOEs, perverse incentive mechanisms and ineffective governance mechanisms often lead to agency conflicts (Mi and Wang, 2000). Hence, SOEs have greater resistance to promoting distribution activities than non-SOEs. When adopting ESOPs, we expect that non-SOEs, who are relatively free from government interference, will benefit from a significant positive improvement in firm productivity. Hence, the following hypothesis is proposed:

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Hypothesis 3a: The positive impact of ESOPs on firms' TFP is more pronounced in non-SOEs.

Second, we predict that the relationship between ESOPs and firm TFP can be weakened in firms with a severe free-riding problem. If a firm has a large number of employees, the inefficient working behaviour of an individual may not have a notable effect on the firm's overall productivity. In such circumstances, a free-riding problem is more likely to arise in the firm (Chang et al., 2015). It has also been argued that the connection between individual performance and reward grows weaker as the number of employees in the firm grows larger (Kruse and Blasi, 1995). Due to the free-riding problem measured by the number of employees, firms with a larger workforce usually have less employee involvement (Hochberg and Lindsey, 2010) and a weaker incentive effect. Hence, when a large-workforce firm facing the free-riding problem adopts an ESOP, the power of this group incentive can be diluted (Chang et al., 2015; Kim and Ouimet, 2014). Conversely, efforts of individual employees can improve a firm's productivity more significantly in a small-workforce firm; the incentive effect of ESOPs may also be more pronounced in smaller firms. Based on these findings, we expect that employee incentives provided by ESOPs have a more significant impact on firm TFP in firms with a less severe free-riding problem, as measured by the number of employees.

Hypothesis 3b: The positive impact of ESOPs on firm TFP is more pronounced in firms with a less severe free-riding problem.

Research design

Data sources

The sample includes all publicly traded Chinese A-share firms from 2012 to 2018. Financial firms and firms in financial distress are excluded, due to their significantly distinctive financial characteristics. Firms with incomplete financial information are also excluded. Financial statement data were obtained from the China Securities Market and Accounting Research (CSMAR) database; ESOP information was taken from the Wind database. Both databases are widely used in research on listed firms in China. Specifically, we examined the mandatory announcements pertaining ESOPs issued by listed firms and confirm the start time, duration, purchased shares, and the proportion purchased by executives and non-executive employees in each ESOP. Then, we accordingly confirm whether a firm has ESOPs in each year. As the announcement of an ESOP is mandatory in China's capital market, our data covered all successfully implemented ESOPs in our sample. The final study sample includes 17,401 firm-year observations.

Variable definitions

The dependent variable in this study is firms' total factor productivity (TFP). TFP is often estimated as the Solow residual from OLS regression for a standard Cobb–Douglas production function. However, OLS estimates are likely to suffer from two endogeneity

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problems: simultaneity and selection bias. Simultaneity bias might be caused by the correlation between a firm's unobserved productivity shocks and input decisions. Selection bias might result from correlation between a firm's low productivity and its decision to exit markets.

To address these biases, this study computed firm TFP using the standard 'control function' approach proposed by Levinsohn and Petrin (2003), and Olley and Pakes (1996). The TFP in these two methods is denoted as *TFP_LP* and *TFP_OP*, respectively. Both methods are widely used in economics and management literature to calculate firm productivity levels (e.g., Liu and Mao, 2019; Jola-Sanchez, 2022). Briefly, both methods are introduced by considering a Cobb–Douglas production function, as presented below:

$$y_{it} = a_0 + a_l l_{it} + a_k k_{it} + a_m m_{it} + \omega_{it} + \varepsilon_{it} \quad (1)$$

where i refers to the firm, and t refers to the year; y_{it} refers to the output, measured by the natural logarithm of firms' sales; l_{it} refers to the labor, measured by the logarithm of the total number of firm's employees; k_{it} refers to the capital, measured by the logarithm of firms' fixed assets; m_{it} refers to the intermediate inputs, measured by the logarithm of firms' current investment, according to the LP approach, and by the logarithm of firms' cash payments for acquiring assets, according to the OP approach, respectively. Term ω_{it} is the component affecting the relevant firm's input choice (following, for instance, Keller and Yeaple, 2009), and term ε_{it} is an error term. Then, firm TFP was computed using the following model:

$$TFP_{it} = y_{it} - a_l l_{it} - a_k k_{it} \quad (2)$$

The dependent variable *ESOP* measures whether firms adopt ESOPs. An *ESOP* takes a value of 1 for firms with ongoing ESOPs in year t, and 0 otherwise.

To mitigate the risk of getting biased coefficients referring to ESOPs and firm TFP due to omitted variables, this study followed prior research in referring to the factors that influence a firm's TFP; a set of control variables (*Controls*) has been included for firm characteristics. Specifically, we include firm size (*Size*), measured as the natural logarithm of the number of employees (Le et al., 2019; Schiffbauer et al., 2017; Tsou and Yang, 2019; Uras, 2014). Firm age (*Age*), measured as the natural logarithm of the number of years since the firm's establishment (Min and Smyth, 2014). Firm profitability (*ROA*) is measured as the ratio of net profit to total assets; growth rate (*Growth*) as the annual growth rate of revenue (Doerr et al., 2018), and financial leverage (*Leverage*) as the ratio of debt to total assets (Le et al., 2019; Uras, 2014). Asset tangibility (*Fixed*), is measured as the ratio of fixed to total assets (Kong et al., 2020), is also controlled. The term *SOE* denotes state ownership, and equals 1 if the firm is state-owned, and 0 otherwise (Kong et al., 2020). Lastly, all continuous variables are winsorised at the 1st and 99th percentiles, in order to avoid the influence of extreme observations.

To test Hypothesis 2a and Hypothesis 2b, two variables are employed to a denote firm's agency cost and R&D investment, respectively. Following previous research (Ang et al., 2000), the ratio of administrative fees to revenue is included, to measure agency cost (*Agency*), which in turn indicates the agency problem between a firm's shareholders

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Table 1. Definitions of main variables.

Variable	Definitions
ESOP	Equals 1 if the firm's ESOP is underway, and 0 otherwise
TFP_LP	The natural logarithm of TFP, calculated by the Levinsohn and Petrin method
TFP_OP	The natural logarithm of TFP, calculated by the Olley and Pakes method
Size	The natural logarithm of the number of employees
Age	The natural logarithm of the number of years since the firm was established
ROA	The ratio of net profit to total assets
Growth	The annual growth rate of revenue
Leverage	The ratio of debt to total assets
Fixed	The ratio of fixed assets to total assets
SOE	Equals 1 if the firm is state-owned, and 0 otherwise
Agency	The ratio of administrative fees to revenue
RDinvest	The ratio of R&D investment to fixed assets
ESOP_Share	The ratio of the shares in ongoing ESOPs to the firm's total shares
ESOP_Ex	The ratio of the proportion of executives' subscriptions in ongoing ESOPs
ESOP_Non	The ratio of the proportion of non-executive employees' subscriptions in ongoing ESOPs

and employees, and which might be affected by ESOPs. In addition, firm R&D investment (*RDinvest*) is measured as the ratio of a firm's investment in R&D activities to fixed assets.

Model specification

To analyse the impact of ESOPs on firms' TFP, the baseline model is constructed as follows:

$$TFP_{it} = \beta_0 + \beta_1 ESOP_{it} + \Sigma Controls_{it} + Firm\,effects_i + Year\,effects_t + \varepsilon_{it} \quad (3)$$

where i and t denote firm i at year t. The dependent variable, TFP_{it}, refers to TFP measurements of the firm. The independent variable is $ESOP_{it}$, which takes a value of 1 if the firm has an ESOP in year t, and 0 otherwise. Next, $Controls_{it}$ is the array of control variables mentioned above. Year fixed effects and firm fixed effects are also included. Standard errors are clustered by firm. All variables are defined in Table 1.

Empirical results

Descriptive statistics

Panel A of Table 2 presents the descriptive statistics for the main variables. One can note that roughly 10.3% of the firms had ESOPs in China during the 2012 to 2018 study period. During this time, *TFP_LP* had a mean (median) value of 8.335 (8.239), while *TFP_OP* had a mean (median) value of 4.145 (4.065).

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Panel B of Table 2 shows the descriptive statistics among firms with ESOPs and firms without. As is shown, firms working with ESOPs in place have relatively higher TFP than firms without ESOP. One can also find that firms with ESOPs are older, larger, and more likely to be non-SOEs.

Table 2, Panel C shows the industry distribution of the sample. The machinery industry has the most sample firms (3686 firm-year observations). All the industries have ESOPs, and the furniture industry has the highest proportion of firms with ESOPs (18.02%). Besides, in the electronics industry, the 'other manufacturing industry', and the information technology industry categories, the percentages of firms with ESOPs are all above 14%.

Table 2. Descriptive statistics of main variables.

Panel A: Descriptive statistics of sample firms.

Variable	N	Mean	St.Dev	Min	Median	Max
ESOP	17,401	0.103	0.303	0.000	0.000	1.000
TFP_LP	17,401	8.335	1.054	5.983	8.239	11.291
TFP_OP	17,401	4.145	0.736	2.653	4.065	6.254
Size	17,401	7.661	1.249	4.585	7.586	11.171
Age	17,401	1.966	0.923	0.000	2.079	3.178
ROA	17,401	0.034	0.060	−0.257	0.034	0.184
Growth	17,401	0.184	0.449	−0.574	0.107	2.885
Leverage	17,401	0.428	0.210	0.053	0.417	0.909
Fixed	17,401	0.215	0.163	0.000	0.182	0.929
SOE	17,401	0.352	0.478	0.000	0.000	1.000
Agency	17,401	0.106	0.077	0.014	0.088	0.392
RDinvest	17,401	0.212	0.537	0.000	0.068	3.980
ESOP_Share	17,401	0.002	0.010	0.000	0.000	0.659
ESOP_Ex	17,401	0.026	0.106	0.000	0.000	1.000
ESOP_Non	17,401	0.076	0.237	0.000	0.000	1.000

Panel B: Descriptive statistics of sample firms divided by ESOP.

Variable	Firms with ESOPs			Firms without ESOPs		
	Mean	Median	St.Dev	Mean	Median	St.Dev
TFP_LP	8.509	8.396	0.985	8.316	8.218	1.060
TFP_OP	4.186	4.091	0.727	4.140	4.061	0.737
Size	7.844	7.763	1.114	7.640	7.567	1.262
Age	1.996	1.946	0.714	1.962	2.197	0.944
ROA	0.033	0.038	0.065	0.034	0.033	0.059
Growth	0.242	0.163	0.417	0.177	0.101	0.452
Leverage	0.416	0.410	0.191	0.430	0.418	0.212
Fixed	0.176	0.152	0.129	0.220	0.185	0.166
SOE	0.122	0.000	0.327	0.378	0.000	0.485

(Continued)

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Table 2. (Continued)

Panel C: Sample distribution by industry.

Industry	N	Firms with ESOPs	Percentage
Agriculture	250	35	14.00%
Mining	462	34	7.36%
Food	697	78	11.19%
Apparel	421	54	12.83%
Furniture	111	20	18.02%
Printing	260	28	10.77%
Gas and chemistry	1658	172	10.37%
Electronic	1554	220	14.16%
Metal	1257	86	6.84%
Machinery	3686	391	10.61%
Medical products	1115	130	11.66%
Other manufacturing	99	14	14.14%
Energy supply	569	28	4.92%
Construction	448	54	12.05%
Retail	936	60	6.41%
Transportation	496	29	5.85%
Accommodation	48	3	6.25%
Information	1341	189	14.09%
Real estate	772	47	6.09%
Environment	245	23	9.39%
Other services	564	70	12.41%
Entertainment	278	17	6.12%
General	134	4	2.99%
Total	17401	1786	10.26%

Source: CSMAR database, Wind database.

Baseline regressions

This section presents the empirical results. One should note that all regressions include firm dummies across all specifications. While equation (3) includes an extensive set of variables that previous studies have found to affect a firm's TFP, the results of this study could potentially have been spurious if the baseline model omitted any variables that affect both employee ownership and firm TFP. Given this concern, a more convincing estimation strategy would include firm fixed effects in equation (3) to absorb firm-specific unobservable factors.

Table 3 reports the estimation results. In Columns (1) and (2), we regress firm TFP on the ESOP indicator without controlling variables. Both the coefficients of ESOP are significant at the 1% level. The baseline model is further re-estimated, controlling firm characteristics, and the results are reported in Columns (3) and (4). The coefficients of ESOP are 0.0599 and 0.0442, respectively, suggesting that ESOPs increase firm TFP by approximately 5.99% and 4.42%. The economic effects are similar to the results in prior

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Table 3. Impact of ESOPs on firm TFP.

Variable	(1)	(2)	(3)	(4)
	TFP_LP	*TFP_OP*	*TFP_LP*	*TFP_OP*
ESOP	0.1253*** (0.000)	0.0517*** (0.002)	0.0599*** (0.000)	0.0442*** (0.002)
Size			0.0697*** (0.000)	0.0415*** (0.006)
Age			0.3041*** (0.000)	0.0037 (0.832)
ROA			1.4911*** (0.000)	1.4432*** (0.000)
Growth			0.2368*** (0.000)	0.2169*** (0.000)
Leverage			0.5860*** (0.000)	0.4927*** (0.000)
Fixed			−1.3971*** (0.000)	−0.8405*** (0.000)
SOE			−0.0191 (0.768)	−0.0130 (0.828)
Constant	8.1276*** (0.000)	4.1434*** (0.000)	5.7285*** (0.000)	3.9500*** (0.000)
Firm effect	Yes	Yes	Yes	Yes
Year effect	Yes	Yes	Yes	Yes
N	17401	17401	17401	17401
Adj. R2	0.1699	0.0215	0.5037	0.2684

Note. *** denotes statistical significance at the 1% level.

research (Jones and Kato, 1995). Overall, these findings support this study's hypothesis that implementing ESOPs can promote enterprises' TFP, which is consistent with the relevant literature (Jones and Kato, 1995; Kim and Ouimet, 2014).

As can be seen, the estimates for the remaining variables are mostly significant with an expected sign. The significant coefficients of return on assets (*ROA*) are 1.4911 and 1.4432 and sales growth rate (*Growth*) are 0.2368 and 0.2169, suggesting that corporate financial performance is positively correlated with firm's productivity. Also, larger, older and more leveraged firms demonstrate a better productivity performance, which is consistent with Le et al. (2019). Nevertheless, the ratio of fixed assets is negatively associated with firm productivity. State ownership is not significantly associated with firm productivity, which is in line with Li (2020).

Mechanism analysis

This study concludes that ESOPs have a positive effect on firm TFP. Accordingly, we further consider the potential mechanisms through which ESOPs affect firm TFP. As discussed before, ESOPs might encourage firms to promote R&D activities and ease agency conflicts. These effects might be the channels through which ESOP increases firm productivity. This study selected *RDinvest* and *Agency* as the mediating variables and employed equations (4) and (5) for mechanism analysis:

$$RDinvest_{it}\left(Agency_{it}\right) = \theta_0 + \theta_1 ESOP_{it} + \Sigma Controls_{it} + Firm\,effects_i + Year\,effects_t + \varepsilon_{it} \quad (4)$$

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$$TFP_{it} = \varphi_0 + \varphi_1 ESOP_{it} + \varphi_2 RDinvest_{it}(Agency_{it}) + \Sigma Controls_{it} + Firm\,effects_i + Year\,effects_t + \varepsilon_{it} \quad (5)$$

where *RDinvest* represents the investment in R&D activities, and *Agency* represents the firm's agency cost. The definitions of these mediating variables were presented in Table 1.

Table 4 presents the regression results of the mechanism analysis. Taking R&D investment and agency cost as dependent variables, Columns (1) and (2) report the results of equation (4). The coefficient of *ESOP* to *RDinvest* is significantly positive, while the coefficient of *ESOP* to *Agency* is significantly negative. These findings indicate that a firm's ESOP can promote R&D investment and mitigate agency problems.

Then, based on equation (5), Columns (3) to (6) show the TFP regressions results, referring to the independent variable (*ESOP*) and the intermediary variables (*RDinvest* and *Agency*). The coefficients of *RDinvest* are significantly positive, while the coefficients of *Agency* are significantly negative, indicating that both R&D investment and agency cost mediate the influence of ESOPs on firm TFP. Also, the coefficients of *ESOP* in Columns (3) to (6) are relatively smaller than those in the baseline regressions, illustrating the sizes of the mediating effects. We further test these mediating effects through the Sobel approach, the Sobel's Z-statistics presented in Table 4 are significant, suggesting the mediating effects are statistically significant. These findings imply that both the promotion of R&D investment and the reduction in agency cost are conducive to improving firm TFP, which supports Hypothesis 2a and Hypothesis 2b.

Moderation analysis

To test Hypothesis 3a and Hypothesis 3b, we formulate equation (6) and examine the moderating effect of state ownership and firm size on the relationship between ESOP and firm TFP.

$$TFP_{it} = \alpha_0 + \delta_1 ESOP_{it} + \delta_2 ESOP_{it} \times SOE_{it}(Size_{it}) + \Sigma Controls_{it} + Firm\,effects_i + Year\,effects_t + \varepsilon_{it} \quad (6)$$

where *SOE* represents state ownership, which equals 1 if the firm is state-owned, and 0 otherwise; *Size* represents the degree of the severity of the free-riding problem, which equals the natural logarithm of the number of employees.

Table 5 presents the regression results of the moderation analysis. In Columns (1) and (2), we target the interaction variable of *ESOP*×*SOE*. The negative coefficients of *ESOP*×*SOE* are both significant. Therefore, for state-owned enterprises, the promoting effect of ESOP on TFP is significantly hindered. In Columns (3) and (4), the interaction variable of *ESOP*×*Size* is emphasised. The coefficients of *ESOP*×*Size* are significantly negative, indicating that, for a large number of employee firms where the free-riding problem is more prevalent, the positive impact of ESOP on firm TFP is stymied.

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Table 4. Mediating effects of firms' agency costs and R&D investment.

Variable	(1)	(2)	(3)	(4)	(5)	(6)
	RDinvest	*Agency*	*TFP_LP*	*TFP_OP*	*TFP_LP*	*TFP_OP*
ESOP	0.0396** (0.025)	−0.0030* (0.084)	0.0532*** (0.000)	0.0418*** (0.004)	0.0458*** (0.000)	0.0303*** (0.008)
RDinvest			0.1701*** (0.000)	0.0609*** (0.002)		
Agency					−4.7624*** (0.000)	−4.6663*** (0.000)
Size	−0.0427** (0.017)	0.0049*** (0.005)	0.0769*** (0.000)	0.0441*** (0.003)	0.0931*** (0.000)	0.0645*** (0.000)
Age	−0.0081 (0.616)	−0.0093*** (0.000)	0.3054*** (0.000)	0.0042 (0.811)	0.2598*** (0.000)	−0.0396*** (0.003)
ROA	0.0192 (0.856)	−0.2368*** (0.000)	1.4878*** (0.000)	1.4421*** (0.000)	0.3636*** (0.000)	0.3385*** (0.000)
Growth	0.0038 (0.660)	−0.0204*** (0.000)	0.2362*** (0.000)	0.2166*** (0.000)	0.1398*** (0.000)	0.1218*** (0.000)
Leverage	−0.1133** (0.046)	−0.0257*** (0.001)	0.6052*** (0.000)	0.4996*** (0.000)	0.4637*** (0.000)	0.3730*** (0.000)
Fixed	−1.0033*** (0.000)	0.0152* (0.086)	−1.2264*** (0.000)	−0.7794*** (0.000)	−1.3246*** (0.000)	−0.7695*** (0.000)
SOE	0.0011 (0.979)	−0.0066 (0.290)	−0.0192 (0.762)	−0.0130 (0.826)	−0.0503 (0.319)	−0.0436 (0.336)
Constant	0.5754*** (0.000)	0.1840*** (0.000)	5.6307*** (0.000)	3.9150*** (0.000)	6.6048*** (0.000)	4.8086*** (0.000)
Firm effect	Yes	Yes	Yes	Yes	Yes	Yes
Year effect	Yes	Yes	Yes	Yes	Yes	Yes
N	17401	17401	17401	17401	17401	17401
Adj. R2	0.0633	0.2022	0.5197	0.2720	0.6645	0.5432
Sobel Z			3.414	3.198	2.292	2.293

Note. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 5. Moderation analysis.

Variable	(1)	(2)	(3)	(4)
	TFP_LP	*TFP_OP*	*TFP_LP*	*TFP_OP*
ESOP	0.0735*** (0.000)	0.0528*** (0.000)	0.1752** (0.013)	0.2202*** (0.001)
ESOP×SOE	−0.1054*** (0.000)	−0.0669** (0.013)		
ESOP×Size			−0.0146* (0.099)	−0.0223*** (0.006)
Size	0.0660*** (0.000)	0.0392*** (0.000)	0.0680*** (0.000)	0.0389*** (0.000)
Age	0.3041*** (0.000)	0.0038 (0.512)	0.3057*** (0.000)	0.0062 (0.289)
ROA	1.4909*** (0.000)	1.4431*** (0.000)	1.4935*** (0.000)	1.4470*** (0.000)
Growth	0.2371*** (0.000)	0.2170*** (0.000)	0.2367*** (0.000)	0.2166*** (0.000)
Leverage	0.5839*** (0.000)	0.4914*** (0.000)	0.5865*** (0.000)	0.4936*** (0.000)
Fixed	−1.3976*** (0.000)	−0.8408*** (0.000)	−1.3968*** (0.000)	−0.8401*** (0.000)
SOE	−0.0086 (0.739)	−0.0063 (0.787)	−0.0182 (0.478)	−0.0116 (0.618)
Constant	5.7304*** (0.000)	3.9512*** (0.000)	5.7182*** (0.000)	3.9343*** (0.000)
Year effect	Yes	Yes	Yes	Yes
Firm effect	Yes	Yes	Yes	Yes
N	17401	17401	17401	17401
Adj. R2	0.3879	0.0973	0.3875	0.0974

Note. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Who is motivated? Executives versus rank-and-file

When a firm adopts an ESOP, both executives and non-executives are potentially included in the plan and are then motivated to work. However, the shareholding proportion of executives and non-executives may lead to differences in the impact of ESOPs on firm performance (Feng et al., 2022). Previous studies have maintained that the rank-and-file (namely non-executive) employees should not be marginalised, and that non-executive ownership plays an important role in mitigating agency conflicts and curbing managerial risk-taking (Faleye et al., 2006; Chen et al., 2020). Thus, this study expects that non-employee ownership in ESOPs positively relates to the impact of ESOPs on firm TFP.

We then tested the effect of the differences in ESOP participants on the association between ESOPs and firm TFP. In firms' existing ESOPs, this study employed variables *ESOP_Ex*, which measured the proportion of executive subscriptions, and *ESOP_Non*, which measured the proportion of non-executive subscriptions in existing ESOPs. The regression model is as follows:

$$TFP_{it} = \alpha_0 + \alpha_1 ESOP\_Ex_{it} + \alpha_1 ESOP\_Non_{it} + \Sigma Controls + Firm\,effects_i + Year\,effects_t + \varepsilon_{it} \quad (7)$$

where *ESOP_Ex* represents the proportion of executive subscriptions, and *ESOP_Non* represents the proportion of non-executive subscriptions.

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Table 6. Effects of subscription proportion of executives (non-executives).

Variable	(1)	(2)
	TFP_LP	*TFP_OP*
ESOP_Ex	0.0459 (0.369)	0.0149 (0.779)
ESOP_Non	0.0723*** (0.001)	0.0637*** (0.004)
Size	0.0697*** (0.000)	0.0414*** (0.006)
Age	0.3040*** (0.000)	0.0035 (0.841)
ROA	1.4900*** (0.000)	1.4419*** (0.000)
Growth	0.2369*** (0.000)	0.2169*** (0.000)
Leverage	0.5863*** (0.000)	0.4928*** (0.000)
Fixed	−1.3973*** (0.000)	−0.8409*** (0.000)
SOE	−0.0181 (0.779)	−0.0125 (0.834)
Constant	5.7282*** (0.000)	3.9517*** (0.000)
Year effect	Yes	Yes
Firm effect	Yes	Yes
N	17401	17401
Adj. R2	0.5038	0.2686

Note. *** denotes statistical significance at the 1% level.

As reported in Table 6, the coefficients of *ESOP_Non* are significant at the 1% level, while the coefficients of *ESOP_Ex* are insignificant. These results imply that the ownership of non-executive employees is the determinant of the impact of ESOPs on firm TFP. This finding supports the idea that non-executives are highly motivated by ESOPs.

Robustness checks

The first concern with this study's baseline regressions is that the particular ESOP may not be exogenous. To address this endogeneity concern, we used the 2SLS instrumental variable framework. According to Jiang et al. (2017), a common practice is to use the category average of the independent variable, where the category seems likely to represent the corporation. We use the province–year proportion of other firms having ESOPs in the same province in the previous year (denoted *ESOP_Neighbour*) as our instrumental variable. A valid instrument must meet two criteria: a strong correlation with the instrumented regressors and orthogonality with the error term. First, due to the close geographical distance between enterprises in the province, imitation behaviour exists in equity grants (Kedia and Rajgopal, 2009) and the implementation of the ESOP by neighbouring enterprises. Therefore, variable *ESOP_Neighbour* might be significantly related to *ESOP*. Second, ESOPs of other local enterprises do not directly affect the TFP of the enterprise itself. Thus, this instrument variable can capture the probability of implementing the ESOPs but is unlikely to correlate with firms' unobserved factors.

We regressed ESOP on the instrument and the controlling variables from the baseline model. The results are documented in Table 7. In Column (1), the estimated coefficient of *ESOP_Neighbour* is significant at the 1% level. Moreover, the F-statistic equals 48.07,

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Table 7. Robustness checks.

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	ESOP	*TFP_LP*	*TFP_OP*	*TFP_LP*	*TFP_OP*	*TFP_LP_L*	*TFP_OP_L*	*TFP_LP*	*TFP_OP*
ESOP		0.6922***	0.5133***	0.0611**	0.0607**	0.0510***	0.0345**		
		0.001)	0.004)	0.019)	0.014)	0.001)	0.020)		
ESOP_Share								0.7699***	0.7780***
								0.001)	0.000)
ESOP_Neighbour	0.4711***								
	(0.000)								
Size	0.1123***	−0.0127	−0.0190	0.0584	0.0289	0.0969***	0.0766***	0.0749***	0.0450***
	(0.000)	0.649)	0.440)	0.221)	0.501)	0.000)	0.000)	0.000)	0.003)
Age	0.0469***	0.2699***	−0.0199*	0.2374***	−0.0789*	0.3127***	0.0018	0.3066***	0.0055
	(0.000)	0.000)	0.070)	0.000)	0.073)	0.000)	0.912)	0.000)	0.754)
ROA	−0.1144**	1.4346***	1.3975***	0.7723***	0.9004***	1.7002***	1.5245***	1.4830***	1.4370***
	0.033)	0.000)	0.000)	0.000)	0.000)	0.000)	0.000)	0.000)	0.000)
Growth	−0.0068	0.2425***	0.2227***	0.1895***	0.1964***	0.2537***	0.2148***	0.2365***	0.2167***
	0.128)	0.000)	0.000)	0.000)	0.000)	0.000)	0.000)	0.000)	0.000)
Leverage	−0.0511	0.5861***	0.4792***	0.5123***	0.4472***	0.5453***	0.4552***	0.5825***	0.4897***
	0.121)	0.000)	0.000)	0.000)	0.000)	0.000)	0.000)	0.000)	0.000)
Fixed	−0.0748*	−1.3219***	−0.7707***	−1.5056***	−0.9752***	−1.3606***	−0.8186***	−1.4006***	−0.8428***
	0.074)	0.000)	0.000)	0.000)	0.000)	0.000)	0.000)	0.000)	0.000)
SOE	−0.0487	0.0079	0.0091	−0.0107	0.0188	−0.0189	−0.0239	−0.0215	−0.0148
	0.153)	0.816)	0.759)	0.837)	0.715)	0.773)	0.685)	0.740)	0.806)
Constant	−0.4815***	6.1168***	4.1877***	6.5807***	4.6437***	5.6183***	3.9242***	5.7050***	3.9342***
	0.000)	0.000)	0.000)	0.000)	0.000)	0.000)	0.000)	0.000)	0.000)
Firm effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	15339	15339	15339	3570	3570	17273	17394	17401	17401
Adj. R^2	0.1552	0.3657	0.1465	0.4849	0.2832	0.4508	0.4827	0.5029	0.2679

Note. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 8. Covariate checks in PSM samples.

Variable	Sample	Mean		*t*-test	
		Treat	Control	*t*	$p > \|t\|$
Size	Unmatched	1.9962	1.9806	0.67	0.501
	Matched	1.9956	1.9990	−0.13	0.900
Age	Unmatched	7.8444	7.6510	6.18	0.000
	Matched	7.8425	7.8904	−1.22	0.223
ROA	Unmatched	0.0334	0.0338	−0.26	0.794
	Matched	0.0334	0.0339	−0.22	0.823
Growth	Unmatched	0.2417	0.1787	5.50	0.000
	Matched	0.2418	0.2555	−0.87	0.385
Leverage	Unmatched	0.4160	0.4290	−2.48	0.013
	Matched	0.4158	0.4228	−1.07	0.285
Fixed	Unmatched	0.1759	0.2178	−10.29	0.000
	Matched	0.1760	0.1743	0.38	0.703
SOE	Unmatched	0.1215	0.3761	−21.57	0.000
	Matched	0.1216	0.1216	0.00	1.000

suggesting that the instrument variable does not suffer from weak identification concerns (Staiger and Stock, 1997). Columns (2) and (3) in Table 7 report the results of the second stage of the 2SLS estimation. The estimated coefficients of *ESOP* are both significantly positive, implying that this study's main findings are robust to the application of the 2SLS method.

Second, as shown in Panel B of Table 2, the sample firms with and without ESOPs are unbalanced. Hence, the heterogeneity in a firm's characteristics may cause selection problems in the baseline estimates. Therefore, a propensity score matching (PSM) approach was used to address the selection bias.

Specifically, the probability of having an ESOP was estimated by running a Probit model to match each ESOP firm with a control non-ESOP firm, using a one-to-one nearest neighbour. The matching variables are the control variables mentioned above, along with the year fixed effect. To confirm that the matched sample is balanced, Table 8 presents the results of the covariate balance checks by testing the differences between ESOP firms and non-ESOP firms in the matched sample. The results indicate that the differences in the firm characteristics in the matched sample are not significant. We then re-estimated the baseline model in the matched sample. In Columns (4) and (5) of Table 7, the coefficients of *ESOP* are significantly positive. In addition, the magnitude of the coefficients for *ESOP* does not significantly change from those in the baseline regressions, indicating that the main findings are robust after considering the self-selection problem.

Third, there is a concern that the impact of ESOPs on firm TFP might be lagged. To ease this concern, this study employed two alternative dependent variables, *TFP_LP_L* and *TFP_OP_L*, measured as one-year-lagged *TFP_LP* and *TFP_OP*, respectively. Then, the baseline model was re-estimated using lagged firms' TFP indicators. The

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regression results are reported in Columns (6) and (7) of Table 7. As the results show, the coefficients of *ESOP* remain significantly positive, and the values of the coefficients are slightly smaller than those in the baseline regressions, indicating that the positive effect of ESOPs on firm TFP is still robust.

Lastly, we also report results when the alternative measure of ESOP is used. This study uses the ratio of subscribed shares in ongoing ESOPs to firm's total shares, denoted as *ESOP_Share*. This quantitative measure can reflect the employees' participation in ESOPs. As the results reported in Columns (8) and (9) of Table 7 show, the coefficients of *ESOP_Share* remain significantly positively.

Conclusion

Boosting firm productivity has been a crucial issue, both in practice and theory, especially for firms in emerging markets. How to best design an incentive mechanism to facilitate a firm's productivity has been argued for decades. China's economy benefited from opening-up market-oriented system reform and the profit-sharing policy in the reform. However, ESOP, a typical form of profit sharing and employee incentive, did not formally develop in Chinese firms until recent years. Little literature exists about the role of employee ownership in the productivity of China's firms. Therefore, this paper tries to fill this gap and provide direction to enterprises in emerging capital markets.

Using a large sample of Chinese firms, we estimate the impact of ESOPs on firm productivity, as proxied by TFP. The empirical results suggest that ESOPs significantly improve firms' TFP, and the economic effects are similar to prior research (Jones and Kato, 1995). Then, we find that this increase in firm TFP is achieved by increasing R&D investment and mitigating agency costs. These results concur with previous research by confirming the role of ESOP in promoting innovation activities (Kruse and Blasi, 1995) and enhancing employees' interest alignment (Jones and Kato, 1995). We also find that the positive effect of ESOPs on TFP is more pronounced in privately-owned firms. Besides, firms with fewer employees face smaller free-riding problems, hence the improvement of their ESOPs on firm TFP is more pronounced. Moreover, further analysis shows that the effect on firm TFP is positively related to the subscription proportion of non-executive employees in ESOPs.

In summary, our findings complement the current body of literature by identifying new channels through which ESOPs improve firm productivity. Specifically, ESOPs in Chinese firms improve productivity by promoting R&D investment and mitigating agency costs. Hence, firm managers in China should realise that ESOP is an effective incentive tool to stimulate production efficiency. Of particular note is that the improvement in firm productivity is weakened in certain conditions, such as state-owned property and serious free-riding problems, and the power of this employee incentive is diluted.

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