

An empirical study of the relationship between management equity incentives and enterprise performance in the manufacturing industry

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Abstract: Based on the optimal contract theory, we explore the impact of management equity incentives on the enterprise performance of the manufacturing industry utilizing Shanghai and Shenzhen A-share listed companies in China's manufacturing industry from 2014 to 2021 as the study object. The findings demonstrate that management equity incentives can significantly improve enterprise performance in the manufacturing industry, with the effect being stronger in traditional than in high-tech manufacturing. The results of the pathway study show that: from the perspective of "open source", management equity incentives may help a company's operating income increase; from the perspective of "cost reduction", equity incentives can lessen the damage to shareholders' interests and enterprise value caused by management's moral hazard behavior, and reduce agency costs; both of which can achieve the purpose of enhancing enterprise performance.

Keywords: management equity incentives; agency costs; operating income; enterprise performance; mediating effects

1. Introduction

In the modern institutional environment where ownership and management are separated, there is a more serious information asymmetry problem between shareholders and management. When the objective functions of management and shareholders do not coincide, an agency conflict will arise, and according to the rational economic man hypothesis, management is selfish, and they may make decisions that are detrimental to shareholders' interests and long-term enterprise development for their self-interest. To mitigate this conflict, the equity incentive system was created. An equity incentive is a system that shares the residual value of a company with its shareholders by granting a portion of the equity with conditions to the incentive recipient. When given equity, management's utility function converges with shareholders', theoretically incentivizing management to put up extra effort to raise enterprise value. Do equity incentives, therefore, have the desired outcome? According to some academics, equity incentives can link the interests of shareholders and executives, encourage the sharing of rewards and risks, reduce the direct agency costs between managers and shareholders, and indirectly support the improvement of enterprise performance [1, 2]. However, some researchers also contend that the equity incentive programs of listed companies have welfare effects and that executives have abused their positions of authority and self-interest to harm shareholders' rights [3, 4, 5]. Moreover, some scholars believe that there is no significant change in enterprise performance before and after the implementation of equity incentives in listed companies [6]. And all these views are supported to some extent by empirical experience [2].

This paper suggests that the reasons for the above inconsistent findings may be related to the different industry heterogeneity of the research subjects and the choice of empirical methods. Most of the studies on equity incentives are conducted on listed companies as a whole, but there are very few industry-specific studies, which may make the research results noisy. Since the real economy is the foundation and lifeblood of national and regional economies, and the manufacturing industry is the core part of the real economy, which is an important support to build the strategic advantage of future economic development, this paper selects manufacturing enterprises in Shanghai and Shenzhen

A-shares as the research object to investigate the effective incentive of human capital. Specifically, this study attempts to answer the following questions to better understand the effect of the implementation of management equity incentives in the manufacturing industry: Firstly, can equity incentives improve the performance of manufacturing enterprises under the environment of continuous improvement of enterprise governance mechanisms and external regulatory regulations? Secondly, most of the existing studies analyze the relationship between management equity incentives and enterprise performance from the perspective of agency costs, but this paper further explores the path of its effect based on this study to investigate whether equity incentives can influence enterprise operating income to improve enterprise performance.

2. Theoretical analysis and research hypothesis

2.1 Management equity incentives and enterprise performance in the manufacturing industry

With the development of the economy, the competition among enterprises becomes more and more intense, and to improve the level of specialization and economy, as well as diversify risks, enterprise owners will hire professional managers in the market to run the company, forming a state of separation between ownership and operation rights. Faced with the agency problem caused by the separation of the two rights, modern enterprises choose the equity incentive system in enterprise governance, so that the management receives a portion of the shareholders' rights and interests, and the management completes the transformation of wage earners' identities to enterprise owners, which motivates them to work hard to create enterprise value to some extent.

To summarize, management equity incentives enhance enterprise performance in the following ways: First, equity incentives can reduce the direct damage to shareholders' interests and enterprise value triggered by management's moral hazard behavior [7, 8]. Second, equity incentives alleviate management's risk aversion and short-sighted behavior to some extent, and management will pay more attention to the firm's long-term value enhancement and invest in project decisions that have some risk but can increase the firm's value [9, 10]. Third, the dynamic compensation and deferred payment features of equity incentives can play the role of "golden handcuffs", which not only reduce the management turnover rate but also attract some risk-averse talents, which is crucial to the development of enterprise sustainability [11, 12]. Based on the above analysis, this paper proposes the following hypotheses.

H1. The implementation of management equity incentives can significantly improve the performance of manufacturing firms.

2.2 Management equity incentives, agency costs, and enterprise performance

In the context of optimal contract theory, equity incentives are the result of a game between management and shareholders, and as an alternative means to directly supervise management, equity incentives can effectively correct management alienation behavior by increasing the private cost of management's moral hazard behavior. Specifically, equity incentives can not only reduce the level of management on-the-job consumption, especially the excess on-the-job consumption, and improve the operational efficiency of the firm [13], but also discourage management from initiating malicious mergers and acquisitions that are detrimental to shareholders' interests and enterprise value for private gain [14, 15]. In addition, the synergy of interests between management and shareholders created by equity incentives can also reduce accounting information manipulation such as management financial restatements, and optimize the quality of accounting surplus [16]. Equity incentives successfully transform shareholders' monitoring of management into management's self-restraint, which reduces management's moral hazard behavior to a certain extent and reduces agency costs between management and shareholders. Jensen and Meckling (1976) pioneered a study on the relationship between equity incentives and the principal-agent problem of modern enterprises and found that under the hypothesis of optimal contract theory, equity incentives can effectively alleviate the conflict of interest between shareholders and management, reduce agency costs and improve corporate performance [1]. Qu and Zhu (2017) defined the agency cost caused by moral hazard behavior of management as explicit agency cost and found that equity incentives exerted a governance effect on enterprise performance by reducing explicit agency cost, using a sample of A-share listed companies in Shanghai and Shenzhen from 2006 to 2015 [17]. Similarly, Wan (2021) finds that equity incentives significantly improve enterprise performance and suppress the growth of agency costs, and that agency

costs partially mediate the effect of equity incentives on enterprise performance. Accordingly, this paper proposes the following hypotheses. Accordingly, this paper proposes the following hypothesis [2].

H2. Management equity incentives in manufacturing firms can suppress agency costs and thus improve enterprise performance, in which agency costs play a mediating effect.

2.3 Management equity incentives, operating income, and enterprise performance

For the manufacturing industry, the sales of products directly affect the business income of the enterprise, and the business income of the enterprise indicates the realization of the value of goods, which is the prerequisite for maintaining continuous operation and profitability, and is also an important source of funds for further development and growth of the enterprise. The equity incentive system makes the talent of management more closely related to the compensation they receive, and in theory, management will try to make the enterprise "cake" bigger. Aboody and Kasznik (2010) compared firms with and without equity incentives and found that appropriate equity incentives led to significantly higher growth in operating profit and cash flow than firms without equity incentives [18]. Fabrizi (2014) found that equity incentives for chief marketing officers in charge of marketing operations induce them to make value-maximizing marketing investments that contribute to firm value [19].

On the other hand, management will actively broaden the sources of income by accepting more projects that carry some risk but are beneficial to the business. Since management's human capital is dedicated and their wealth is firmly tied to the company they work for, they are less able to diversify investment risks than shareholders, which makes them more likely to choose conservative projects to avoid risks. To a certain extent, the implementation of equity incentives for management can make them focus less on the immediate short-term interests and more on the long-term value enhancement of the company. For example, the management may pay more attention to the R&D and innovation investment of the company, although in the short term, R&D and innovation activities mean higher cost and resource consumption, the R&D activities are in line with the long-term strategic development of the company, which can form the core competitiveness of the company, and the transformation of R&D results can help the company to gain more market share and bring the growth of the company's business income [20, 21]. In summary, this paper proposes the following hypothesis:

H3. Management equity incentives in manufacturing firms can promote the growth of enterprise operating income and thus improve enterprise performance, in which operating income plays a mediating effect.

3. Study design

3.1 Sample selection and data sources

This paper selects the data of manufacturing companies listed in Shanghai and Shenzhen A-shares from 2014-2021 as the overall sample and refers to Shao (2020) [22] to classify chemical fiber manufacturing; chemical raw materials and chemical products manufacturing; computer, communication, and other electronic equipment manufacturing; pharmaceutical manufacturing and instrumentation manufacturing as high-tech manufacturing industries according to the Conditions for the Identification of High-tech Enterprises, and the rest as Traditional manufacturing industry. The relevant data are obtained from the Guotaian database (CSMAR), and the data not queried are obtained manually by reviewing the company's annual reports, and the required annual reports are queried by the official website of Juchao Information Network. To ensure the validity of the sample data, the sample companies are processed as follows: (1) exclude ST and *ST manufacturing companies; (2) exclude listed companies with missing continuous data from 2014-2021 to obtain balanced panel data; (3) exclude companies with significant omissions in data. To eliminate the possible influence of extreme values on the study findings, this paper also does tailoring on continuous variables at the 1% and 99% levels. Finally, 1195 companies with 9560 valid observations were obtained. The raw data collected were organized by EXCEL, and the data were analyzed by using STATA 16.0 statistical econometric software.

3.2 Variable definition

3.2.1 Explanatory variable: enterprise performance

Return on net assets is an important indicator of enterprise operating performance, reflecting shareholders' return on investment. To eliminate possible measurement errors caused by nonrecurring gains and losses on enterprise performance, this paper uses the weighted average return on net assets, net of nonrecurring gains and losses, as a proxy variable for enterprise performance.

3.2.2 Explanatory variables: management equity incentives

While previous studies have more often used dummy variables to measure equity incentives, in recent years, more and more scholars have used the management shareholding ratio as its measure [23]. This paper draws on Qu and Zhu (2017) et al [17] and also defines management as the directors, supervisors, and senior managers announced in the annual reports of listed companies based on the definition of the scope of management in the Company Law, and uses the share of management shareholding in the total number of shares of the enterprise as a measure of management equity incentives.

3.2.3 Intermediary variables: agency costs and operating income

Given that the management expense ratio can better reflect the agency costs triggered by managers' moral hazard behaviors, this paper will refer to most studies [2][17] and choose the management expense ratio as a proxy variable for this indicator.

Due to the differences in scale and other differences between enterprises, the total operating income varies greatly and lacks comparability, so this paper uses the operating income growth rate index to measure.

3.2.4 Control variables. details of the control variable selection are shown in Table 1

Table 1: Definition of variables

Variable category	Variable name	Variable symbol	Definition
Explained variable	Enterprise performance	ROE	Weighted average return on net assets, net of non-recurring gains and losses
		ROA	Net profit / Average total assets
Explanatory variable	Management Equity Incentives	MSR	Number of shares held by management/total number of shares
Intermediary variables	Agency Costs	AC	Administrative expenses/operating income
	Operating income growth rate	Growth	Increase in operating income for the year / Operating income for the previous year
Control variables	Company Size	Size	The logarithm of total enterprise assets
	Shareholding Concentration	Top3	The shareholding ratio of the top three shareholders
	Gearing ratio	Lev	Total liabilities/total assets
	Institutional investors' shareholding ratio	Inst	Number of shares held by institutional investors/total number of shares
	Nature of business	State	1 for state-owned enterprises, 0 for non-state-owned enterprises
	Independent Directors	Outdir	Number of independent directors/number of board of directors
	Two jobs in one	Dual	1 for both chairman and general manager, 0 otherwise
Time effect	Year	7annual dummy variables were set for 8 study years	

3.3 Model construction

To test hypothesis 1, model I is constructed:

$$\text{Model I } ROE_{i,t} = \alpha_0 + \alpha_1 MSR_{i,t} + \alpha Controls_{i,t} + \delta_{i,t}$$

To test hypotheses 2 and 3, the following model is constructed in this paper, drawing on the mediation effects testing procedure used by Baron and Kenny (1986) [24] and Wen and Ye (2014) [25]:

$$\text{Model II(A) } AC_{i,t} = \alpha_0 + \alpha_1 MSR_{i,t} + \alpha Controls_{i,t} + \delta_{i,t}$$

$$\text{Model II(B) } Growth_{i,t} = \alpha_0 + \alpha_1 MSR_{i,t} + \alpha Controls_{i,t} + \delta_{i,t}$$

$$\text{Model III(A) } ROE_{i,t} = \alpha_0 + \alpha_1 MSR_{i,t} + AC_{i,t} + \alpha Controls_{i,t} + \delta_{i,t}$$

$$\text{Model III(B) } ROE_{i,t} = \alpha_0 + \alpha_1 MSR_{i,t} + Growth_{i,t} + \alpha Controls_{i,t} + \delta_{i,t}$$

4. Empirical tests and analysis of results

4.1 Descriptive statistical analysis

Table 2: Descriptive statistics of the main variables

Variables	Observed values	Average value	Median	Standard deviation	Minimum value	Maximum value
ROE	9560	0.051	0.053	0.107	-0.432	0.318
MSR	9560	0.124	0.014	0.176	0	0.648
AC	9560	0.085	0.073	0.054	0.011	0.311
Growth	9560	0.154	0.109	0.305	-0.438	1.678
Size	9560	22.35	22.20	1.163	20.18	25.86
Top3	9560	0.459	0.453	0.144	0.169	0.820
Lev	9560	0.397	0.393	0.1777	0.063	0.788
Inst	9560	0.412	0.434	0.238	0.003	0.878
State	9560	0.315	0	0.465	0	1
Outdir	9560	0.376	0.333	0.054	0.333	0.571
Dual	9560	0.722	1	0.448	0	1

Table 3: Test for differences in sample means

Variable Name	Traditional Manufacturing			High-tech manufacturing			Coefficient of variation
	Sample size	Average value	Median	Sample size	Average value	Median	
ROE	5904	0.047	0.049	3656	0.057	0.059	-0.010**
MSR	5904	0.121	0.010	3656	0.128	0.020	-0.007**
AC	5904	0.078	0.069	3656	0.096	0.082	-0.018***
Growth	5904	0.143	0.101	3656	0.172	0.120	-0.029***
Size	5904	22.43	22.257	3656	22.22	22.127	0.209***
Top3	5904	0.473	0.468	3656	0.437	0.431	0.036***
Lev	5904	0.422	0.418	3656	0.357	0.344	0.065***
Inst	5904	0.428	0.450	3656	0.386	0.407	0.041***
State	5904	0.324	0	3656	0.302	0	0.022**
Outdir	5904	0.374	0.333	3656	0.378	0.364	-0.004***
Dual	5904	0.731	1	3656	0.707	1	0.024**

Note: *, **, *** represent significant at the 10%, 5%, 1% levels, respectively.

The specific results of the descriptive statistical analysis on the screened data are shown in Table 2, the range of enterprise performance (ROE) is between -0.432 to 0.318, the standard deviation is 0.107, and the sample dispersion is high, indicating that the overall performance level of listed companies in the manufacturing industry varies greatly. The minimum value of management shareholding is 0 and the maximum value is 64.8%. The degree of equity incentive varies greatly among enterprises, with a mean value of 12.4% and the median value of only 1.4%, indicating that the majority of enterprises' management shareholding is still at a low level. The mean value of the agency cost of the intermediary variable is 0.085, and the standard deviation is 0.054, which is not much different among enterprises. The operational income growth rate is 15.4% on average, with a standard deviation of 0.305. The sample is highly discrete, and the level of operating income varies widely among enterprises. Table 3 reports the difference test of the mean values of the sub-samples of the traditional manufacturing

industry and the high-tech manufacturing industry. The table intuitively shows that there are considerable disparities in the values of each index of the traditional manufacturing industry and the high-tech manufacturing industry, thus sub-sample regression is required to investigate the influence of equity incentives for the two types.

4.2 Correlation analysis

According to Table 4, the correlation coefficients between enterprise performance (ROE) and management equity incentives (MSR), and operating revenue growth (Growth) are significantly positive, while the correlation coefficient with agency costs (AC) is significantly negative, and the correlation coefficient between management equity incentives (MSR) and operating revenue growth (Growth) is significantly positive. These initially confirm some of the previous hypotheses. However, the correlation coefficient between agency cost (AC) and management equity incentive (MSR) is positive, which is not consistent with the previous hypothesis, and further regression models are required to test the relationship between them. The main control variables show a more significant correlation with enterprise performance, indicating that the selection of control variables in this paper is effective. There are no significant cointegration issues among the variables in the regression model, according to the absolute values of the correlation coefficients for the variables in the table. To further verify whether there is multicollinearity among the variables, this paper uses the variance inflation factor(VIF) to test, where the maximum value of VIF is 4.64 and the mean value is 1.92, which is much smaller than 10, further excluding the possibility of multicollinearity among the variables.

Table 4: Correlation coefficients of variables

	ROE	MSR	AC	Growth	Size	Top3	Lev	Inst	State	Outdir	Dual
ROE	1										
MSR	0.067 ***	1									
AC	-0.226 ***	0.164 ***	1								
Growth	0.286 ***	0.075 ***	-0.083 ***	1							
Size	0.131 ***	-0.316 ***	-0.380 ***	0.053 ***	1						
Top3	0.174 ***	0.036 ***	-0.056 ***	0.029 ***	0.125 ***	1					
Lev	-0.209 ***	-0.249 ***	-0.297 ***	0.025 **	0.520 ***	-0.006	1				
Inst	0.164 ***	-0.655 ***	-0.176 ***	0.024 **	0.413 ***	0.550 ***	0.191 ***	1			
State	-0.060 ***	-0.444 ***	-0.129 ***	-0.070 ***	0.313 ***	0.103 ***	0.242 ***	0.401 ***	1		
Outdir	-0.031 ***	0.060 ***	0.049 ***	-0.006	0.005	0.049 ***	0.009	-0.053 ***	-0.019 *	1	
Dual	-0.004	-0.216 ***	-0.107 ***	-0.028 ***	0.123 ***	-0.00600	0.072 ***	0.176 ***	0.260 ***	-0.110 ***	1

Note: *, **, *** represent significant at the 10%, 5%, 1% levels, respectively.

4.3 Regression results and analysis

The F-test, LM-test, and Hausman test were performed on all models, and the fixed-effects model was chosen based on the results. The regression results of Model 1 in Table 5 show that the coefficient of management equity incentives (MSR) for manufacturing enterprises is significantly positive ($\alpha=0.157, p<0.01$), indicating that the implementation of equity incentives for the management of manufacturing enterprises can significantly improve the performance of enterprises, and the stronger the implementation, the higher the performance level and hypothesis 1 is supported by the data. The regression coefficient of agency cost in Model II (A) is significantly negative ($\alpha = -0.015, P < 0.01$), indicating that implementing equity incentives can significantly reduce the agency cost caused by management's moral hazard behavior, and the stronger the incentive, the lower the agency cost. The regression results are shown in Mode III(A), where the regression coefficient of agency cost (AC) and

enterprise performance (ROE) is significantly negative ($\alpha=-0.846$, $p<0.01$), indicating that agency cost has a certain inhibitory effect on enterprise performance; the regression coefficient of management equity incentive (MSR) and enterprise performance. The regression coefficient of MSR is still significantly positive, and the value of MSR coefficient decreases from 0.157 to 0.144 compared to the model I. In addition, the inclusion of agency cost variables improves the overall explanatory power of the model. The findings imply that equity incentives for manufacturing executives can greatly increase company performance and that this benefit is achieved in part by lowering agency costs as a mediating mechanism. Empirical evidence supports Hypothesis 2.

Model II (B) and Model III (B) are constructed in this paper to test whether management equity incentives can increase the operating income of manufacturing enterprises and whether operating income also plays a mediating role in the realization of the equity incentive effect. According to the regression results of Model II (B) in Table 5, the regression coefficient between MSR and Growth is significantly positive ($\alpha = 0.234$, $p<0.01$) which means that the stronger the equity incentive, the higher the growth rate of the enterprise's operating income. Based on model 1, model 3 (B) adds the growth rate of operating income (Growth), and the results show that the regression coefficient between Growth and ROE is significantly positive ($\alpha=0.093$, $p<0.01$), indicating that the management equity incentive can significantly improve the level of corporate operating income. The regression coefficient of management equity incentive and enterprise performance is still significantly positive, and the coefficient value decreases from 0.157 to 0.135 compared with model 1, and the model's explanatory power increases. It shows that a further part of the process by which management equity incentives affect corporate performance is transmitted through raising the level of corporate operating income, demonstrating the mediating effect of operating income, and hypothesis 3 is tested.

Table 5: Regression results for the full sample of manufacturing industries

Variable Name	Agency cost as a mediating variable			Operating income as a mediating variable	
	Model I	Model II(A)	Model III(A)	Model II(B)	Model III(B)
	ROE	AC	ROE	Growth	ROE
MSR	0.157*** (7.513)	-0.015*** (-5.121)	0.144*** (7.359)	0.234*** (6.971)	0.135*** (7.859)
AC	--	--	-0.846*** (-12.014)	--	--
Growth	--	--	--	--	0.093*** (7.336)
Size	0.044** (2.717)	-0.015*** (-5.017)	0.031* (2.300)	0.128** (2.819)	0.032** (2.466)
Top3	0.060** (3.483)	0.003 (0.299)	0.062*** (3.525)	0.246*** (7.421)	0.037* (1.997)
LEV	-0.269*** (-5.212)	-0.010 (-1.057)	-0.278*** (-6.125)	0.121*** (3.968)	-0.280*** (-5.601)
Inst	0.079*** (3.596)	0.001 (0.324)	0.080*** (4.030)	0.423*** (9.776)	0.039* (2.364)
State	-0.027** (-2.507)	0.006*** (4.684)	-0.023* (-2.046)	-0.125*** (-3.549)	-0.016 (-1.695)
Outdir	0.011 (0.470)	0.013** (2.920)	0.022 (1.018)	0.051 (0.402)	0.006 (0.409)
Dual	0.002 (0.526)	-0.001 (-0.920)	0.001 (0.240)	0.009 (1.789)	0.001 (0.218)
TE	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes
_cons	-0.874** (-2.548)	0.417*** (7.286)	-0.522 (-1.767)	-3.037** (-2.909)	-0.590* (-2.212)
N	9560	9560	9560	9560	9560
R ²	0.112	0.360	0.194	0.098	0.218

Note: *, **, *** represent significance at the 10%, 5%, and 1% levels, respectively, and T-values are in parentheses.

4.4 Further Analysis

In this part, we utilize group regressions to compare the effects of management equity incentives in

traditional and high-tech manufacturing industries, and we employ "bootstrap" to examine the significance of the differences between groups (Efron and Tibshirani, 1993). The regression coefficients for the traditional and high-tech groups were 0.133 and 0.097, respectively, and were significant at the 1% and 5% levels, demonstrating that implementing equity incentives for both types of firms increased enterprise performance significantly. The experience p-value produced by the Bootstrap approach is 0.061, which is significant at the 10% level, demonstrating that there is a difference in the impact of management equity incentives on enterprise performance between the two types of businesses, and the effect of the high-tech manufacturing industry is slightly worse than that of the traditional manufacturing industry, which should be the result of a combination of factors, for example, according to Table 3, the coefficient of difference between traditional manufacturing industry and high-tech manufacturing industry enterprise size is 0.209, which is significant at the 1% level, indicating that the overall size of the high-tech manufacturing industry is smaller than that of the traditional manufacturing industry. Usually, the larger the size of the enterprise, the easier it is to obtain abundant resources. When the management effort and the company's rate of return are the same for enterprises of different sizes, the management equity incentive payoffs may be limited by the size of the resources owned by the enterprise, and the management of larger enterprises tends to receive more generous equity incentive payoffs and therefore better incentive effects. The test of variance in Table 3 also reflects that the equity concentration and the percentage of institutional investors' shareholding are significantly higher in the traditional manufacturing industry than in the high-tech manufacturing industry. In general, the greater the concentration of shareholding and the greater the shareholding of institutional investors, the stronger the supervision of management by shareholders and other stakeholders, and the less opportunistic management behavior, the higher the enterprise performance.

Table 6: Tests for agency cost mediating effects

Variable Name	Model I		Model II(A)		Model III(A)	
	Traditional group	High-tech group	Traditional group	High-tech group	Traditional group	High-tech group
MSR	0.174*** (11.463)	0.129** (3.358)	-0.009** (-3.403)	-0.031*** (-6.093)	0.165*** (12.027)	0.106** (2.905)
AC	-- --	-- --	-- --	-- --	-0.989*** (-7.924)	-0.728*** (-19.699)
Size	0.043** (2.736)	0.045** (2.646)	-0.011*** (-6.223)	-0.019*** (-3.941)	0.033* (2.294)	0.031* (2.295)
Top3	0.102*** (3.655)	0.013 (1.209)	-0.029** (-3.056)	0.050*** (3.966)	0.073** (2.761)	0.049** (2.868)
LEV	-0.269*** (-4.700)	-0.272*** (-6.171)	-0.018* (-2.117)	-0.002 (-0.160)	-0.287*** (-5.515)	-0.273*** (-7.124)
Inst	0.061** (2.720)	0.100*** (3.791)	0.014*** (3.790)	-0.017** (-2.512)	0.075** (3.441)	0.088*** (3.716)
State	-0.016 (-1.474)	-0.040** (-2.909)	0.005** (2.560)	0.007* (2.028)	-0.011 (-1.128)	-0.035** (-2.388)
Outdir	0.034* (1.938)	-0.029 (-0.634)	-0.004 (-0.717)	0.038** (3.465)	0.031* (2.000)	-0.001 (-0.030)
Dual	-0.001 (-0.267)	0.005 (1.206)	0.000 (0.331)	-0.003 (-1.414)	-0.001 (-0.198)	0.003 (0.665)
TE	Yes	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes
_cons	-0.896** (-2.704)	-0.864* (-2.306)	0.341*** (11.016)	0.500*** (5.079)	-0.560 (-1.836)	-0.500 (-1.641)
N	5904	3656	5904	3656	5904	3656
R ²	0.115	0.132	0.365	0.377	0.194	0.207
Experience p-value	0.061*		0.012**		0.027**	

Note: *, **, *** represent significance at the 10%, 5%, and 1% levels, respectively, and T-values are in parentheses.

The regression results in Tables 6 and 7 also show that agency costs and operating income still play a mediating role in the relationship between management equity incentives and enterprise performance in both groups of firms, respectively. Among them, it is noteworthy that according to the regression results of model 2 in Table 6, the coefficients of management equity incentives and agency costs in the

traditional and high-tech groups are -0.009 and -0.031, which are significant at the 5% and 1% levels, respectively, and the experience p-value is 0.012, which is significant at the 5% level, indicating that management equity incentives in high-tech manufacturing industries are more effective in reducing agency cost. This may be related to the different attributes of the two types of enterprises, the high-tech manufacturing industry is more dependent on technological innovation compared to the traditional manufacturing industry, and incremental innovation is easy to be imitated and difficult to bring competitive advantage to the enterprise, and breakthrough innovation activities protected by patents are crucial for the high-tech manufacturing industry [26], which leads to the management of high-tech manufacturing industry faces more risk compared to the traditional manufacturing industry. They need to be compensated for the additional risk by more on-the-job spending and other overcompensation, which leads to a high overhead rate. By giving management equity incentives, the interests of management are highly tied to the interests of the company, and management will consider that they are harming their interests when they act against the interests of the company, which will largely reduce moral hazard behavior.

Table 7: Test of the mediating effect of operating income

Variable Name	Model I		Model II(B)		Model III(B)	
	Traditional group	High-tech group	Traditional group	High-tech group	Traditional group	High-tech group
MSR	0.174*** (11.463)	0.129** (3.358)	0.261*** (7.842)	0.179** (2.920)	0.149*** (11.399)	0.113** (3.379)
Growth	-- --	-- --	-- --	-- --	0.098*** (7.748)	0.088*** (6.298)
Size	0.043** (2.736)	0.045** (2.646)	0.131*** (3.516)	0.128** (2.408)	0.031** (2.399)	0.034** (2.431)
Top3	0.102*** (3.655)	0.013 (1.209)	0.140 (1.383)	0.394*** (4.006)	0.088** (2.477)	-0.022* (-2.052)
LEV	-0.269*** (-4.700)	-0.272*** (-6.171)	0.116* (2.256)	0.119* (2.197)	-0.280*** (-5.152)	-0.282*** (-6.254)
Inst	0.061** (2.720)	0.100*** (3.791)	0.378*** (12.412)	0.497*** (5.701)	0.024 (1.202)	0.056** (3.274)
State	-0.016 (-1.474)	-0.040** (-2.909)	-0.082** (-2.406)	-0.176*** (-3.831)	-0.008 (-0.822)	-0.024* (-2.314)
Outdir	0.034* (1.938)	-0.029 (-0.634)	0.131 (0.862)	-0.104 (-0.823)	0.022 (1.186)	-0.020 (-0.482)
Dual	-0.001 (-0.267)	0.005 (1.206)	-0.004 (-1.103)	0.030* (2.267)	-0.000 (-0.130)	0.003 (0.545)
TE	Yes	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes
_cons	-0.896** (-2.704)	-0.864* (-2.306)	-3.115** (-3.483)	-2.973** (-2.545)	-0.592* (-2.318)	-0.602* (-1.973)
N	5904	3656	5904	3656	5904	3656
R ²	0.115	0.132	0.102	0.106	0.212	0.234
Experience p-value	0.061*		0.192		0.078*	

Note: *, **, *** represent significance at the 10%, 5%, and 1% levels, respectively, and T-values are in parentheses.

4.5 Robustness test

To enhance the reliability of the findings, this paper employs the method of replacing the explained variables for robustness testing, replacing the weighted average return on net assets, net of non-recurring gains and losses (ROE) with return on total assets (ROA) to put the regression model to the test. The acquired results are compatible with the conclusions of the main portion of the research, and the results of the robustness tests are not reported owing to space constraints.

5. Research Conclusion

To investigate the relationship between management equity incentives and corporate performance, this study builds two mediating effect models of "management equity incentive-agency cost/operating income-enterprise performance" using balanced panel data of the A-share manufacturing industries in Shanghai and Shenzhen from 2014 to 2021. The study's findings indicate that: firstly, management equity incentives in the manufacturing industry, can play the anticipated incentive role and significantly boost company performance. The effect is stronger in the traditional manufacturing industry, which may be related to its larger scale and more stringent supervision. Secondly, management equity incentives, particularly in high-tech manufacturing, can significantly reduce agency costs. However, agency costs are still relatively high in the high-tech manufacturing industry, therefore enterprises should suitably raise equity incentives while strengthening supervision and management of management. Furthermore, management equity incentive has a significant effect on the enterprise's operating income, indicating that equity incentive can regulate the conflict of interest between management and shareholders while also motivating management to operate the enterprise as the owner and strive to grow and develop the enterprise. Thirdly, the results of the mediating effect model show that both agency costs and operating income play a mediating role in the relationship between equity incentives and firm performance, implying that management equity incentives can indirectly influence firm performance by directly influencing agency costs and operating income.

This paper provides some inspiration to open the "black box" of the relationship between management equity incentives and enterprise performance in the manufacturing industry and reveal the path of management equity incentives. We investigated the paths of "open source" and "cost reduction" based on this paper, which has enhanced the theoretical results on the paths of equitable incentives affecting firm performance to some extent. However, there are still a lot of questions about equity incentives in manufacturing enterprises that deserve further investigation. For example, the realization of the equity incentive effect is a complex process, and there may be other transmission paths besides lowering agency expenses and boosting operational income. Furthermore, it is also worthwhile to explore whether there are unique paths for the realization of the equity incentive effect in traditional and high-tech manufacturing industries.

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