

Equity Incentives, Agency Costs and Firm Performance-Based on Data from Listed A-Share Manufacturing Companies

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Abstract: This paper examines the dual principal-agent problem, using A-share manufacturing listed companies as the object of study. It integrates equity incentives, agency costs, and corporate performance into a unified analytical framework, and establishes a mediation effect model of equity incentives, agency costs, and corporate performance in listed companies. Selected panel data of manufacturing industry listed companies on the main boards of the China SSE and SZSE from 2018 to 2022 were empirically examined to assess the impact of equity incentives on corporate performance and agency costs. The mediating role of agency costs in the relationship between equity incentives and corporate performance was also analyzed. It has been discovered that equity incentives significantly improve company performance and effectively suppress Type I agency costs. However, the governance effect on Type II agency issues is not significant. Type I agency costs play a fully mediating role between equity incentives and company performance, whereby equity incentives improve company performance by suppressing the path of Type I agency costs, whilst Type II agency costs do not significantly affect it.

Keywords: Equity Incentives; First Type of Agency Costs; Second Type of Agency Costs; Firm Performance; Dual Principal-Agent; Intermediary Effect

1. Introduction

The separation of ownership and operation, known as the separation of powers, is a hallmark of modern businesses. Its principal-agent relationship aims to enhance the economy of enterprise specialisation, bolster efficiency, and diversify risk. However, while

corporate shareholders, as principals, are more focused on maximizing the value of the company, executives as agents are more inclined towards maximizing their own interests. This creates a conflict of interest between principals and agents, resulting in the occurrence of first type agency costs within the principal-agent relationship. Aside from that, in enterprises with relatively concentrated or highly concentrated ownership, the controlling shareholders often serve as the actual controllers of the company. They wield their control rights to exert influence over corporate decision-making, seek personal benefits from acquiring control, undermine the interests of the company, or encroach upon the interests of minority shareholders. This, in turn, accentuates the conflicts of interest between controlling shareholders and minority shareholders, resulting in the emergence of the second category of agency costs. The elevated levels of agency costs have a detrimental impact on the efficiency of resource allocation, resulting in resource wastage and compromising the interests of stakeholders. Consequently, both categories of agency costs significantly impede the enhancement of corporate performance. Against this backdrop, the equity incentive mechanism arises as a highly effective means to tackle the two categories of agency problems and foster the advancement of enterprises.

Equity incentive mechanisms, as an important component of improving internal corporate governance, have both positive and negative implications. On one hand, by granting a certain amount of shares to executives, equity incentives can strengthen the awareness of shared interests and risks between shareholders and managers. This helps to avoid situations where managers, due to having fewer or no shares, may not align their interests with those of shareholders. Additionally, when managers

obtain equity stakes, they become part of the minority shareholders, alleviating the principal-agent problem and reducing the cost of two types of agents for the company, ultimately enhancing corporate performance. On the other hand, when shareholders entrust managerial rights to executives, it may result in executives having access to more internal information, leading to asymmetrical information between shareholders and management.

The theories of agency theory and human capital theory have laid a solid theoretical groundwork for the implementation of equity incentive mechanisms in publicly traded companies. As a result, scholars both domestically and internationally have extensively researched the intricate relationship between equity incentives and corporate performance. However, the current research landscape regarding equity incentives and firm performance remains predominantly focused on examining the straightforward relationship between the two or investigating the interplay between equity incentives, firm performance, and agency costs. Moreover, the majority of studies have been conducted on all A-share listed companies, with a noticeable dearth of specialized research specifically targeting listed companies in the manufacturing industry. What are the specific channels or mechanisms through which equity incentives exert their influence on firm performance? Furthermore, do the two types of agency costs have a mediating effect between equity incentives and company performance?

Building upon existing research, this paper presents a comprehensive analysis framework that incorporates equity incentives, agency costs, and firm performance within the context of listed companies in the manufacturing industry. Specifically, it develops a mediation effect model to examine how equity incentives affect firm performance by exerting influence through two distinct categories of agency costs. Empirical analysis is conducted using panel data from China's A-share listed companies on the Shanghai Stock Exchange and the Shenzhen Stock Exchange for the period spanning 2018 to 2022. This study empirically investigates the role of stock-based compensation on both enterprise performance and the two types of agency costs, while also exploring the mediating role played by the two

categories of agency costs.

2. Literature Review and Theoretical Hypotheses

2.1 The Linkage between Equity Incentives and Firm Performance

In the context of contemporary corporate governance mechanisms, the separation between ownership and control gives rise to divergent interests between enterprise shareholders as principals and corporate executives as agents. The agency theory posits that by providing management with the opportunity to share in residual profits, it can effectively align the interests of managers and owners, thereby motivating managers to attain exceptional performance[1]. According to Manso's research, long-term equity incentive plans can foster a longer-term focus on investment and innovation, thereby resulting in improved operational performance of the firm[2]. Through an extensive review of literature, Burns have demonstrated that equity incentive enhances a firm's risk-bearing capacity, thus elevating its performance levels[3]. In a study focused on the financial industry, Xu and Xu found empirical evidence supporting the notion that the adoption of equity incentives effectively mitigates agency costs and enhances firms' financial performance[4]. Liu and Wang empirical study reveals a positive correlation between management ownership percentage and both research and development R&D investment and firm performance. This suggests that equity incentive mechanisms can strengthen the rationale behind firms' R&D investments, ultimately leading to improved financial results[5]. Chen and Jia argue that equity incentive schemes significantly enhance firm operational performance and mitigate first-order agency costs[6]. Hence, this paper postulates an assumption:

Hypothesis 1: A significant positive association is anticipated between equity incentives and firm performance.

2.2 The Linkage between Equity Incentives and Principal-Agent Agency Costs

Existing scholarly research, both domestic and international has been found that higher levels of equity incentives for top executives can effectively reduce agency costs and improve

firm performance. For instance, Holmstrom argue that executives possess private information, which presents challenges for the board of directors in evaluating their investment decisions. In companies with strong growth prospects, market evaluation becomes a crucial factor in assessing the quality of executive decision-making. Therefore, implementing equity incentives ties performance to market outcomes and mitigates information asymmetry between the board and management to some extent[7]. Similarly, Davidson find that executive equity incentives help alleviate agency costs, and greater managerial ownership enhances the alignment of interests between managers and shareholders[8]. Lv argue that executive stock incentives can effectively mitigate issues of excessive investment and inadequate investment, while also benefiting the resolution of conflicts between management and shareholders[9]. Zhou examines the relationship between management incentive mechanisms and agency costs of free cash flow. The findings demonstrate that executive stock incentives can reduce agency costs stemming from FCFF and increase the investment efficiency of listed companies[10].

The majority of scholars contend that executive stock incentives are a viable approach to mitigate the first-class principal-agent issues. They assert that such incentives facilitate managerial involvement in corporate decision-making, profit-sharing, and risk-bearing as shareholders, thereby reducing conflicts of interest between shareholders and managers and subsequently diminishing the costs associated with the first type of agency problem[1]. Jensen and Murphy posit that the implementation of management stock ownership plans, which allow managers to participate in the allocation of residual claims, effectively promotes synergy between management and owners, consequently reducing agency costs[11]. Hanson and Song's research demonstrates that the adoption of equity incentives by executives contributes to a decrease in free cash flow and a subsequent reduction in agency costs[12]. Davidson and Singh's study reveals that managerial ownership fosters alignment between company managers and shareholders, thereby alleviating agency conflicts. Additionally, their findings reveal an inverse relationship between the

percentage of management ownership and agency costs, indicating a higher degree of convergence of interests between managers and shareholders as management ownership increases[13]. Tzioumis examines a sample of publicly traded U.S. companies that have implemented equity incentive plans and concludes that such implementations significantly mitigate the first type of agency costs for these firms[14].

The majority of academic perspectives suggest that equity incentives have a similar governance effect on the second-class principal-agent issues. Van's research findings, it has been empirically demonstrated that higher levels of incentives provided to agents result in increased attentiveness towards the accuracy of their decision-making. Consequently, agents exhibit a greater tendency to adhere to their own viewpoints and are more likely to refuse commands from principals[15]. In a related study, Wang and Xiao have posited that majority shareholders commonly engage in collusive practices with top executives, thereby exploiting the interests of minority shareholders, which consequently undermines overall corporate performance. However, through equity incentives, the relationship between executive remuneration and company performance is strengthened[16]. Chou examined the inhibitory role of incentive mechanism utilization on the expropriation behavior of controlling shareholders and found that CEO shareholding or equity incentive arrangements are beneficial in aligning the interests of managers with those of minority shareholders, thus suppressing the expropriation behavior of controlling shareholders in listed companies[17]. Huang granted moderate equity incentives to managers who have a preference for fairness in listed companies characterized by relatively concentrated or highly concentrated ownership, aiming to maintain aligned interests with minority shareholders, which can effectively restrain the expropriation actions of controlling shareholders to some extent[18]. Xu and Ren argue that the heightened intensity of equity incentives enhances managers' drive to support optimal decision-making. This, in turn, increases the likelihood of evaluating and selectively rejecting decisions made by controlling shareholders. Moreover, the

resistance effect against erroneous decisions by controlling shareholders intensifies, potentially leading to a relative attenuation of their motivation for expropriation[19]. Therefore, this study believes that the implementation of equity incentives transforms managers into stakeholders among minor stockholders, enhancing their desire to improve more successfully and reducing their inclination to collusion with the controlling shareholders. This can effectively mitigate the second type of agency conflict. Therefore, this paper postulates the following hypotheses:

Hypothesis 2a: Equity incentives have a mitigating role in the first kind agent cost.

Hypothesis 2b: Equity incentives have a mitigating role in the second kind agent cost.

2.3 Mediating Effects of Two Types of Agency Costs.

The implementation of equity incentives is a systematic process that may involve certain transmission mechanisms or pathways of effects. The ultimate manifestation of these decisions is reflected in the firm's performance^[1]. Xu and Ren also note that the original intention behind the establishment of equity incentive systems is to address the principal-agent problem between owners and managers in modern corporations, aiming to reduce agency costs. They argue that it is only when a company's agency costs are controlled that its performance can be guaranteed^[19]. Zhou and Yuan employed balanced panel data from listed companies in the Shanghai and Shenzhen stock markets to examine the partial mediating role of the first and second type of agency costs between different corporate governance mechanisms and firm performance[20]. Thus, this study contends that equity incentives, as a vital corporate governance mechanism, also serve as an intermediary mechanism by mitigating the two types of agency costs to enhance firms' operational performance. Given this, the following assumptions are proposed in this article:

Hypothesis 3a: The first type of agency costs plays a significant mediating role between equity incentives and corporate performance.

Hypothesis 3b: The second type of agency costs plays a significant mediating role between equity incentives and corporate performance.

Based on the above, the proposed model of mediating effects in this article is presented in Figure 1.

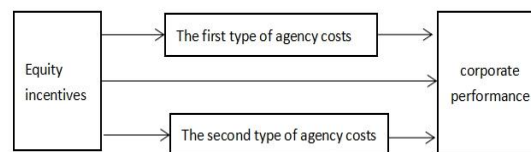


Figure 1. The Intermediary Effect Model of "Equity Incentive Agency Cost Enterprise Performance"

3. Research Design

3.1 Sample Selection and Data Sources

This study selects panel data from manufacturing companies listed on the Shanghai Stock Exchange (SSE) and the Shenzhen Stock Exchange (SZSE) in China, covering the period from 2018 to 2022, as the overall sample. In order to ensure the validity of the sample data, this study applies exclusion criteria to eliminate manufacturing companies listed under the "ST" (Special Treatment) category, as well as those with missing or anomalous data. Consequently, a refined sample of 1,303 manufacturing companies that meet the specified conditions is obtained, resulting in 5,875 valid data observations. All pertinent data related to the companies involved in the sample, including various enterprise-related variables, are collected, downloaded, and meticulously organized from the CSMAR database. In addition, the data analysis for this study was conducted using Stata 17.0.

3.2 Variable Definition and Selection

Dependent Variable. The dependent variable in this study is defined as the company's performance, which is primarily evaluated using the indicator of Return on Equity (ROE), as recommended by Chen and Jia^[6]. As a robustness check, alternative variables such as ROA and Earnings per Share have been selected as substitute measures for the dependent variable. These alternatives will undergo rigorous testing in order to validate the reliability and consistency of the study's conclusions.

Independent Variables. The independent variable in this study is executive stock incentives. In both domestic and international research, many scholars have commonly used

the proportion of executive shareholding as a proxy variable for stock incentives. Therefore, this study selects the ratio of the number of shares held by executives to the total share capital of the enterprise as the measure of stock incentives.

Mediating Variables. Drawing on the research conducted by Wei[21], the management expense ratio is employed as a measure of the first type of agency costs. Similarly, following the measurement methods proposed by Xu and Xu[22] as well as Wei[21], the ratio of year-end balance of other receivables to total assets is utilized as an indicator of the second type of

agency costs.

Control Variables. This study adopts control variables based on previous literature research, including company size, growth capability, equity concentration, managerial cash compensation, board independence, total asset turnover ratio, financial leverage indicators. Moreover, the analysis controls for the impact of annual factors to enhance the accuracy and effectiveness of the data analysis.

The specific names, symbols, and definitions of each variable in this article are shown in Table 1.

Table 1. Variable Definitions

| Variable types | Variable Names | Variable Symbols | Variable Definitions |
|-----------------------|---------------------------------|------------------|---|
| Dependent Variable | corporate performance | ROE | Ratio of net profit to net assets at the end of the period |
| Independent Variables | Equity incentives | MSR | The ratio of the number of shares held by senior executives to the total share capital of the company |
| Mediating Variables | The first type of agency costs | AC1 | Ratio of management expenses to main business income |
| | The second type of agency costs | AC2 | Ratio of other receivables to total assets at the end of the period |
| Control Variables | company size | SIZE | Natural logarithm of total assets |
| | growth capability | Growth | Business revenue growth rate |
| | equity concentration | Topone | Shareholding ratio of the largest shareholder |
| | managerial cash compensation | Inpay | Natural logarithm of total management compensation |
| | board independence | Outdir | Ratio of the number of independent directors to the number of directors |
| | total asset turnover ratio | CF | Ratio of cash flow from operating activities to total assets at the end of the year |
| | financial leverage indicators | Levi | Ratio of total liabilities to total assets at the end of the period |

3.3 Model Construction

This article employs regression modeling and conducts empirical analysis using Stata 17.0. This study aims to investigate the relationship between equity incentives, two categories of agency costs, and firm performance. Additionally, it explores the potential mediating effect of agency costs on the relationship between equity incentives and firm performance. The regression model formulated in this research is presented as follows:

In order to test hypothesis 1, this study establishes Model (1) as follows:

$$ROE = \alpha_0 + \alpha_1 MSR + \alpha_2 SIZE + \alpha_3 Growth + \alpha_4 Topone + \alpha_5 Inpay + \alpha_6 Outdir + \alpha_7 CF + \alpha_8 Levi + e_1 \quad (1)$$

In order to examine hypothesis 2a, this study constructs Model (2) as follows:

$$AC1 = \alpha_0 + \alpha_1 MSR + \alpha_2 SIZE + \alpha_3 Growth + \alpha_4 Topone + \alpha_5 Inpay + \alpha_6 Outdir + \alpha_7 CF + \alpha_8 Levi + e_2 \quad (2)$$

In order to examine hypothesis 2b, this study constructs Model (3) as follows:

$$AC2 = \alpha_0 + \alpha_1 MSR + \alpha_2 SIZE + \alpha_3 Growth + \alpha_4 Topone + \alpha_5 Inpay + \alpha_6 Outdir + \alpha_7 CF + \alpha_8 Levi + e_3 \quad (3)$$

In order to examine hypothesis 3a, this study

constructs Model (4) as follows:

$$ROE = \alpha_0 + \alpha_1 MSR + \alpha_2 AC1 + \alpha_3 SIZE + \alpha_4 Growth + \alpha_5 Topone + \alpha_6 Inpay + \alpha_7 Outdir + \alpha_8 CF + \alpha_9 Levi + e_3 \quad (4)$$

In order to examine hypothesis 3b, this study constructs Model (5) as follows:

$$ROE = \alpha_0 + \alpha_1 MSR + \alpha_2 AC2 + \alpha_3 SIZE + \alpha_4 Growth + \alpha_5 Yopone + \alpha_6 Inpay + \alpha_7 Outdir + \alpha_8 CF + \alpha_9 Levi + e_4 \quad (5)$$

4. Empirical Testing Results and Analysis.

4.1 Descriptive Statistics

This study employed Stata 17.0 to perform descriptive statistical analysis on the pre-

screened sample data. The analysis results are shown in Table 2. According to the analysis results, the mean value of the dependent variable, firm performance (ROE), is 0.0435. The minimum and maximum values are -45.74 and 1.402, respectively. The standard deviation is 0.714, indicating a high level of dispersion in the sample. The average value of the explanatory variable, executive equity incentives (MSR), is 0.0912. The minimum and maximum values are 0 and 0.778, respectively. The standard deviation is 0.150, suggesting a relatively lower level of intensity in equity incentives. The average value of the first type agency cost for the mediator variable is 0.0636, with a minimum of 0.00286 and a maximum of 1.616.

Table 2. Descriptive Statistics of Key Variables

| | Sample Size | Mean | Standard Deviation | Min | Max |
|--------|-------------|--------|--------------------|---------------|-------|
| ROE | 5,875 | 0.0435 | 0.714 | -45.74 | 1.402 |
| MSR | 5,875 | 0.0912 | 0.150 | 0.00000000942 | 0.778 |
| AC1 | 5,875 | 0.0636 | 0.0560 | 0.00286 | 1.616 |
| AC2 | 5,875 | 0.152 | 0.0999 | 0.000015 | 0.608 |
| SIZE | 5,875 | 22.44 | 1.203 | 19.62 | 26.93 |
| GROWTH | 5,875 | 0.186 | 1.298 | -0.892 | 58.84 |
| Topone | 5,875 | 32.07 | 13.68 | 1.844 | 87.70 |
| Inpay | 5,875 | 15.28 | 0.772 | 12.92 | 18.73 |
| Outdir | 5,875 | 0.377 | 0.0561 | 0.143 | 0.800 |
| CF | 5,875 | 0.660 | 0.349 | 0.0235 | 3.531 |
| Levi | 5,875 | 0.409 | 0.173 | 0.0143 | 0.993 |

The standard deviation is 0.0560. Similarly, for the second type agency cost, the average value is 0.152, with a minimum of 0.000015 and a maximum of 0.608. The standard deviation is 0.0999. These statistics indicate that there is relatively low variability in both the first and second type agency costs across different companies. For the controlled variable, the average value of growth ability is 0.186, with a minimum of -0.892 and a maximum of 58.84. The manufacturing industry has shown rapid growth and promising market prospects. The average value of controlling variable, the equity concentration, is 0.3207, with a minimum value of 0.01844 and a maximum value of 0.877. The standard deviation is 13.68, indicating a significant variation and high level of dispersion in equity concentration within the sample. The mean value of board independence is 0.1528, with a range from 0.1292 to 0.1873. The standard deviation of 0.772 suggests that the company exhibits a favorable level of independent director

supervision.

4.2 Correlation Analysis

Before conducting regression analysis, this study performed Pearson correlation tests to observe the preliminary relationships among the variables included in the constructed model. The analysis results are shown in Table 3. The correlation coefficient between company performance (ROE) and executive stock incentives (MSR) is 0.027, demonstrating a statistically significant positive correlation. This finding implies that a stronger implementation of stock incentives is associated with higher levels of company performance. The coefficient between the first type of agency costs and company performance is -0.159, indicating a significant negative correlation. This suggests that lower levels of the first type of agency costs are associated with higher company performance. The coefficient between the second type of agency costs and company performance is -0.006, indicating a negative correlation, although it is not statistically significant. The coefficient between executive stock incentives and the first type of agency costs is -0.027, showing a statistically

significant negative association. This indicates that executive stock incentives have a mitigating effect on the first type of agency costs within the company. However, the coefficient between executive stock incentives and the second type of agency costs is 0.061, exhibiting a statistically significant positive

relationship. This finding contradicts hypothesis 2b. Moreover, all variables in this study have undergone a VIF (Variance Inflation Factor) test, which confirms the absence of multicollinearity among the variables.

Table 3. Pearson Correlation Coefficient Matrix

| | ROE | MSR | AC1 | AC2 | SIZE | GROWTH | Topone | Inpay | Outdir | CF | Levi |
|--------|-----------|-----------|-----------|-----------|----------|----------|-----------|-----------|----------|----------|------|
| ROE | 1 | | | | | | | | | | |
| MSR | 0.027** | 1 | | | | | | | | | |
| AC1 | -0.159*** | -0.027** | 1 | | | | | | | | |
| AC2 | -0.00600 | 0.061*** | -0.082*** | 1 | | | | | | | |
| SIZE | 0.038*** | -0.274*** | -0.248*** | -0.158*** | 1 | | | | | | |
| GROWTH | 0.027** | 0.0110 | -0.0210 | -0.0170 | 0.058*** | 1 | | | | | |
| Topone | 0.040*** | 0.099*** | -0.061*** | -0.054*** | -0.0190 | 0.028** | 1 | | | | |
| Inpay | 0.061*** | -0.117*** | -0.112*** | -0.097*** | 0.563*** | 0.041*** | -0.031** | 1 | | | |
| Outdir | 0.0110 | 0.078*** | -0.00300 | -0.00900 | -0.0150 | -0.00500 | 0.065*** | -0.044*** | 1 | | |
| CF | 0.040*** | -0.035*** | -0.388*** | 0.109*** | 0.128*** | 0.034*** | 0.116*** | 0.121*** | -0.00600 | 1 | |
| Levi | -0.135*** | -0.166*** | -0.108*** | 0.124*** | 0.462*** | 0.046*** | -0.091*** | 0.165*** | 0.00700 | 0.161*** | 1 |

4.3 Multiple Regression Analysis

This study employed multiple regression analysis to further test the hypotheses proposed, utilizing Model 1, Model 2, and Model 3. The regression results are presented in Table 4.

Table 4. Multiple Regression Analysis

| | Model1 | Model2 | Model3 |
|--------------|----------|-----------|-----------|
| | ROE | AC1 | AC2 |
| MSR | 0.134** | -0.039*** | 0.021** |
| | (0.064) | (0.005) | (0.009) |
| SIZE | 0.068*** | -0.014*** | -0.023*** |
| | (0.011) | (0.001) | (0.001) |
| GROWTH | 0.001 | 0.000 | 0.000 |
| | (0.002) | (0.000) | (0.000) |
| Topone | 0.001 | -0.000 | -0.000*** |
| | (0.001) | (0.000) | (0.000) |
| Inpay | 0.025* | 0.006*** | 0.003 |
| | (0.015) | (0.001) | (0.002) |
| Outdir | 0.155 | 0.003 | -0.017 |
| | (0.164) | (0.012) | (0.022) |
| CF | 0.107*** | -0.060*** | 0.031*** |
| | (0.027) | (0.002) | (0.004) |
| Levi | control | control | control |
| Observations | 5,875 | 5,875 | 5,875 |
| R-squared | 0.036 | 0.207 | 0.101 |

Based on the regression results, it is evident that in Model 1, the coefficient (α) for executive stock incentives (MSR) on company performance (ROE) is estimated to be 0.134, exhibiting a statistically significant positive relationship at $p < 0.05$. This finding implies that stock incentives have a pronounced positive effect on company performance,

indicating that a greater intensity of stock incentive implementation is associated with improved company performance. Therefore, Hypothesis 1 is confirmed.

Based on the results of Model 2, it is evident that the coefficient (α) for executive stock incentives (MSR) on the first type of agency costs (AC1) is estimated to be -0.039, exhibiting a statistically significant negative relationship at $p < 0.01$. This finding suggests that stock incentives have a substantial negative impact on the first kind of agency costs, indicating that a higher intensity of stock incentive implementation is associated with lower levels of the first type of agency costs. Therefore, stock incentives exert a mitigating effect on the first type of agency costs. Therefore, Hypothesis 2a is confirmed. The regression results from Model 3 indicate that the coefficient (α) for the relationship between managerial stock ownership incentives (MSR) and the second type of agency costs (AC2) is 0.021, with a significant positive effect at $P < 0.05$. This suggests that stock ownership incentives have a significant positive impact on the second type of agency costs. The implementation intensity of stock ownership incentives does not effectively reduce the second type of agency costs. This suggests that stock ownership incentives are unable to address the conflicts arising from the diverging interests between controlling shareholders and minority shareholders. Therefore, stock ownership incentives do not have a restraining role in the second-class agency cost. Therefore,

Hypothesis 2b has not been corroborated.

agency costs, respectively, to assess whether they act as mediators between equity incentives and firm performance. The results of the tests are displayed in Tables 5 and 6.

4.4 Testing for Mediation Effect

This study employed Sobel mediation tests on first-order agency costs and second-order

Table 5. Sobel Mediation Effect Test for the First Type Agency Cost (AC1)

| Sobel-Good man Mediation Tests | | | | |
|--|-----------|-----------|----------|-----------|
| | Coef | Std Err | Z | P> Z |
| Sobel | .7906754 | .01167846 | 6.775 | 1.244e-11 |
| Goodman-1(Aroian) | .07906754 | .01169986 | 6.758 | 1.399e-11 |
| Goodman-2 | .07906754 | .011641 | 6.7922 | 1.105e-11 |
| | Coef | Std Err | Z | P> Z |
| a coefficient= | -.038797 | .004567 | -8.49562 | 0 |
| b coefficient= | -2.03798 | .181495 | -11.2289 | 0 |
| Indirect effect = | .079068 | .01167 | 6.77501 | 1.2e-11 |
| Direct effect = | .051534 | .063848 | .8714 | .419586 |
| Total effect= | .130602 | .064132 | 2.03645 | .041705 |
| Proportion of total effect that is mediated: | | | | .00540912 |
| Ratio of indirect to direct effect: | | | | 1.5342705 |
| Ratio of total to direct effect: | | | | 2.5342705 |

According to the test results presented in Table 5, the absolute value of Z in the Sobel mediation test for first-order agency costs is greater than 1.96, with a significant p-value of 0. This indicates that the mediation effect is confirmed. Therefore, it can be concluded that there is a significant mediating effect of first-order agency costs between equity incentives and firm performance. Hypothesis 3a is validated. Moreover, the total effect is 0.130602 ($p=0.041705$), which is significant at the 0.05 level. The coefficient for variable "a" is -0.038797 ($p=0$), indicating a significant relationship. The coefficient of first-order agency costs on firm performance, denoted as "b coefficient," is -2.03798 ($p=0$), demonstrating a significant relationship. However, the direct effect is 0.051534

($p=0.419586$), which is greater than 0.05 and thus not significant. The mediating variable fully mediates the relationship between the independent and dependent variables, effectively neutralizing the direct effect. This suggests a complete mediation effect of first-order agency costs.

Based on the results indicated in Table 6, the absolute value of Z in the Sobel mediation test for second-order agency costs falls below 1.96, with a p-value of 0.06873205, exceeding the significance level of 0.05. Consequently, the mediation effect is not supported, suggesting the absence of a significant mediating role of second-order agency costs between equity incentives and firm performance. Hypothesis 3b has not been corroborated.

Table 6. Sobel Mediation Effect Test for the Second Type Agency Cost (AC2)

| Sobel-Good man Mediation Tests | | | | |
|--|-----------|-----------|---------|-----------|
| | Coef | Std Err | Z | P> Z |
| Sobel | .00556816 | .00305913 | 1.82 | .06873205 |
| Goodman-1(Aroian) | .00556816 | .00317162 | 1.756 | .07915308 |
| Goodman-2 | .00556816 | .00294235 | 1.892 | .05843488 |
| | Coef | Std Err | Z | P> Z |
| a coefficient= | .021411 | .008671 | 2.46944 | .013532 |
| b coefficient= | .260056 | .096555 | 2.69334 | .007074 |
| Indirect effect = | .005568 | .003059 | 1.82018 | .068732 |
| Direct effect = | .125034 | .064131 | 1.94965 | .051217 |
| Total effect= | .130002 | .064132 | 2.03645 | .041705 |
| Proportion of total effect that is mediated: | | | | .04263462 |
| Ratio of indirect to direct effect: | | | | .04453328 |
| Ratio of total to direct effect: | | | | 1.0445333 |

4.5 Robustness Analysis

To assess the robustness of the empirical results and ensure the reliability of the conclusions, this study performed robustness checks at two levels: the variables employed in the analysis and the methodology used for testing the mediation effects. At the variable level, regression analyses were conducted by substituting the dependent variable, first-order agency costs, and second-order agency costs with alternative variables, in order to examine the robustness of the hypotheses proposed in the article. The following replacements were made: ① First-order agency costs were replaced with total asset turnover ratio B from the

CSMAR database. ② Second-order agency costs were substituted with the ratio of accounts receivable to total assets. ③ Replace enterprise performance with earnings per share. ④ Replace enterprise performance with Return on Assets (ROA(A)). The results are shown in Tables 7 to 10. At the methodological level of assessing mediating effects, the robustness of the mediating effect agency costs is examined using the Bootstrap method as an alternative to the Sobel method. The results are shown in Tables 11 to 20. The findings from all the robustness tests align with the conclusions derived in the preceding analysis, exhibiting no substantive alterations.

Table 7. Replace the first type of agency costs with total asset turnover rate B

| Sobel-Goodman Mediation Tests | | | | |
|--|-----------|-----------|---------|-----------|
| | Coef | Std Err | Z | P> Z |
| Sobel | .11505068 | .0140955 | 8.162 | 2.220e-16 |
| Goodman-1(Aroian) | .11505068 | .0141196 | 8.148 | 4.441e-16 |
| Goodman-2 | .11505068 | .01407137 | 8.176 | 2.220e-16 |
| | Coef | Std Err | Z | P> Z |
| a coefficient= | .054356 | .005363 | 10.1354 | 0 |
| b coefficient= | 2.11663 | .153737 | 13.7678 | 0 |
| Indirect effect = | .115051 | .014096 | 8.16223 | 2.2e-16 |
| Direct effect = | .018923 | .063676 | .29717 | .766337 |
| Total effect= | .133973 | .064132 | 2.08901 | .036707 |
| Proportion of total effect that is mediated: | | | | .8587583 |
| Ratio of indirect to direct effect: | | | | 6.0800621 |
| Ratio of total to direct effect: | | | | 7.0800621 |
| Sobel-Goodman Mediation Tests | | | | |
| | Coef | Std Err | Z | P> Z |
| Sobel | .0054191 | .00301782 | 1.796 | .07254259 |
| Goodman-1(Aroian) | .0054191 | .0031318 | 1.73 | .08356835 |
| Goodman-2 | .0054191 | .00289937 | 1.869 | .06161438 |
| | Coef | Std Err | Z | P> Z |
| a coefficient= | .021129 | .008669 | 2.43725 | .014799 |
| b coefficient= | .25648 | .096574 | 2.6558 | .007912 |
| Indirect effect = | .005419 | .003018 | 1.7957 | .072543 |
| Direct effect = | .128554 | .064132 | 2.00453 | .045013 |
| Total effect= | .133973 | .064132 | 2.08901 | .036707 |
| Proportion of total effect that is mediated: | | | | .04044909 |
| Ratio of indirect to direct effect: | | | | .04215419 |
| Ratio of total to direct effect: | | | | 1.0421542 |

Table 8. Substitute the Second Type of Agency Costs with the Ratio of Accounts Receivable to Total Assets

| Sobel-Goodman Mediation Tests | | | | |
|-------------------------------|-----------|-----------|-------|-----------|
| | Coef | Std Err | Z | P> Z |
| Sobel | .07892572 | .01165966 | 6.769 | 1.296e-11 |
| Goodman-1(Aroian) | .07892572 | .01168909 | 6.752 | 1.457e-11 |
| Goodman-2 | .07892572 | .01163017 | 6.786 | 1.151e-11 |

| | Coef | Std Err | Z | P> Z |
|--|-----------|-----------|----------|-----------|
| a coefficient= | -.038756 | .004565 | -8.48921 | 0 |
| b coefficient= | -2.03648 | .181555 | -11.2169 | 0 |
| Indirect effect = | .078926 | .01166 | 6.76912 | 1.3e-11 |
| Direct effect = | .055048 | .063849 | .862148 | .388606 |
| Total effect= | .064132 | 2.08901 | .036707 | .064132 |
| Proportion of total effect that is mediated: | | | | .58911529 |
| Ratio of indirect to direct effect: | | | | 1.4337727 |
| Ratio of total to direct effect: | | | | 2.4337727 |
| Sobel-Goodman Mediation Tests | | | | |
| | Coef | Std Err | Z | P> Z |
| Sobel | .04202797 | .07609128 | .5523 | .58071805 |
| Goodman-1(Aroian) | .04202797 | .07609589 | .5523 | .58074098 |
| Goodman-2 | .04202797 | .07608667 | .5524 | .58069512 |
| | Coef | Std Err | Z | P> Z |
| a coefficient= | 23.3516 | .257082 | 90.8335 | 0 |
| b coefficient= | .0018 | .003258 | .552346 | .580711 |
| Indirect effect = | .042028 | .076091 | .552336 | .580718 |
| Direct effect = | .091945 | .099514 | .923939 | .355518 |
| Total effect= | .133973 | .064132 | 2.08901 | .036707 |
| Proportion of total effect that is mediated: | | | | .31370406 |
| Ratio of indirect to direct effect: | | | | .45709736 |
| Ratio of total to direct effect: | | | | 1.4570974 |

Table 9. Corporate Performance Replaced by Earnings Per Share

| Sobel-Goodman Mediation Tests | | | | |
|--|------------|-----------|----------|------------|
| | Coef | Std Err | Z | P> Z |
| Sobel | .07316281 | .01348557 | 5.425 | 5.787e-08 |
| Goodman-1(Aroian) | .07316281 | .01354081 | 5.403 | 6.549e-08 |
| Goodman-2 | .07316281 | .01343011 | 5.448 | 5.103e-08 |
| | Coef | Std Err | Z | P> Z |
| a coefficient= | -.038756 | .004565 | -8.48921 | 0 |
| b coefficient= | -1.88778 | .267631 | -7.05366 | 1.7e-12 |
| Indirect effect = | .073163 | .013486 | 5.42527 | 5.8e-08 |
| Direct effect = | .791961 | .094121 | 8.41432 | 0 |
| Total effect= | .865124 | .093936 | 9.20976 | 0 |
| Proportion of total effect that is mediated: | | | | .08450915 |
| Ratio of indirect to direct effect: | | | | .0923818 |
| Ratio of total to direct effect: | | | | 1.0923818 |
| Sobel-Goodman Mediation Tests | | | | |
| | Coef | Std Err | Z | P> Z |
| Sobel | -.00477395 | .00357434 | -1.336 | .18167422 |
| Goodman-1(Aroian) | -.00477395 | .00377899 | -1.263 | .20648594 |
| Goodman-2 | -.00477395 | .00335724 | -1.422 | .1550295 |
| | Coef | Std Err | Z | P> Z |
| a coefficient= | .021129 | .008669 | 2.43725 | .014799 |
| b coefficient= | -.225946 | .141507 | -1.59672 | .110329 |
| Indirect effect = | -.004774 | .003574 | -1.33562 | .181674 |
| Direct effect = | .869898 | .093971 | 9.25712 | 0 |
| Total effect= | .865124 | .093936 | 9.20976 | 0 |
| Proportion of total effect that is mediated: | | | | -.00551823 |
| Ratio of indirect to direct effect: | | | | -.00548795 |
| Ratio of total to direct effect: | | | | .99451205 |

Table 10. Replacing Enterprise Performance with Total Asset Net Profit Ratio ROA (A)

| Sobel-Good man Mediation Tests | | | | |
|--|-----------|-----------|----------|-----------|
| | Coef | Std Err | Z | P> Z |
| Sobel | .02638517 | .00328534 | 8.283 | 2.220e-16 |
| Goodman-1(Aroian) | .02638517 | .0031864 | 8.281 | 2.220e-16 |
| Goodman-2 | .02638517 | .00318428 | 8.286 | 2.220e-16 |
| | Coef | Std Err | Z | P> Z |
| a coefficient= | -.038756 | .004565 | -8.48921 | 0 |
| b coefficient= | -.680803 | .017992 | -37.8398 | 0 |
| Indirect effect = | .026385 | .003185 | 8.28331 | 2.2e-16 |
| Direct effect = | .018966 | .006327 | 2.99742 | .002723 |
| Total effect= | .045351 | .007014 | 6.46536 | 1.0e-10 |
| Proportion of total effect that is mediated: | | | | .58180107 |
| Ratio of indirect to direct effect: | | | | 1.3912065 |
| Ratio of total to direct effect: | | | | 2.3912065 |
| Sobel-Good man Mediation Tests | | | | |
| | Coef | Std Err | Z | P> Z |
| Sobel | .00026382 | .0024814 | 1.063 | .28768435 |
| Goodman-1(Aroian) | .00026382 | .0026451 | .9974 | .31856626 |
| Goodman-2 | .00026382 | .0023061 | 1.144 | .25200632 |
| | Coef | Std Err | Z | P> Z |
| a coefficient= | .021129 | .008669 | 2.43725 | .014799 |
| b coefficient= | .012487 | .010568 | 1.18157 | .237376 |
| Indirect effect = | .000264 | .000248 | 1.06322 | .287684 |
| Direct effect = | .045087 | .007015 | 6.42471 | 1.3e-10 |
| Total effect= | .045351 | .007014 | 6.46536 | 1.0e-10 |
| Proportion of total effect that is mediated: | | | | .0058174 |
| Ratio of indirect to direct effect: | | | | .00585144 |
| Ratio of total to direct effect: | | | | 1.0058514 |

Table 11. Bootstrap Test for the First Type of Agency Cost

| Bootstrap results | | | | | Number of obs=5,875 Replications=1000 |
|--|----------------------|-----------|---------------------|----------------------|--|
| | Observed coefficient | Bias | Bootstrap std. err. | [95% comf.inter val] | |
| bs_1 | .07906754 | -.0017307 | .02319831 | .0360246 | .1250446 (P) |
| | | | | .0384611 | .1296392 (BC) |
| bs_2 | .05153429 | .0014601 | .04015203 | -.0133469 | .1413628 (P) |
| | | | | -.0072883 | .1548337 (BC) |
| Key: P: Percentile BC: Bias-corrected | | | | | |

Table 12. Bootstrap Test for the Second Type of Agency Cost

| Bootstrap results | | | | | Number of obs=5,875 Replications=1000 |
|--|----------------------|-----------|---------------------|----------------------|--|
| | Observed coefficient | Bias | Bootstrap std. err. | [95% comf.inter val] | |
| bs_1 | .00556816 | -.0002471 | .00532276 | -.0007813 | .0195754 (P) |
| | | | | -.0000349 | .0279355 (BC) |
| bs_2 | .12503367 | -.0027547 | .03259363 | .0693868 | .1949498 (P) |
| | | | | .0777743 | .2145271 (BC) |
| Key: P: Percentile BC: Bias-corrected | | | | | |

Table 13. Bootstrap test (AC1) for Replacing the First Type Agency Cost with the Total Asset Turnover Rate b

| Bootstrap results | | | | | Number of obs=5,875 Replications=1000 |
|-------------------|----------------------|-----------|---------------------|----------------------|--|
| | Observed coefficient | Bias | Bootstrap std. err. | [95% comf.inter val] | |
| bs_1 | .11505068 | -.0008806 | .04672836 | .0495447 | .2321825 (P) |

| | | | | | |
|--|-----------|----------|-----------|-----------|---------------|
| | | | | .0532478 | .2445948 (BC) |
| <u>bs_2</u> | .01892262 | .0011095 | .02100964 | -.0257463 | .0571554 (P) |
| | | | | -.0351088 | .0526739 (BC) |
| Key: P: Percentile BC: Bias-corrected | | | | | |

Table 14. Bootstrap Test (AC2) for Replacing the First Type Agency Cost with the Total Asset Turnover Rate B

| Bootstrap results | | | | | Number of obs=5,875 Replications=1000 |
|--|----------------------|----------|---------------------|-----------------------|--|
| | Observed coefficient | Bias | Bootstrap std. err. | [95% conf.interv val] | |
| <u>bs_1</u> | .0054191 | .0000739 | .00554511 | -.0013027 | .0198902 (P) |
| | | | | -.0000799 | .0262349 (BC) |
| <u>bs_2</u> | .1285542 | .0010261 | .0343292 | .0712392 | .2035255 (P) |
| | | | | .0758702 | .2144159 (BC) |
| Key: P: Percentile BC: Bias-corrected | | | | | |

Table 15. Bootstrap Test for Replacing the Second Type of Agency Cost with the Ratio of Accounts Receivable to Total Assets (AC1)

| Bootstrap results | | | | | Number of obs=5,875 Replications=1000 |
|--|----------------------|-----------|---------------------|-----------------------|--|
| | Observed coefficient | Bias | Bootstrap std. err. | [95% conf.interv val] | |
| <u>bs_1</u> | .07892572 | -.0019787 | .02414987 | .0341403 | .1263887 (P) |
| | | | | .0388337 | .1335906 (BC) |
| <u>bs_2</u> | .05504758 | .0032057 | .04039902 | -.0075726 | .148284 (P) |
| | | | | -.007209 | .1497321 (BC) |
| Key: P: Percentile BC: Bias-corrected | | | | | |

Table 16. Bootstrap Test for Replacing the Second Type of Agency Cost with the Ratio of Accounts Receivable to Total Assets (AC2)

| Bootstrap results | | | | | Number of obs=5,875 Replications=1000 |
|--|----------------------|-----------|---------------------|-----------------------|--|
| | Observed coefficient | Bias | Bootstrap std. err. | [95% conf.interv val] | |
| <u>bs_1</u> | .04202797 | .00204 | .021657 | .0044258 | .0879098 (P) |
| | | | | .0021403 | .0860899 (BC) |
| <u>bs_2</u> | .09194533 | -.0026605 | .04420351 | .0080736 | .1874088 (P) |
| | | | | .0205463 | .2008294 (BC) |
| Key: P: Percentile BC: Bias-corrected | | | | | |

Table 17. Bootstrap Test for Replacing Corporate Performance with Earnings Per Share (AC1)

| Bootstrap results | | | | | Number of obs=5,875 Replications=1000 |
|--|----------------------|----------|---------------------|-----------------------|--|
| | Observed coefficient | Bias | Bootstrap std. err. | [95% conf.interv val] | |
| <u>bs_1</u> | .07316281 | .0020739 | .0154242 | .0473223 | .1071514 (P) |
| | | | | .0459584 | .1057781 (BC) |
| <u>bs_2</u> | .79196127 | .0029152 | .1232107 | .5788247 | 1.066078 (P) |
| | | | | .5841694 | 1.090201 (BC) |
| Key: P: Percentile BC: Bias-corrected | | | | | |

Table 18. Bootstrap Test for Replacing Corporate Performance with Earnings Per Share (AC2)

| Bootstrap results | | | | | Number of obs=5,875 Replications=1000 |
|--|----------------------|-----------|---------------------|-----------------------|--|
| | Observed coefficient | Bias | Bootstrap std. err. | [95% conf.interv val] | |
| <u>bs_1</u> | -.00477395 | -.0002147 | .00406689 | -.0146876 | .0009278 (P) |
| | | | | -.0159994 | .0003696 (BC) |
| <u>bs_2</u> | .86989804 | .0008719 | .12161256 | .6536892 | 1.128785 (P) |
| | | | | .6609999 | 1.134481 (BC) |
| Key: P: Percentile BC: Bias-corrected | | | | | |

Table 19. Bootstrap Test (AC1) for Replacing Enterprise Performance with Total Asset Net Profit Ratio ROA (A)

| Bootstrap results | | | | | Number of obs=5,875 Replications=1000 |
|--|----------------------|-----------|---------------------|----------------------|--|
| | Observed coefficient | Bias | Bootstrap std. err. | [95% comf.inter val] | |
| bs_1 | .02638517 | -.0010864 | .009754 | .0130456 | .0460591 (P) |
| | | | | .0135711 | .0483829 (BC) |
| bs_2 | .01896567 | .0010005 | .0077594 | .004141 | .0338105 (P) |
| | | | | .0014937 | .0320736 (BC) |
| Key: P: Percentile BC: Bias-corrected | | | | | |

Table 20. Bootstrap Test (AC2) for Replacing Total Asset Net Profit Ratio (ROA) with Enterprise Performance

| Bootstrap results | | | | | Number of obs=5,875 Replications=1000 |
|--|----------------------|-----------|---------------------|----------------------|--|
| | Observed coefficient | Bias | Bootstrap std. err. | [95% comf.inter val] | |
| bs_1 | .00026382 | -.0000111 | .00033554 | -.0002837 | .0011069 (P) |
| | | | | -.0001255 | .0014367 (BC) |
| bs_2 | .04508701 | -.0000804 | .00700323 | .031863 | .0598982 (P) |
| | | | | .0326229 | .0607101 (BC) |
| Key: P: Percentile BC: Bias-corrected | | | | | |

5. Conclusions and Future Prospects

This study utilizes panel data from manufacturing companies listed on the Shanghai Stock Exchange (SSE) and Shenzhen Stock Exchange (SZSE) between 2018 and 2022. Drawing upon the "equity incentives-agency costs-firm performance" mediated effect model, This study empirically examine the effects of executive stock incentives on firm performance and two types of agency costs. Additionally, This study investigate the mediating role of these agency costs in the relationship between equity incentives and firm performance. The research findings demonstrate that, firstly, there exists a positive relationship between equity incentives and firm performance. The equity incentives has the potential to effectively stimulate employees, thereby improving overall corporate performance. Secondly, there is a remarkable negative correlation between equity incentives and the first type of agency costs. Implementing equity incentives can to some extent reduce the first type of agency costs in a firm, thereby mitigating the divergence of interests between owners and managers. However, equity incentives do not have the ability to lower the second type of agency costs, as they fail to effectively address conflicts between minority shareholders and controlling shareholders. Lastly, according to the results of the mediation analysis, it is evident that the first type of agency costs plays

a significant mediating role. Furthermore, the mediation effect is found to be complete mediation, indicating that equity incentives enhance firm performance by suppressing the first type of agency costs. However, the mediating effect of the second type of agency cost is not apparent.

This paper primarily investigates the effects of equity incentives on firm performance and two types of agency costs, as well as the mediating effect of these agency costs between equity incentives and firm performance. Apart from the influencing factor of agency costs, it may also be influenced by factors such as the intensity of performance indicators in equity incentives, the mode of equity incentives, internal governance conditions within the firm, and external environmental factors. Further exploration is needed to fully understand these additional factors and their impact on the effectiveness of equity incentives.

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