Routledge
Taylor & Francis Group

Economic Research-Ekonomska Istraživanja

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rero20

Shareholding structure, private benefit of control and incentive intensity: from the perspective of enterprise strategic behaviour

Kai Zhao, Hua-Hua Huang & Wan-Shu Wu

To cite this article: Kai Zhao, Hua-Hua Huang & Wan-Shu Wu (2021) Shareholding structure, private benefit of control and incentive intensity: from the perspective of enterprise strategic behaviour, Economic Research-Ekonomska Istraživanja, 34:1, 856-879, DOI: 10.1080/1331677X.2020.1805345

To link to this article: https://doi.org/10.1080/1331677X.2020.1805345

Published online: 27 Aug 2020.

ECONOMIC RESEARCH-EKONOMSKA ISTRAŽIVANJA
2021, VOL. 34, NO. 1, 856–879
https://doi.org/10.1080/1331677X.2020.1805345

Shareholding structure, private benefit of control and incentive intensity: from the perspective of enterprise strategic behaviour

Kai Zhao[a], Hua-Hua Huang[a] and Wan-Shu Wu[b]

[a]School of Statistics, Huaqiao University, Xiamen, China; [b]School of Architecture, Huaqiao University, Xiamen, China

ABSTRACT

This paper studies theoretically and empirically the relationship among shareholding structure, the private benefit of control and incentive intensity. By integrating the principal–agent theory and the market competition theory into the three-stage dynamic game model, we built the dual principal–agent relationship including both 'shareholder-manager' and 'controlling shareholders-small and medium shareholders'. Empirically, the panel data of 1971 listed enterprises in China from the year 2007 to 2014 are analysed in order to justify the theoretical results by using two-way fixed effect model, dynamic panel model, and threshold regression model. It is shown that for enterprise managers, the higher their ability level and risk aversion, the stronger their incentive intensity will be. However, for shareholders, the private benefit of control and the incentive intensity show a non-linear relationship with the change of ownership concentration.

ARTICLE HISTORY
Received 14 November 2019
Accepted 29 July 2020

KEYWORDS
Private benefit of control; principal–agent; shareholding structure; incentive intensity

SUBJECT CLASSIFICATION CODES
D21; D22; L26

1. Introduction

This study discusses whether the private benefit of control is associated with the level of incentive intensity and shareholding structure, from the perspective of enterprise strategic behaviour.

Effective decision-making within the enterprises is a widely discussed area both in practice and in the research community (Staszkiewicz & Szelągowska, 2019). The seminal researches related to enterprise strategic behaviour is mainly based on two theories: the principal–agent theory (Fama & Jensen, 1983) and the market competition theory (An & Yang, 2002; Chaim & Pakes, 2000; Porter, 1983). The former emphasises that shareholders or owners motivate the managers in order to reduce the production cost and optimise the production process. The latter highlights the impact of market competition outside an enterprise on strategic behaviour in production,

CONTACT Kai Zhao kzhao_kai@126.com

research and development (henceforth, R&D), *etc.* Combining the above two theories, this paper makes an in-depth discussion on the relationship among private benefit of control, ownership structure and managers' salary incentives, from the perspective of strategic behaviour of enterprises. It is beneficial to clarify the relationship between various interest communities within the enterprise and the mechanism of their mutual influence, providing certain theoretical guidance for the improvement of the operation and management level of listed enterprises. On the other hand, it can help the government to better understand the possible problems and needs of listed enterprises, and provide important reference for the government to formulate effective enterprise supervision and support policies.

This paper may have the following contributions:

Theoretically, we use the three-stage dynamic game model to combine the principal–agent theory and the market competition theory. Current researches focus only on a single principal–agent relationship, we pay attention to the dual principal–agent relationship, precisely 'shareholders-managers' relationship and 'controlling shareholders-small and medium shareholders' relationship. This paper explores the intrinsic link between the shareholding structure, the private benefit of control and the incentive intensity based on the dual principal–agent relationship. Moreover, considering the level of manager's ability and risk preference in the research framework, this paper emphasises the role of professional managers in reducing enterprise costs and inhibiting the private benefit of control. We try to explore a series of questions such as 'whether the incentives will be affected by ability and risk preference of manager? What is the sign and magnitude of the influence?'

Empirically, based on the panel data of 1971 listed companies from the year 2007 to 2014, this paper uses various estimation methods such as the two-way fixed effect model, the dynamic panel model, the panel threshold regression model, to justify the theoretical results. Furthermore, the existing researches on private benefit of control have some problems, for example the definition of concept is fuzzy, the measurement method is not accurate *etc.* This paper attempts to measure the preference of controlling shareholders for private benefit of control by the changing rate in the ratio of manager's wage to the net profit of the enterprise. The advantages of this measurement method are as follows. First, the research on the control benefit is extended to a multi-interest relationship including both 'shareholder-shareholder' and 'shareholder-manager'. It not only enriches the relevant empirical research but also strengthens the relationship between the theory and empirical. Second, due to the endogeneity of control benefit, the controlling shareholder could obtain private benefit only when the private benefit of control is difficult to determine or observe. The preference of control benefit can effectively avoid the existing problems of 'indirect', 'inaccurate' and 'difficult to obtain data'.

The rest of the paper proceeds as follows. Section 2 describes the literature review. Section 3 discusses the theoretical model construction. Section 4 shows the main theoretical results and provides the empirical hypothesis to be tested. Section 5 conducts empirical analysis and discusses the empirical results. Section 6 discusses the robustness of the estimation results. Finally, conclusions are drawn in section 7.

2. Literature review

The traditional principal–agent theory attributes the strategic behaviour of an enterprise to the agency relationship between shareholders and managers. However, limited attention has been paid to discuss the agency problem between controlling shareholder and small and medium shareholders (Liu et al., 2015). Non-controlling shareholders have the potential to play two roles. They have the incentive and voting power to constrain the objectives of the controlling shareholder, but they may also join the controlling shareholder in expropriating wealth from smaller shareholders (Cai et al., 2016). The literature review section reorganises the principal–agent theory in the study of enterprise strategic behaviour, and summarises it into 'shareholder-manager' and 'controlling shareholder-small and medium shareholders'.

First, the principal–agent relationship between shareholders and managers. The separation of ownership and management is the foundation of the enterprise governance (Alonso-Paulí, 2019). Due to the limitations of equity structure and competence of shareholders, owners of enterprises prefers to delegate the managerial authority to a professional manager. The manager conducts as the agent of shareholders to assume the responsibility of reducing enterprise cost and ensuring the preservation and appreciation of enterprise assets (Dai & Song, 2018). At the same time, shareholders offer the incentive salary contract to managers, in order that shareholders and managers have the same goal, maximising enterprise profits (Etro, 2011).

Second, the principal–agent relationship between the controlling shareholder and small and medium shareholders. The centralised governance structure of enterprise ownership is very common in the world. Judging from the reality of listed enterprises in China, the phenomenon of 'dominant shareholder in state-owned enterprises', 'controlled by the family members in family enterprises' and 'skeletonization of the board of directors' is obvious. The problem of principal–agent is not only the conflict between shareholders and managers but also between controlling shareholders and small and medium shareholders (La Porta et al., 1999; Xia & Yang, 2017). The founders of 'incomplete contract theory' distinguish the benefits of shareholders as equity gains and the private benefit of control (Grossman & Hart,1988). The former refers to the value of cash flow generated by the management, and all shareholders can enjoy the earning. While the latter is rather vague, which differs in different research perspectives (Jia et al., 2007). For example, Aghion and Bolton (1992) and Holderness (2003) define the control benefit primarily from a monetary or non-monetary perspective, while Johnson et al. (2000) define it from the perspective of transferring assets. However, regardless of the perspectives, the focus is the conflicts of interests between the controlling shareholders and small and medium shareholders.

Although the related researches on the private benefit of control emphasise the conflict of interests between the controlling shareholder and small and medium shareholders, private benefit of control is not equivalent to infringement on small and medium shareholders. The influence of the private benefit of control is still controversial, mainly including 'harmful but unhelpful' (Haw et al., 2004; La Porta et al., 2000) and 'incentive and compensatory' (Cronqvist & Fahlenbrach, 2009; Korsakienė et al., 2019). The former confirms that the private benefit of control is an illegal excess benefit of the controlling shareholder. It will lead to many negative effects,

such as investment decision deviating from enterprise value objectives, plundering the interests of small and medium shareholders, enhancing inefficient decision-making behaviours (Liu et al., 2018). The latter considers that the private benefit of control are possibly reasonable, and it is an incentive for controlling shareholders (Andres, 2008; Gilson & Schwartz, 2014). Private benefit of control in moderate level can play a positive role in improving corporate performance and optimising investment efficiency. For example, when supervising managers' efforts, the cost of supervision is mostly borne by controlling shareholders, and small and medium shareholders have 'free-riding' behaviour. The earning gained from the controlling shareholder's supervision is shared by all shareholders, which leads to externalities and makes the cost paid by the controlling shareholder unable to be internalised, thus seriously undermining the enthusiasm of the controlling shareholder. Therefore, the private benefit of control includes the reasonable compensation for the supervision cost. In addition, from the viewpoint of the causes for the private benefit of control, there are two major reasons in related literature. First, the 'Economic man' attribute of the controlling shareholders force them to pursuit for maximum benefit and make private benefit of control (Ran et al., 2015). Second, the unsound corporate governance mechanism leads to the lack of proper supervision and restriction on controlling shareholders (Hao & Liu, 2010). Besides, private benefit of control has the characteristics of diversity and concealment, which is difficult to directly observe and measure. Therefore, many indirect methods have been used to measure private benefit of control, for example the changed hands premium of the control (Dyck & Zingales, 2004), the premium value of a voting share (Doidge, 2004; Nenova, 2003), the cumulative abnormal return (Yu et al., 2006) and the control premium of the paired sample (Ye, 2003). Nevertheless, the measurement of the private benefit of control is not accurate, because these methods do not involve the subjective spiritual value of controlling shareholders in controlling resources (Deng & Gu, 2017).

The level of private benefit of control of controlling shareholder is affected by the ownership structure (Bøhren et al., 2019; Saona & Martin, 2016). Generally, there are two types of ownership structure: ownership concentration and ownership dispersion. Ownership concentration affects the performance of enterprises, meanwhile the conflicts of principal–agent relationship arises (Aluchna & Kaminski, 2017; Yang & Ko, 2020). There are many measures to alleviate the conflicts are proposed, 'compensation policy'[1] is one of the important measures (Jensen & Murphy, 1990). In order to mitigate the agency costs related to the expropriation risk, shareholders may adopt various sets of monitoring and incentive mechanisms provided by different governance structures (Shleifer & Vishny, 1997).

The current references on strategic behaviour of enterprises are mainly focussed on a single principal–agent relationship including 'shareholders-managers' and 'controlling shareholders-small and medium shareholders', respectively. Limited attention has been paid to discuss the principal–agent conflict between controlling shareholders, small and medium shareholders, and managers. In other words, there is no discussion on the relationship between ownership structure, private benefit of control, and incentive intensity.

3. Theoretical model construction

To cover the shortage of existing literature, this section builds a dual principal–agent relationship including both 'shareholder-manager' and 'controlling shareholder-small and medium shareholders' to study the relationship between private benefit of control and incentive intensity under different shareholding structure.

3.1. Enterprise heterogeneity and manager differences

There are differences in incentive behaviours for managers under different shareholding structures. In the enterprise with dispersed ownership, the interests of shareholders are all aiming at maximising enterprise profits. At this time, the shareholder motivates the manager to obtain more equity returns. However, the controlling shareholder has the motive to convert some enterprises' profits into private benefits in the enterprise with a high-ownership concentration (Aluchna & Kaminski, 2017). At this time, the controlling shareholder maximises the sum of the enterprise's profits and the control benefit by formulating incentives for the manager. Suppose there are two listed enterprises in a certain industry. The two enterprises have differences in the shareholding structure $\theta \in \{H, L\}$:H indicates the enterprise with higher-ownership concentration (such as family businesses); L indicates the enterprise with lower ownership concentration. Because of the $H-type$ enterprise has the characteristics of 'dominant shareholder' and 'skeletonization of the board of directors', controlling shareholder often have the motivation to engage in the private benefit of control.

Regardless of the type of enterprise, controlling shareholders (principals) are risk-neutral (Staszkiewicz & Szelągowska, 2019). They employ competent and experienced professional managers (agents) to reduce the production cost[2]. The shareholders are less professional than managers in technology such as R&D, innovation, cost control. It is difficult for principals to monitor whether or how hard an agent is working, so there is a moral hazard problem. One of the solutions is to provide managers with a (linear) salary contract related to cost control (cost reduction due to technological innovation) $\Delta_\theta = c - c_\theta$. Where c is the initial production cost of the industry, and the industry has the same initial production cost, c_θ is the actual marginal cost of the $\theta-type$ enterprise. Since c_θ is affected by the effort level of managers e_θ, the level of managers' ability δ_θ, and the random variables ε describing the impact of the external environment, the expression of c_θ can be defined as follow:

$$c_\theta = c - (\delta_\theta e_\theta + \varepsilon) \tag{1}$$

Different managers may differ in their level of effort e_θ and ability δ_θ. Generally, the higher the manager's ability and effort, the greater the reduction in production cost. Therefore, we assume that $\frac{\partial^2 \Delta_\theta}{\partial \delta_\theta e_\theta} \geq 0$. In addition to the role of manager's ability and effort in reducing the production cost, the actual cost will also be affected by factors beyond the manager's control[3], which is expressed as ε. The random factors obey a normal distribution with a mean of zero and a variance of σ^2.

3.2. Incentive contract and moral hazard

The contract provided by the $\theta-type$ enterprise to the manager can be regarded as an incentive wage w_θ. The wage is related to the basic wage b_θ, performance Δ_θ(the extent of cost reduction), and the incentive intensity k_θ of manger:

$$w_\theta = b_\theta + k_\theta \Delta_\theta \tag{2}$$

From Equation (2), the variance of manager's wage w_θ is $\mathrm{Var}(w_\theta) = k_\theta^2 \sigma^2$, which means that for managers, the greater the risk (σ^2) in the industry market, the more difficult to decide whether to accept the contract or not. As the manager is not willing to bear all the market risk alone, the shareholder can motivate the manager by sharing the market risk.

3.3. Manager's ability and effort

Suppose the effect function of the $\theta-type$ enterprise manager is

$$U(w_\theta, e_\theta) = -\exp\left[-\gamma_\theta\left(w_\theta - C(e_\theta)\right)\right] \tag{3}$$

where $C(e_\theta) = e_\theta^2/2$ is the cost of the manager's effort, and γ_θ measures the risk preference of the manager. According to Equation (2), since the wage is $w_\theta = b_\theta + k_\theta \delta_\theta e_\theta + k_\theta \varepsilon$ and ε follows a normal distribution, the maximisation of the manager's effect function (Eq.3) can be transformed into the maximisation of manager's expected return, that is,

$$\max_{w_\theta,\, e_\theta} U(w_\theta, e_\theta) \equiv \max_{e_\theta} f(e_\theta) = \left[\mathrm{E}(w_\theta) - \frac{1}{2} e_\theta^2 - \frac{1}{2}\gamma_\theta \mathrm{Var}(w_\theta)\right] \tag{4}$$

where $\mathrm{E}(w_\theta)$ is the expected return of the manager. Since the variance of the incentive wage w_θ is $\mathrm{Var}(w_\theta) = k_\theta^2 \sigma^2$, $\frac{1}{2}\gamma_\theta \mathrm{Var}(w_\theta) = \frac{1}{2}\gamma_\theta k_\theta^2 \sigma^2$ can be interpreted as the risk premium that the enterprise owner should compensate to the manager.

3.4. Incentive constraints and participation constraints

In order to motivate the manager, the wage contract provided by the owner (principal) should meet the constraints of 'incentive feasibility constraint' and 'participation constraint'.

First, the 'incentive feasibility constraints'. Managers make an effort (e_θ) to maximise their effect function $f(e_\theta)$. As $\mathrm{E}(w_\theta) - \frac{1}{2} e_\theta^2 - \frac{1}{2}\gamma_\theta \mathrm{Var}(w_\theta) = \alpha_\theta + k_\theta \delta_\theta e_\theta - \frac{1}{2} e_\theta^2 - \frac{1}{2}\gamma_\theta k_\theta^2 \sigma^2$, according to the first-order condition, the optimal effort level of manager e_θ^* in different enterprises can be obtained,

$$e_\theta^* = k_\theta \delta_\theta \tag{5}$$

Combining Equation (1) with Equation (5), we have

$$\mathrm{E}(c_\theta) = \mathrm{E}[c - (\delta_\theta e_\theta + \varepsilon)] = c - k_\theta \delta_\theta^2 \tag{6}$$

It can be seen that in order to minimise the marginal cost of production, the owner is willing to hire managers with high levels of competence and provide them with a higher level of incentives k_θ.

Second, the 'participation constraints'. The wage contract provided by the owner should at least meet the retention effect level $\bar{w}$ of the manager effect function. In a competitive market, the level of manager's retention effect is equal to the level of their expected effects

$$f(e^*) = b_\theta + \frac{1}{2}k_\theta^2\delta_\theta^2 - \frac{1}{2}\gamma_\theta k_\theta^2\sigma^2 = \bar{w} \tag{7}$$

Equation (7) is the participation constraint of the manager, which can be used to derive the expression of the basic salary in the manager's wage:

$$b_\theta = \bar{w} - \frac{1}{2}k_\theta^2\delta_\theta^2 + \frac{1}{2}\gamma_\theta k_\theta^2\sigma^2 \tag{8}$$

In the case of satisfying both the 'incentive feasibility constraint' and the 'participation constraint', the expression of manager's wage w_θ can be derived according to Equation (2):

$$\begin{aligned} w_\theta &= b_\theta + k_\theta(\delta_\theta e_\theta + \varepsilon) \\ &= \bar{w} - \frac{1}{2}k_\theta^2\delta_\theta^2 + \frac{1}{2}\gamma_\theta k_\theta^2\sigma^2 + k_\theta\delta_\theta e_\theta + k_\theta\varepsilon \\ &= \bar{w} + \frac{1}{2}k_\theta^2\delta_\theta^2 + \frac{1}{2}\gamma_\theta k_\theta^2\sigma^2 + k_\theta\varepsilon \end{aligned} \tag{9}$$

3.5. Target revenue and control benefit

The ownership concentration is low in the *L−type* enterprise, the shareholders have the same goal to maximise the profit of the enterprise. In the *H−type* enterprise, the controlling shareholder holds the majority of the shares, which makes its owner have the motive to convert the profit of the enterprise into the control benefit. The control benefit enjoyed exclusively by the controlling shareholder and not shared with the small shareholder. It resulted in a principal–agent problem between controlling shareholder and small shareholder. At this time, the *H−type* enterprise's owner maximises the sum of enterprise's profits and control benefit by setting incentives for managers:

$$\max_{k_H}[\pi_H(k_H) + \alpha Z(k_H)] \tag{10}$$

where $\pi_H = (p_H - c_H)q_H - w_H$, $Z(\cdot)$ is the private benefit of control, and α is the preference of the controlling shareholder for the control benefit. The private benefit of control Z consists of two parts and can be expressed as:

$$Z = \bar{z} - \frac{1}{2}(k_H\delta_H)^2 \tag{11}$$

where the first part $\bar{z}$ is the expected control benefit level of the controlling shareholder; the second part $\frac{1}{2}(k_H\delta_H)^2$ describes the disagreement between manager and

controlling shareholder on the interest goal (Bandiera et al., 2015). The goal of the manager is to perform his duties to ensure the preservation and appreciation of property for all shareholders. The higher the manager's ability δ_H is, the stronger the incentive k_H will be, and the more effectively the manager can restrain the control benefit behaviour of controlling shareholder.

According to Equation (10) and Equation (11), and combining the two constraints of 'incentive feasibility constraint' and 'participation constraint', the maximisation objective function of $H-type$ enterprise owner can be derived:

$$\begin{aligned} &\max_{k_H}\left[\pi_H(k_H)+\alpha Z(k_H)\right] \equiv \max_{k_H}\left[(p_H-c_H)q_H-w_H+\alpha Z\right] \\ &\equiv \max_{k_H}\left[(p_H-c_H)q_H-\bar{w}-\frac{1}{2}k_H^2\delta_H^2-\frac{1}{2}\gamma_H k_H^2\sigma^2-k_H\varepsilon+\alpha\bar{z}+\frac{1}{2}\alpha k_H^2\delta_H^2\right] \\ &\equiv \max_{k_H}\left[(p_H-c_H)q_H-\frac{1}{2}I_H k_H^2-\bar{w}-k_H\varepsilon+\alpha\bar{z}\right] \end{aligned} \tag{12}$$

where $I_H=(1+\alpha)\delta_H^2+\gamma_H\sigma^2$. Different from the $H-type$ enterprise, the goal of the owner is to maximise enterprise profits in the $L-type$ enterprise:

$$\begin{aligned} &\max_{k_L}\left[\pi_L(k_L)\right] \equiv \max_{k_L}\left[(p_L-c_L)q_L-w_L\right] \\ &\equiv \max_{k_L}\left[(p_L-c_L)q_L-\bar{w}-\frac{1}{2}k_L^2\delta_L^2-\frac{1}{2}\gamma_L k_L^2\sigma^2-k_L\varepsilon\right] \\ &\equiv \max_{k_L}\left[(p_L-c_L)q_L-\frac{1}{2}I_L k_L^2-\bar{w}-k_L\varepsilon\right] \end{aligned} \tag{13}$$

where $I_L=\delta_L^2+\gamma_L\sigma^2$.

4. Theoretical analysis and main results

Based on the dual principal–agent relationship built in previous section, this section will conduct the analysis and try to find the Nash equilibrium by dynamic game theory.

4.1. Game process

The theoretical model is divided into three stages:

- In the first stage, the owner of the $\theta-type$ enterprise provides the linear incentive contract to the manager satisfying the 'incentive feasibility constraint' and the 'participation constraint'. At the same time, the manager chooses whether to accept the contract or not. If the manager accepts it, he will assume the responsibility to preserve and appreciate the property of the enterprise. Specifically, on the one hand, the manager relies on his ability δ_θ and efforts e_θ to promote technological innovation, and reduce the production cost Δ_θ effectively. On the other hand, manger reduces the level of control benefit Z of controlling shareholder.

- In the second stage, the enterprises carry on the Cournot competition in the industry.
- In the third stage, random events (external environmental shocks ε) occur, and enterprises observe actual production cost of their own and competitors. At the same time, the manager receives the expected wage set in the contract.

It is worth noting that in the whole process, the enterprise owner cannot measure the efforts of the manager due to technical barriers and high monitoring costs.

The model is solved by backward induction. First, the level of expected marginal cost $E(c_\theta)$ is determined according to the incentive intensity k_θ in Equation (6) in the third stage. In the second stage, the optimal yield q^* under the given incentive intensity k_θ is derived according to the Cournot competition. Finally, the owners of different-type enterprises achieve their maximum target returns by setting optimal (linear) incentive contracts k_θ^* (see Eq.12 and Eq.13) in the first stage.

4.2. Equilibrium solution and main results

In the first stage, enterprises maximise their respective target return according to their type. For a *H−type* enterprise:

$$\max_{k_H}[\pi_H(k_H)+\alpha Z(k_H)] = \left(q_H + c - \delta_H^2 k_H - c_H\right)q_H - \frac{1}{2}I_H k_H^2 - \bar{w} - k_H\varepsilon + \alpha\bar{z} \tag{14}$$

For a *L−type* enterprise:

$$\max_{k_L}[\pi_L(k_L)] = \left(q_L + c - \delta_L^2 k_L - c_L\right)q_L - \frac{1}{2}I_L k_L^2 - \bar{w} - k_L\varepsilon \tag{15}$$

The maximisation of target return in above two enterprises is solved, and it can be obtained after sorting out:

$$\begin{gathered} k_H\left[9(1+\alpha)\delta_H^2 + 9\gamma_H\sigma^2 - 8\delta_H^4\right] + 4\delta_L^2\delta_H^2 k_L = 4(a-c)\delta_H^2 \\ k_L\left(9\delta_L^2 + 9\gamma_L\sigma^2 - 8\delta_L^4\right) + 4\delta_L^2\delta_H^2 k_H = 4(a-c)\delta_L^2 \end{gathered} \tag{16}$$

Equilibrium of the incentive intensity k_θ^* can be obtained by combining Equation (16)

$$\begin{aligned} k_H^* &= \frac{4(a-c)\delta_H^2\left(A_2 - 4\delta_L^4\right)}{A} \\ k_L^* &= \frac{4(a-c)\delta_L^2\left(A_1 - 4\delta_H^4\right)}{A} \end{aligned} \tag{17}$$

Where $A_1 = 9(1+\alpha)\delta_H^2 + 9\gamma_H\sigma^2 - 8\delta_H^4 \geq 4\delta_H^4$, $A_2 = 9\delta_N^2 + 9\gamma_N\sigma^2 - 8\delta_N^4 \geq 4\delta_N^4$, and $A = A_1A_2 - 16\delta_F^4\delta_N^4 \geq 0$. It can be seen from the above equations that the equilibrium incentive intensity k_θ^* is related to the level of manager's ability δ_θ and the risk preference γ_θ. First, from the relationship between k_θ^* and δ_θ, $\text{sign}\left(\frac{\partial k_H^*}{\partial \delta_H}\right) =$

$\text{sign}\left(\frac{\partial(\delta_H^2 A^{-1})}{\partial \delta_H}\right)$, since $\frac{\partial(\delta_H^2 A^{-1})}{\partial \delta_H} = \frac{\delta_H A_2\left(2A_1 - \delta_H \frac{\partial A_1}{\partial \delta_H}\right) + 32\delta_L^4 \delta_H^5}{A^2}$ and $2A_1 - \delta_H \frac{\partial A_1}{\partial \delta_H} = 6\gamma_H \sigma^2 + 16\delta_H^4 \geq 0$, so $\frac{\partial k_H^*}{\partial \delta_H} \geq 0$. Similarly, $\frac{\partial k_L^*}{\partial \delta_L} \geq 0$. Second, from the relationship between k_θ^* and γ_θ, $\text{sign}\left(\frac{\partial k_H^*}{\partial \gamma_H}\right) = \text{sign}\left(\frac{\partial A^{-1}}{\partial \gamma_H}\right)$. since $\frac{\partial A^{-1}}{\partial \gamma_H} = \frac{-9A_2\sigma^2}{A^2} \leq 0$, so $\frac{\partial k_H^*}{\partial \gamma_H} \leq 0$. Similarly, $\frac{\partial k_L^*}{\partial \gamma_L} \leq 0$. Therefore, the following hypothesis are proposed.

Hypothesis 1a: *The incentive intensity of the enterprise owner for the manager will increase with the improvement of the level of manager's ability.*

Hypothesis 1b: *The incentive intensity of the enterprise owner for the manager will decrease with the rise of risk preference.*

Substituting Equation (17) into the equilibrium production q_θ^*, we have

$$q_F^* = \frac{3I_F k_F^*}{4\delta_F^2}, q_N^* = \frac{3I_N k_N^*}{4\delta_N^2} \tag{18}$$

Then substituting the Equation (18) into the equilibrium price and quantity respectively, the expressions on the equilibrium price (Eq.19) and the equilibrium wage of manager can be obtained:

$$p_H^* = c + \frac{3k_H^*\left[(1+\alpha)\delta_H^2 + \gamma_H\sigma^2\right] - 4k_H^*\delta_H^4}{4\delta_H^2}$$
$$p_L^* = c + \frac{3k_L^*\left(\delta_L^2 + \gamma_L\sigma^2\right) - 4k_L^*\delta_L^4}{4\delta_L^2}$$

$$\mathrm{E}(w_H^*) = \bar{w} + \frac{8\delta_H^4\left(\delta_H^2 + \gamma_H\sigma^2\right)(q_H^*)^2}{9I_H^2}$$
$$\mathrm{E}(w_L^*) = \bar{w} + \frac{8\delta_L^4(q_L^*)^2}{9I_L} \tag{19}$$

According to the above equations, $\frac{\partial \mathrm{E}(w_H^*)}{\partial \delta_H} = \frac{(k_H^*)^2}{2}\frac{\partial I_H}{\partial \delta_H} + I_H k_H^* \frac{\partial k_H^*}{\partial \delta_H} \geq 0$, $\frac{\partial \mathrm{E}(w_L^*)}{\partial \delta_L} = \frac{(k_L^*)^2}{2}\frac{\partial I_L}{\partial \delta_L} + I_L k_L^* \frac{\partial k_L^*}{\partial \delta_L} \geq 0$. Since $\text{sign}\left(\frac{\partial \mathrm{E}(w_H^*)}{\partial \gamma_H}\right) = \text{sign}\left(\frac{\partial (I_H A^{-2})}{\partial \gamma_H}\right)$ and $\frac{\partial (I_H A^{-2})}{\partial \gamma_H} = -\frac{A_2\sigma^2(8\delta_H^4 + 9I_H) + 16\delta_L^4\delta_H^4}{A^3} \leq 0$, so $\frac{\partial \mathrm{E}(w_H^*)}{\partial \gamma_H} \leq 0$. Similarly, $\frac{\partial \mathrm{E}(w_L^*)}{\partial \gamma_L} \leq 0$. Hence, the following hypothesis is proposed.

Hypothesis 2: *The wage of manager increases with the improvement of his ability, and decreases with the rise of his risk preference.*

The private benefit of control is the main and key interest motive of the owner or controlling shareholder. Therefore, the controlling shareholder's preference of benefit control α may affect the incentive intensity k_θ^* for the manager in an enterprise with high-ownership concentration. Specifically, for the $H-type$ enterprise, as $\text{sign}\left(\frac{\partial k_H^*}{\partial \alpha}\right) = \text{sign}\left(\frac{\partial A^{-1}}{\partial \alpha}\right)$ and $\frac{\partial A^{-1}}{\partial \alpha} \leq 0$, so $\frac{\partial k_H^*}{\partial \alpha} \leq 0$. And for the $L-type$ enterprise, $\frac{\partial k_L^*}{\partial \alpha} = -\frac{4\delta_L^2\delta_H^2}{A_2}\frac{\partial k_H^*}{\partial \alpha} \geq 0$. Therefore, the hypothesis are proposed below.

Hypothesis 3a: *The strengthening of the owners' preference for the control benefit will reduce the incentive intensity in the H−typeenterprise.*

Hypothesis 3b: *The strengthening of the owners' preference for the control benefit will increase the incentive intensity in the L−typeenterprise.*

5. Empirical test and analysis

5.1. Data sources and variables

5.1.1. Data sources

The samples of this paper are Chinese A-share listed enterprises from 2007 to 2014[4]. The financial data[5] are derived from the RESSET database, the enterprise characteristic information, industry information, and other related data are derived from the CSMAR database. The information on the registration and manager's wage of listed enterprises is derived from the CCER China Economic and Financial database.

In the process of data matching, we find that many listed companies have the same controlling owner in the same year. Therefore, we identify whether listed enterprises belong to the same controlling owner through manual cross-comparison, and merges such companies into enterprise groups. In order to ensure the integrity and accuracy of the data, this paper follows the processing methods of Dai and Song (2018), Peng et al. (2018). These data are treated as follows: (1) Excluding observations of the listed companies with abnormal financial conditions or other abnormal conditions, such as special treatment and delisting risk warning, and observations of financial and insurance enterprises. (2) Deleting observations with negative values of the key variables, such as the observed values of insolvency at the end of the period. (3) Eliminating variables with many omitted observations, and performing the Winsorize tailing treatment on the 1% and 99% quantiles of the continuous variables involved in the study. Finally, there is non-balanced panel data of 1971 listed enterprises from the year 2007 to 2014.

5.1.2. Variable definitions and calculation methods

The empirical part uses the same symbol of the theoretical part as much as possible, making the connection between the theory and the empirical research clearer and closer. The symbol, definition and calculation method of each variable are shown in Table 1.

Referring to the research design of Faccio et al. (2011) and Xiao et al. (2018), this paper uses the forward and reverse indicators to measure the risk aversion of managers. Specifically, the financial leverage at the end of the period *lever* is used as a reverse indicator to measure the risk aversion of the manager. When *lever* is at a higher level, the manager is willing to bear higher asset-liability ratios, which reflects the lower risk aversion of managers. On the other hand, the proportion of cash and its equivalent *cash* is used as a forward indicator to measure the degree of risk aversion. The manager prefers current assets with lower risk, indicating he has a higher degree of risk aversion. The higher *cash* is, the higher the risk aversion of the manager. In addition, since it is difficult to directly measure the efforts of manager, and it lacks relevant variables that can measure the ability level of the manager, this paper

Table 1. Variable definition and calculation method.

Key variable	Variable definition	Calculation method
Dependent variables		
k_{it}	Incentive intensity of enterprise owners to managers	$\frac{Managershareholding}{Totalnumberofshares}$
w_{it}	Wage of manager	$ln(managerwageoflistedenterprise)$
Independent variables		
$lever_{it}$	Reverse indicator of manager's risk aversion	Financial leverage (asset-liability ratio at end of period)
$cash_{it}$	Forward indicator of manager's risk aversion	$\frac{\text{Cash and its equivalents}}{\text{Total assets at the end of the period}}$
θ_{it}	Ownership concentration	$\frac{Numberofsharesheldbythebiggestshareholder}{Totalnumberofshares}$
$w_{i,t-1}$	Level of manager's ability and effort	Taking the manager's previous wage as an external representation and measurement of his ability and effort
α_{it}	Preference of controlling shareholder in control benefit	$-\left[\frac{(W_{it}/enterprise\ net\ profit_t)-(W_{i,t-1}/enterprise\ net\ profit_{t-1})}{W_{i,t-1}/enterprise\ net\ profit_{t-1}}\right]$
Control variables		
$state_{it}$	Nature of the enterprise	Dummy variable that equals 1 if the enterprise is state-owned
$indep_{it}$	Percentage of independent directors	$\frac{Numberofindependentdirectors}{Numberofboardmembers}$
$board_{it}$	Board size	$board_{it}=ln(numberofboardmembers)$
$dual_{it}$	Chairman and general manager	Dummy variable that equals 1 if the chairman and the general manager is the same person
$size_{it}$	Size of the enterprise	$size_t=ln(annualoperatingincome)$
$indus_{it}$	Industry classification of listed enterprises	
gdp_{it}	GDP growth rate	GDP growth rate of the province (31 in total) where the listed enterprise is registered.

uses the lagged wage of the manager $w_{i,t-1}$ as an external representation and indirect measure of his ability and effort[6]. In addition, this paper uses the negative changing rate of the ratio of manager wage to enterprise's net profit to measure the preference of the control benefit $\alpha_{i,t}$. The main reason for the measurement of $\alpha_{i,t}$ is that the higher the changing rate, the more the profit distribution of the enterprise is tilted towards the manager, and the lesser likely the enterprise owner obtains the private benefit of control.

The control variables in the empirical part can be divided into three levels: enterprise, industry and region. First, we select the nature of the enterprise $state_{it}$, percentage of independent directors $indep_{it}$, board size $borad_{it}$, chairman and general manager $dual_{it}$, the size of the enterprise $size_{it}$ as control variables at the enterprise level. Second, control the industry classification of listed enterprises $indus_{it}$. Finally, the regional level is controlled by the GDP growth rate gdp_{it} of the province (31 in total) where the listed enterprise is registered. Based on the above variables, we use a variety of panel data analysis models to empirically test the theoretical hypothesis through STATA software.

5.2. Methodology

5.2.1. Panel data model

Panel data model contains Pooled regression model (Pooled), Fixed-Effect model (FE), Two-way Fixed Effect model (TFE) and Random Effect model (RE). First, the Pooled regression model:

$$y_{it} = a + \mathbf{x'_{it}b} + \mathbf{z'_i d} + \varepsilon_{it} \quad (i = 1, \ldots, N;\ t = 1, \ldots, T) \tag{20}$$

Where$board_t$ is the individual characteristics of listed enterprises that do not change with time, x_{it} is the variable that changes with the individual and time, and $dual_t$ is the disturbance term that varies with the individual and time. If an unobservable random variable$size_t$ is introduced in the Equation (20), it will be a Fixed-Effect model:

$$y_{it} = a + \mathbf{x'_{it}b} + \mathbf{z'_i d} + u_i + \varepsilon_{it} \tag{21}$$

Where $indus_t$ represents the intercept term of the enterprise individual heterogeneity, gdp_t and ε_{it} constitute the compound disturbance term. When u_i is related to an independent variable, it refers to FE model. If u_i is not related to all independent variables (x_{it}, z_i), it refers to RE model.

If the time-fixed effect is introduced in Equation (21), the problem of omitted variables which do not vary with the individual but change with time can be further solved. There is the Two-way Fixed Effects (TFE) model:

$$y_{it} = a + \mathbf{x'_{it}b} + \mathbf{z'_i d} + \lambda_t + u_i + \varepsilon_{it} \tag{22}$$

where the time-fixed effect λ_t is the intercept term unique to the $t-$th period.

5.2.2. Dynamic panel model

The dynamic panel model is as follow:

$$y_{it} = a + \rho y_{i,t-1} + \mathbf{x'_{it}b} + \mathbf{z'_i d} + u_i + \varepsilon_{it} \quad (t = 2, \ldots, T) \tag{23}$$

where the explained variable y_{it} represents the wage of manager, while the $y_{i,t-1}$ expresses the ability and effort of manager, and ρ shows the influence of the manager's ability and effort on the current wage. The Equation (23) can be estimated by using differential GMM and system GMM. The differential GMM is a first-order difference to Equation (23),

$$\Delta y_{it} = \rho \Delta y_{i,t-1} + \mathbf{\Delta x'_{it}b} + \mathbf{\Delta z'_i d} + \Delta \varepsilon_{it} \tag{24}$$

The influence of individual effect u_i is eliminated by first-order difference. Since $y_{i,t-1}$ is related to the disturbance term $\varepsilon_{i,t-1}$, the $\Delta y_{i,t-1}$ is still related to the difference of the disturbance term $\Delta\varepsilon_{it}$, and $\Delta y_{i,t-1}$ is still an endogenous variable. $y_{i,t-2}$ is used as an instrumental variable for $\Delta y_{i,t-1}$ in order to eliminate the influence of endogeneity. In addition, the system GMM combines the differential GMM with the horizontal GMM as an equation system for regression analysis.

5.2.3. Threshold regression model

According to Hansen (1999), the threshold model can be set up as following:

$$y_{it} = \mathbf{b'}_1 \alpha_{it} \cdot I\left(\theta_{it} \le \bar{\theta}\right) + \mathbf{b'}_2 \alpha_{it} \cdot I\left(\theta_{it} > \bar{\theta}\right) + \mathbf{x'_{it}b} + \mathbf{z'_i d} + u_i + \varepsilon_{it} \tag{25}$$

where the dependent variable is the incentive intensity k_{it}, the ownership concentration θ_{it} is the threshold variable, and the preference for the control benefit α_{it} of owners is the key independent variable. The observations are divided into two regimes depending on whether the threshold variable θ_{it} is smaller or larger than the threshold $\bar{\theta}$.

5.3. Empirical results and discussion

5.3.1. Incentive intensity, manager's ability and risk aversion

This subsection examines the influence of manager's ability and risk aversion on incentive intensityk_{it}. Four possible models (Pooled regression model, Fixed Effect model, Two-way Fixed Effect model and Random Effect model) are used to estimate the unbalanced panel data, and the models are tested by F test, LM test and Hausman test. The estimated results are shown in Table 2.

According to Table 2, it is shown that: (1) F test rejects the null hypothesis $u_i = 0$, which indicates that the Fixed-Effect model (FE) is significantly better than the Pooled regression model, and each enterprise should have its own intercept term. (2) F test rejects the null hypothesis of 'no time effect', suggesting that the model should include the time effect and it is more suitable to choose the Two-way Fixed Effect model (TFE) between the two types of Fixed-Effect models. (3) LM test strongly rejects the null hypothesis that there is no individual random effect, indicating that between the Random Effect model (RE) and the Pooled regression model, the RE

Table 2. Results of panel data model estimation.

Independent variables		Dependent variable: incentive intensity k_{it}			
Variable definition	Variable symbol	Pooled	FE	TFE	RE
Level of manager's ability and effort	$w_{i,t-1}$	−0.0011	0.0012	0.0023*	0.0022*
		(0.0028)	(0.0016)	(0.0013)	(0.0012)
Reverse indicator of manager's risk aversion	$level_{it}$	−0.0312	0.0000	−0.0184*	−0.0018
		(0.0113)	(0.0072)	(0.0097)	(0.0106)
Forward indicator of manager's risk aversion	$cash_{it}$	0.0055	0.0073	0.0135	0.0010
		(0.0183)	(0.0081)	(0.0092)	(0.0089)
Ownership concentration	θ_{it}	0.0217	0.0404***	0.0273	0.0374
		(0.0149)	(0.0118)	(0.0199)	(0.0274)
Chairman and general manager	$dual_{it}$	0.0904***	0.0358***	0.0478***	0.0360***
		(0.0078)	(0.0024)	(0.0074)	(0.0079)
Nature of enterprise	$state_{it}$	0.0358***	−0.0033	0.0368***	−0.0029
		(0.0032)	(0.0050)	(0.0049)	(0.0030)
Size of enterprise	$size_{it}$	−0.0057***	0.0008	−0.0049***	0.0023
		(0.0017)	(0.0015)	(0.0017)	(0.0022)
Regional economic development level	gdp_{it}	−0.3063***	0.0768**	−0.0080	−0.0781**
		(0.0828)	(0.0345)	(0.0318)	(0.0380)
Hypothetical test	(1)	**F test** H_0: $u_i = 0$			
		$F(1567, 3680) = 24.30$ $Prob>F = 0.0000$			
	(2)	**F test** H_0: No time effect			
		$F(6, 1567) = 4.23$ $Prob>F = 0.0003$			
	(3)	**LM test** H_0: No individual random effects			
		$chibar2 = 1861.23$ $Prob>chibar2 = 0.0000$			
	(4)	**Hausman test** H_0: u_i is not related to x_{it}, z_i			
		$chi2 = 558.36$ $Prob>chi2 = 0.0000$			
Goodness of fit	R2	0.2995	0.1521	0.1494	0.2588
Number of observations	N	5256	5256	5265	5265

Note: a) Standard errors are in parentheses.
b) ***, **, * indicate significance at the 1, 5, and 10 percent level, respectively.

model should be chosen. (4) Hausman test rejects the null hypothesis 'u_i is not related tox_{it}, z_i', indicating that the Fixed Effect model (FE) should be used instead of the Random Effects model (RE). According to the results of the above hypotheses testing, the Two-way Fixed Effect model (TFE) is finally selected for estimation.

The ability of the manager has a positive effect on the incentive intensity k_{it} at the 10% significance level, while the reverse indicator of manager's risk aversion has a negative effect on the incentive intensity statistically. In addition, the influence of the manager's risk aversion forward indicator on the incentive intensity is positive, but the influence is not significant statistically. It indicates that, given other factors, controlling shareholders are willing to provide a higher incentive wage to managers who have high ability and low risk preference. The above estimation results verify the hypothesis 1a and 1b.

5.3.2. Manager's wage, ability and risk aversion

This subsection uses a dynamic panel model to test whether the wage of managers is affected by their abilities and risk preference or not. The estimation results are presented in Table 3.

First, the results of the hypothesis testing are presented in Table 3. In the differential GMM estimation, the *p*-values corresponding to the first-order and second-order difference of the disturbance term ε_{it} are 0.000 and 0.354, respectively. It suggests that the first-order difference has a statistically significant correlation but the second-order difference has no autocorrelation and the estimation of the differential GMM is

Table 3. Results of differential GMM and system GMM estimation.

Independent variables		Dependent variable: w_{it}	
Variable definition	Variable symbol	Differential GMM	System GMM
Level of manager's ability and effort	$w_{i,t-1}$	0.4221***	0.7686***
		(0.0633)	(0.0349)
Reverse indicator of manager's risk aversion	$level_{it}$	0.0033	0.0469
		(0.1834)	(0.0921)
Forward indicator of manager's risk aversion	$cash_{it}$	−0.0021	−0.1565**
		(0.1163)	(0.0749)
Other variables	–	control	control
Hypothetical Test			
AR (1) statistic		$z = -5.46$	$z = -7.08$
		$Prob>z = 0.000$	$Prob>z = 0.000$
AR (2) statistic		$z = 0.93$	$z = 1.19$
		$Prob>z = 0.354$	$Prob>z = 0.234$
Sargan test		$chi2 = 263.76$	$chi2 = 331.73$
		$Prob>chi2 = 0.249$	$Prob>chi2 = 0.402$
Number of observations		3531	5256

Note: a) Adjusted standard errors are in parentheses.
b) ***, **, * indicate significance at the 1, 5, and 10 percent level, respectively.

reasonable. The results of the Sargan test show that the null hypothesis that 'all instrument variables are valid' cannot be rejected. On the other hand, the p-values corresponding to the first-order and second-order difference of the disturbance term ε_{it} are 0.000 and 0.234 in the system GMM estimation. It indicates that there is a significant correlation for the first-order difference and no autocorrelation for the second-order difference. The estimation of the system GMM is reasonable. As the results of the Sargan test shows that the null hypothesis that 'all instrumental variables are valid' cannot be rejected.

Second, considering the magnitude and significant of the coefficient, the level of manager's ability and effort have positively promoted his income, and the manager's risk aversion forward indicator has a negative inhibitory effect on the wage, which are statistically significant in the system GMM estimation equation with p-value $<$ 0.01. This estimation result verifies the hypothesis 2, and it is also consistent with the main finding of Cruz et al. (2010), which confirms the shareholders of listed enterprises are willing to increase inventive wage for competent managers.

5.3.3. Control benefit and incentive intensity

This subsection uses the panel data threshold regression model[7] to verify the hypothesis 3a and 3b. The estimation results are organised in Table 4.

Table 4 discloses that the bootstrap result of single threshold hypothesis is statistically significant with the p-value 0.070, while the result of double threshold hypothesis is not significant. It indicates that there is only one significant threshold value for the ownership concentrationθ_{it} in this model. According to the estimated result of threshold, listed enterprises can be classified into 'low ownership concentration' $\{\theta_{it} \leq 0.1035\}$ enterprise $(L-type)$ and 'high ownership concentration' $\{\theta_{it}>0.1035\}$ enterprise $(H-type)$ according to the concentration of ownership. In addition, the estimation results of the threshold regression model are summarised in Table 5.

Table 5 explores the link between the preference of control benefit and incentive intensity. In the enterprise with lower ownership concentration ($L-type$ enterprise),

Table 4. Results of threshold testing.

				Threshold		
	Threshold value	F statistics	*p*-value	1%	5%	10%
Single threshold	$\bar{\theta} = 0.1035$	24.27	0.070	246.894	25.445	13.513
Double threshold	$\bar{\theta}_1 = 0.1035$ $\bar{\theta}_2 = 0.2135$	2.81	0.490	98.870	30.775	17.122

Table 5. Results of threshold regression estimation.

Variable α_{it}	Model 1	Model 2	Model 3	Model 4
Low-ownership concentration, $\theta_{it} \leq \bar{\theta}$	0.0412***	0.0413***	0.0416***	0.0413***
	(0.0093)	(0.0094)	(0.0094)	(0.0097)
High-ownership concentration, $\theta_{it} > \bar{\theta}$	−0.0000	−0.0000	−0.0000	−0.0000
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Other variables	control	control	control	control
Threshold value	$\bar{\theta} = 0.1035$	$\bar{\theta} = 0.1035$	$\bar{\theta} = 0.1035$	$\bar{\theta} = 0.1035$
Number of observations	2244	2244	2244	2244

Note: a) Adjusted standard errors are in parentheses.
b) ***, **, * indicate significance at the 1, 5, and 10 percent level, respectively.

the correlation between the preference of the control benefit and the incentive intensity is statistically significant positive. And at a higher concentrated level (*H−type* enterprise), the relationship between the two is negative. In addition, in order to further verify the robustness of the results, different variables are added to or dropped from the benchmark model in the model 2, 3, and 4. We add variable *TobinQ* in model 2, the variables of *TobinQ* and *grow* in model 3, specifically. And we drop the variable of *dual* in model 4. The results of the above four models show that the threshold value is $\bar{\theta} = 0.1035$. It indicates that adding or dropping variables does not change the sign of coefficient and the significance of the threshold variables in the original model, and the model is stable. The empirical finding shows that given other influencing factors, the influence of the controlling shareholders' preference for control benefit on equity incentive is influenced by the equity structure of enterprises. The ownership concentration of enterprises is bounded by the threshold value of 0.1035, and the influence of the private benefit of control preference on incentive intensity is opposite in enterprises with high-ownership concentration and low-ownership concentration. The strengthening of the owners' preference for the control benefit will reduce the incentive intensity in the *H−type* enterprise but increase the incentive intensity in the *L−type* enterprise. This empirical finding verifies the hypothesis 3a and 3b in the theoretical part. The result reveals the key relationship among corporate ownership structure, the private benefit of control and incentive intensity, which are non-linear with the change of ownership concentration.

6. Robustness checks

This section will discuss the robustness of the empirical results in two ways: (1) by adding gradually the new control variables, such as$indr_{it}$(number of shares held by major shareholders)[8], $grow_{it}$(growth of the enterprise)[9] and $perf_{it}$ (business performance)[10], we investigate whether the coefficient and significance of the core explanatory variables have changed; (2) by testing the main models on alternative

Table 6. Robustness test (incentive intensity, manager's ability and risk aversion).

Independent variables		Dependent variable: k_{it}				
		Panel A	Panel B			Panel C
Variable definition	Variable symbol	Full Sample 2007-2014	Full Sample 2007-2014	Full Sample 2007-2014	Full Sample 2007-2014	Sub-sample 2008-2012
Level of manager's ability and effort	$w_{i,t-1}$	0.0023*	0.0022*	0.0021*	0.0024*	0.0019*
		(0.0013)	(0.0013)	(0.0012)	(0.0013)	(0.0010)
Reverse indicator of manager's risk aversion	$level_{it}$	−0.0184*	−0.0189*	−0.0001	−0.0005	−0.0012
		(0.0097)	(0.0106)	(0.0106)	(0.0108)	(0.0107)
Forward indicator of manager's risk aversion	$cash_{it}$	0.0135	0.0010	0.0003	0.0003	0.0038
		(0.0092)	(0.0089)	(0.0090)	(0.0089)	(0.0091)
Ownership concentration	θ_{it}	0.0273	0.0374	0.0364	0.0365	0.0401
		(0.0199)	(0.0275)	(0.0273)	(0.0273)	(0.0269)
Chairman and general manager	$dual_{it}$	0.0478***	0.0360***	0.0359***	0.0360***	0.0358***
		(0.0074)	(0.0079)	(0.0079)	(0.0079)	(0.0070)
Nature of enterprise	$state_{it}$	0.0368***	0.0291***	0.0347***	0.0355***	0.0300***
		(0.0049)	(0.0030)	(0.0031)	(0.0031)	(0.0021)
Size of enterprise	$size_{it}$	−0.0049***	−0.0024***	−0.0011*	−0.0006	−0.0016
		(0.0017)	(0.0002)	(0.0004)	(0.0027)	(0.0022)
Regional economic development level	gdp_{it}	−0.0080	−0.0781**	−0.0801**	−0.0822**	−0.0309
		(0.0318)	(0.0380)	(0.0382)	(0.0387)	(0.0473)
Number of shares held by major shareholders	$indr_{it}$		−0.0012	−0.0002	−0.0007	
			(0.0288)	(0.0288)	(0.0287)	
Business performance	$perf_{it}$			0.0011	0.0010	
				(0.0009)	(0.0009)	
Growth of the enterprise	$grow_{it}$				0.0022	
					(0.0020)	

Note: a) Standard errors are in parentheses.
b) ***, **, * indicate significance at the 1, 5, and 10 percent level, respectively.

sub-samples, we select sub-samples from the year 2008 to 2012 as research samples to examine whether the results of the empirical study is robust.

6.1. Robustness test: incentive intensity, manager's ability and risk aversion

We perform robustness test to support the results of Table 2, by supplementing the regressions with some other control variables (Panel B in Table 6) and using the sub-samples (Panel C in Table 6). To be more clearly, we put the estimation results of Table 2 in Panel A of Table 6.

Panel B in Table 6 shows the regression results after gradually adding control variables. The coefficient and significance of the main variables are consistent with those of panel A. After adding the control variables, there is still a positive relationship between $w_{i,t-1}$ and k_{it}, which is statistically significant. Besides, Panel C in Table 6 is the estimation result based on sub-samples from 2008 to 2012. The sign and significance of the coefficients $w_{i,t-1}$ have not changed. The results and the interpretations of Panel B and C are qualitatively the same as shown in Panel A, confirming the main results.

6.2. Robustness test: manager's wage, ability and risk aversion

We tested the robustness of the estimation results in Table 3, and the results are shown in Table 7. The estimation results in Table 7 confirm the robustness of the estimation using the system GMM model, and hypothesis 2 is further verified.

Table 7. Robustness test (manager's wage, ability and risk aversion).

Independent variables		Dependent variable: w_{it}				
Variable definition	Variable symbol	Panel A		Panel B		Panel C
Level of manager's ability and effort	$w_{i,t-1}$	0.7686***	0.7686***	0.7585***	0.7536***	0.7769***
		(0.0349)	(0.0351)	(0.0307)	(0.0365)	(0.0385)
Reverse indicator of manager's risk aversion	$level_{it}$	0.0469				
		(0.0921)	0.0461	0.0055	0.0085	0.0903
			(0.0928)	(0.0889)	(0.0744)	(0.1218)
Forward indicator of manager's risk aversion	$cash_{it}$	−0.1565**				
		(0.0749)	−0.1563**	−0.1151**	−0.0123	−0.0554***
			(0.0928)	(0.0312)	(0.0909)	(0.0187)
Other variables	–	control	control	control	control	control
Number of shares held by major shareholders	$indr_{it}$		−0.0162	0.0501	0.0733	
			(0.4274)	(0.3982)	(0.3978)	
Business performance	$perf_{it}$			0.0511***	0.0554***	
				(0.0134)	(0.0146)	
Growth of the enterprise	$grow_{it}$				−0.0121	
					(0.0277)	
Hypothetical Test						
AR (1) statistic		$z = -7.08$	$z = -7.07$	$z = -7.14$	$z = -7.06$	$z = -5.74$
		$Prob>z = 0.000$	$Prob>z = 0.000$	$Prob>z = 0.000$	$Prob>z = 0.000$	$Prob>z = 0.000$
AR (2) statistic		$z = 1.19$	$z = 1.19$	$z = 1.34$	$z = 1.34$	$z = 1.38$
		$Prob>z = 0.234$	$Prob>z = 0.234$	$Prob>z = 0.181$	$Prob>z = 0.180$	$Prob>z = 0.167$
Sargan test		$chi2 = 331.73$	$chi2 = 331.69$	$Prob>chi2 = 0.226$	$chi2 = 340.53$	$chi2 = 170.89$
		$Prob>chi2 = 0.402$	$Prob>chi2 = 0.387$		$Prob>chi2 = 0.241$	$Prob>chi2 = 0.466$

Note: a) Adjusted standard errors are in parentheses.
b) ***, **, * indicate significance at the 1, 5, and 10 percent level, respectively.

Table 8. Robustness test (control benefit and incentive intensity).

Variable α_{it}	Panel A		Panel B		Panel C
Low-ownership concentration,$\theta_{it} \leq \bar{\theta}$	0.0412***	0.0412***	0.0423***	0.0426***	0.0005*
	(0.0093)	(0.0094)	(0.0094)	(0.0094)	(0.0002)
High-ownership concentration,$\theta_{it} > \bar{\theta}$	−0.0000	−0.0000	−0.0000	−0.0000	−0.0000
	(0.0002)	(0.0002)	(0.0001)	(0.0002)	(0.0002)
Other variables	control	control	control	control	control
$indr_{it}$		−0.0003	−0.0007	0.0001	
		(0.0145)	(0.0146)	(0.0144)	
$perf_{it}$			0.0014	0.0013	
			(0.0008)	(0.0008)	
$grow_{it}$				0.0006	
				(0.0017)	
Threshold value	$\bar{\theta} = 0.1035$	$\bar{\theta} = 0.1035$	$\bar{\theta} = 0.1035$	$\bar{\theta} = 0.1035$	$\bar{\theta} = 0.2092$
Number of observations	2244	2244	2244	2244	1668

Note: a) Adjusted standard errors are in parentheses.
b) ***, **, * indicate significance at the 1, 5, and 10 percent level, respectively.

6.3. Robustness test: control benefit and incentive intensity

We conduct a robustness test on the estimation results in Table 5, and the outcome of robustness test are shown in Table 8. It is found that the non-linear influence of private interest of control on incentive intensity is still valid, the estimation results are robust.

7. Conclusion

The separation of ownership and management is the trend of the development of enterprises, while the conflict of principal–agent relationship generated by the separation of ownership and management restricts the development of enterprises. This is a universal problem, and this study is just trying to find the answer to this question from both theoretical and empirical aspects[11].

This paper conducts a theoretical and empirical analysis of the relationship between shareholding structure, the private benefit of control and incentive intensity. We use the two-way fixed effects model, the dynamic panel model, and the panel threshold regression model to investigates the principal–agent relationship in the Chinese listed from 2007 to 2014. The empirical hypotheses are based on the results of the three-stage dynamic game model. It is found that managers with greater ability and higher risk aversion will more likely be incentive. The relationship between incentive intensity and the control benefit is non-linear. In other words, the more the owner's preference for the control benefit, the weaker the incentive intensity in a higher concentrated enterprise, and the greater the incentive intensity in a lower concentrated enterprise.

In addition, there are still some imperfections in this study, which can be expanded in the following aspects. First, the theoretical part only deals with the duopoly market of heterogeneous enterprises, future research can be based on the oligopoly market and make the conclusion more general. Second, this paper considers only the private benefit of the controlling shareholder, ignoring the situation of the manager has the actual control in highly separation between ownership and managerial authority, that the manager will also have the motive to pursue the private benefit of control (Bebchuk & Jolls, 1999). Future research can integrate the control benefit of

both the controlling shareholder and the manager into the research framework. Third, the main assumption 'the higher the manager's effort, the greater the reduction in production cost' in the theoretical model neglects the over-investment of the effort by the manager, the over-investment should be in-depth analysed in future research.

Notes

1. Compensation policy usually contains performance-based bonuses and salary revisions, stock options, and performance-based dismissal decisions. Compared to stock options, non-stock options (performance-based bonuses and salary revisions) can more effectively reduce agency costs.
2. The way to reduce the cost mainly includes improving the production process and efficiency of using raw materials through R&D and innovation. The focus is on the principal-agent conflict between "controlling shareholders - small and medium shareholders" and "shareholders - managers", which mainly affects the agency cost.
3. For example, the common risks in the industry environment in which the enterprise is located.
4. Due to the limit of data update speed and access rights, the authors can only update the data until 2014.
5. China Accounting Standards (henceforth, CAS) began to learn from international practices in 1998. Since then, the convergence degree between CAS and IFRS in asset valuation has been increasing. Since January 2007, China has implemented new accounting standards (New CAS), which are basically consistent with IFRS (Liu et al., 2018). The time span of the sample data selected in this paper is from 2007 to 2014. Within this sample range, China has begun to implement the New CAS, the statistical caliber of the relevant variables in this paper is consistent with the international standards (IFRS). Therefore, the data involved in the empirical study does not have the statistical caliber problem caused by the change of standards.
6. The wage of managers mostly follows the "incentive salary system", the wage level can directly reflect the manager's ability and efforts (Cruz et al., 2010). This study takes the lagging period of manager's salary as the proxy variable to measure the manager's ability and effort, mainly including the following three reasons. First, to avoid the endogenous problems that may be caused by the current salary level in the analysis process, we choose the lag period of salary as a core variable to measure the manager's ability and effort. Second, the higher the lag period, the more difficult to accurately reflect the managers' current ability and effort, we select the manager's salary with one period lag in order to ensure the timeliness. Third, if the manager's salary with lag two periods is used to measure the manager's ability and effort, the number of research samples will be greatly reduced due to the lack of manager salary data for 2005 and 2006, which may lead to bias in the estimation results.
7. Before making a panel data threshold regression, make sure the data is a balanced panel. Based on the original data, some observations with omitted values is removed, and the balance panel data of 374 listed enterprises form the year 2008 to 2013 is obtained.
8. The calculation method is the number of shares held by the largest shareholder divided by the total number of shares.
9. The calculation method is growth rate of annual operating income.
10. The calculation method is logarithm of net profit.
11. To ensure the consistency of theoretical model design and empirical research, we choose the China's listed companies as the research object. The reason is that there is no obvious difference between China and the "free economy" countries in terms of listed enterprises operation and government management. Therefore, the empirical test of the theoretical model results using the data of China's listed companies has certain universality, and is also applicable to other "free economy" countries.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This study was supported by the National Natural Science Foundation of China [grant number 51908229] and the National Natural Science Foundation of China [grant number 71603087].

References

Aghion, P., & Bolton, P. (1992). An incomplete contract approach to financial contracting. The Review of Economic Studies, *59*(3), 473–494. https://doi.org/10.2307/2297860

Alonso-Paulí, E. (2019). Contracting with a quiet-life manager. *Economic Research-Ekonomska Istraživanja*, *32*(1), 2231–2251. https://doi.org/10.1080/1331677X.2019.1645717

Aluchna, M., & Kaminski, B. (2017). Ownership structure and company performance: A panel study from Poland. *Baltic Journal of Management*, *12*(4), 485–502. https://doi.org/10.1108/BJM-01-2017-0025

An, T. L., & Yang, Y. Y. (2002). Characteristics of the industry prone to price competition and the firms' strategic behavior. *Economic Research Journal*, *6*, 46–54 + 95.

Andres, C. (2008). Large shareholders and firm performance: An empirical examination of founding-family ownership. *Journal of Corporate Finance*, *14*(4), 431–445. https://doi.org/10.1016/j.jcorpfin.2008.05.003

Bandiera, O., Guiso, L., Prat, A., & Sadun, R. (2015). Matching firms, managers, and incentives. *Journal of Labor Economics*, *33*(3), 623–681. https://doi.org/10.1086/679672

Bebchuk, L. A., & Jolls, C. (1999). Managerial value diversion and shareholder wealth. *Journal of Law, Economics, and Organization*, *15*(2), 487–502. https://doi.org/10.1093/jleo/15.2.487

Bøhren, Ø., Stacescu, B., Almli, L., & Søndergaard, K. (2019). When does the family govern the family firm? *Journal of Financial and Quantitative Analysis*, *54*(5), 2085–2117. https://doi.org/10.1017/S0022109018001102

Cai, C. X., Hillier, D., & Wang, J. (2016). The cost of multiple large shareholders. *Financial Management*, *45*(2), 401–430. https://doi.org/10.1111/fima.12090

Chaim, F., & Pakes, A. (2000). A dynamic oligopoly with collusion and price wars. The Rand Journal of Economics, *31*(2), 207–236. https://doi.org/10.2307/2601038

Cronqvist, H., & Fahlenbrach, R. (2009). Large shareholders and corporate policies. *Review of Financial Studies*, *22*(10), 3941–3976. https://doi.org/10.1093/rfs/hhn093

Cruz, C. C., Gomez-Mejia, L. R., & Becerra, M. (2010). Perception of benevolence and the design of agency contracts: CEO-TMT relationships in family firms. *Academy of Management Journal*, *53*(1), 69–89. https://doi.org/10.5465/amj.2010.48036975

Dai, L., & Song, D. (2018). The influence of mandatory requirement of performance hurdles in executive equity incentive contracts on corporate management performance. *China Industrial Economics*, *4*, 117–136.

Deng, J. L., & Gu, N. K. (2017). Enterprises' investment decisions under heterogeneous beliefs between insiders and outsiders. *Finance and Trade Research*, *11*, 88–100.

Doidge, C. (2004). U.S. cross-listings and the private benefits of control: Evidence from dual-class firms. *Journal of Financial Economics*, *72*(3), 519–553. https://doi.org/10.1016/S0304-405X(03)00208-3

Dyck, A., & Zingales, L. (2004). Private benefits of control: An international comparison. *The Journal of Finance*, *59*(2), 537–600. https://doi.org/10.1111/j.1540-6261.2004.00642.x

Etro, F. (2011). Endogenous market structures and contract theory: Delegation, principal-agents contracts, screening, franchising and tying. *European Economic Review*, *55*(4), 463–479. https://doi.org/10.1016/j.euroecorev.2010.08.001

Faccio, M., Marchica, M. T., & Mura, R. (2011). Large shareholder diversification and corporate risk-taking. *Review of Financial Studies*, *24*(11), 3601–3641. https://doi.org/10.1093/rfs/hhr065

Fama, E. F., & Jensen, M. C. (1983). Agency problems and residual claims. *The Journal of Law and Economics*, *26*(2), 327–349. https://doi.org/10.1086/467038

Gilson, R. J., Schwartz, A. (2014). *Corporate control and credible commitment*. Columbia Law and Economics Research Paper, No. 436. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2182781#

Grossman, S., & Hart, O. (1988). One-share-one-vote and the market for corporate control. *Journal of Financial Economics*, *20*, 175–202. https://doi.org/10.1016/0304-405X(88)90044-X

Hansen, B. E. (1999). Threshold effects in non-dynamic panels: Estimation, testing, and inference. *Journal of Econometrics*, *93*(2), 345–368. https://doi.org/10.1016/S0304-4076(99)00025-1

Hao, Y., & Liu, X. (2010). Study on efficiency of investment and extrusion effect based on the private benefit of control. *Science Research Management*, *31*(3), 165–170.

Haw, I. M., Hu, B. B., Hwang, L. S., & Wu, W. (2004). Ultimate ownership, income management, and legal and extra-legal institutions. *Journal of Accounting Research*, *42*(2), 423–462. https://doi.org/10.1111/j.1475-679X.2004.00144.x

Jensen, M. C., & Murphy, K. J. (1990). Performance pay and top-management incentives. *Journal of Political Economy*, *98*(2), 225–264. https://doi.org/10.1086/261677

Jia, M., Zhang, Z., & Wang, D. F. (2007). A survey of private benefits of control. *China Journal of Accounting Studies*, *6*, 86–96.

Johnson, S., Kaufmann, D., McMillan, J., & Woodruff, C. (2000). Why do firms hide? Brides and unofficial activity after communism. *Journal of Public Economics*, *76*(3), 495–520. https://doi.org/10.1016/S0047-2727(99)00094-8

Korsakienė, R., Bekešienė, S., & Hošková-Mayerová, Š. (2019). The effects of entrepreneurs' characteristics on internationalisation of gazelle firms: A case of Lithuania. *Economic Research-Ekonomska Istraživanja*, *32*(1), 2864–2881. https://doi.org/10.1080/1331677X.2019.1655658

La Porta, R., Lopez-De-Silanes, F., & Shleifer, A. (1999). Corporate ownership around the world. *The Journal of Finance*, *54*(2), 471–517. https://doi.org/10.1111/0022-1082.00115

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., & Vishny, R. (2000). Investor protection and corporate governance. *Journal of Financial Economics*, *58*(1–2), 3–27. https://doi.org/10.1016/S0304-405X(00)00065-9

Liu, X., Fu, Q., & Hao, Y. (2015). Agency of ultimate owner, modes of the separation of control benefit from cash flow rights and private benefits of control. *Systems Engineering-Theory & Practice*, *1*, 75–85.

Liu, Q., Ge, G. Q., Ning, C., Tao, X. B., & Sun, Y. B. (2018). Do private benefits of control affect corporate social responsibility? Sustainability, *10*(9), 3309–3319. https://doi.org/10.3390/su10093309

Nenova, T. (2003). The value of corporate voting rights and control: A cross-country analysis. *Journal of Financial Economics*, *68*(3), 325–351. https://doi.org/10.1016/S0304-405X(03)00069-2

Peng, Y. C., Ni, X. R., & Shen, J. (2018). The effect of transforming the economy from substantial to fictitious on financial market stability: An analysis on stock price crash risk. *Economic Research Journal*, *10*, 50–66.

Porter, R. H. (1983). Optimal cartel trigger price strategies. *Journal of Economic Theory*, *29*(2), 313–338. https://doi.org/10.1016/0022-0531(83)90050-9

Ran, R., Wang, D., & Xie, Y. (2015). Control right paradox, compensations of control right cost and R&D investment. *Science Research Management*, *36*(8), 87–95.

Saona, P., & Martin, P. (2016). Country level governance variables and ownership concentration as determinants of firm value in Latin America. *International Review of Law and Economics*, *47*, 84–95. https://doi.org/10.1016/j.irle.2016.06.004

Shleifer, A., & Vishny, R. (1997). A survey of corporate governance. The Journal of Finance, *52*(2), 737–783. https://doi.org/10.1111/j.1540-6261.1997.tb04820.x

Staszkiewicz, P., & Szelągowska, A. (2019). Ultimate owner and risk of company performance. *Economic Research-Ekonomska Istraživanja*, *32* (1), 3795–3812. https://doi.org/10.1080/1331677X.2019.1678499

Xia, X., & Yang, J. Q. (2017). Private benefits of control and capital structure of the firm under incomplete markets. *Chinese Journal of Management Science*, *10*, 31–41.

Xiao, J. L., Pan, Y., & Dai, Y. Y. (2018). Couples' joint holdings and corporate risk-taking. *Economic Research Journal*, *5*, 190–204.

Yang, L. L., Ko, P. (2020). The empirical study of shareholding structure and firm performance in China. In *5th International Conference on Economics, Management, Law and Education (EMLE 2019)* (pp. 132–137). Atlantis Press.

Ye, K. T. (2003). The private benefit of control of enterprise control: A study on non-tradable shares transfer market in China. *Economic Science*, *5*, 61–69.

Yu, M. G., Xia, X. P., & Pan, H. B. (2006). Empirical analysis of the private benefits of control. *Management Sciences in China*, *3*, 27–33.