

Executive Compensation, Compensation Gaps, Ownership Concentration and Corporate Performance: An Optimal Control and Stability Analysis for the Chinese Technology Sector

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Abstract: This study investigates the relationship between executive compensation, compensation gaps, ownership concentration, and firm performance in the Chinese technology sector using both empirical analysis and a control-theoretic framework. Drawing on a panel dataset of 6,750 firm-year observations from 847 listed firms, the study examines the effects of CEO compensation, non-CEO compensation, and vertical and horizontal compensation gaps on corporate performance. The results show that CEO compensation, non-CEO compensation, and the non-CEO–employee compensation gap have significant positive effects on firm performance, indicating that incentive-based compensation mechanisms remain effective in enhancing managerial productivity. In contrast, the CEO–non-CEO compensation gap and CEO–industry compensation gap is not statistically significant, suggesting that not all compensation disparities function as effective incentives. Furthermore, ownership concentration is found to weaken the positive relationship between executive compensation and firm performance, highlighting its moderating role within corporate governance structures. By incorporating a control-theoretic model, the study conceptualizes compensation as a dynamic policy instrument and demonstrates that higher ownership concentration reduces the effectiveness of incentive mechanisms by lowering control gains. The equilibrium analysis further shows that firms converge to a stable performance level, although higher ownership concentration leads to a lower steady-state outcome. Overall, the study contributes to the literature by integrating empirical findings with dynamic modeling, offering a more comprehensive understanding of how compensation structures and governance mechanisms jointly influence firm performance.

Keywords: corporate governance dynamics; pay dispersion; Lyapunov stability; firm valuation; optimal control; emerging markets; managerial incentives

1. Introduction

The swift growth of China's technology sector has heightened the necessity for robust corporate governance structures, especially in aligning executive incentives with organizational success. Executive remuneration is a key mechanism for alleviating agency disputes and improving managerial effectiveness. Nonetheless, in addition to total compensation amounts, the configuration of compensation disparities both vertical and horizontal has become a pivotal factor influencing organizational results. In the Chinese environment, marked by a mixed ownership system that integrates state-owned and private firms, ownership concentration significantly influences executive conduct and decision-making authority. Elevated ownership concentration may enhance oversight but can also skew incentive systems, thereby affecting the efficacy of compensation frameworks. This study examines the dynamic interplay between executive remuneration, compensation disparities, and corporate performance within China's technology industry, with ownership concentration serving as a moderating

influence. The research employs a substantial panel dataset and utilizes empirical modeling to assess the efficacy of compensation mechanisms as control procedures inside organizations. This study aims to analyze the impact of CEO remuneration structures on business performance and to assess if ownership concentration modifies these dynamics in a swiftly changing technological and institutional landscape.

2. Literature Review

2.1. Executive Compensation and Firm Performance

Executive compensation is a fundamental mechanism in corporate governance, primarily explained through the principal-agent theory, which posits that compensation contracts align managerial interests with those of shareholders [1]. Empirical studies consistently report a positive relationship between executive compensation and firm performance, as higher compensation enhances managerial motivation and decision-making efficiency [2,3].

However, much of the existing literature has focused predominantly on CEO compensation, overlooking the role of non-CEO executives. This limitation is significant because executive decision-making is often collective, particularly in complex sectors such as technology [4]. Recent studies suggest that non-CEO executives also contribute substantially to firm performance, indicating the need for a more comprehensive evaluation of executive compensation structures.

2.2 Compensation Gap and Incentive Mechanisms

The notion of compensation gap is based on tournament theory, which posits that greater pay differentials motivate individuals to expend increased effort to attain higher-ranking positions. Empirical data indicates that vertical compensation disparities such as those between CEOs and non-CEO executives or between executives and employees can improve business performance by fostering competitiveness and productivity [6]. However, significant remuneration differences may lead to adverse behavioral consequences, such as diminished collaboration and a sense of inequity. This viewpoint aligns with equity theory, which posits that individuals assess justice by juxtaposing their rewards with those of others [7]. Excessive compensation disparities can erode morale and disrupt corporate cohesion. Alongside vertical disparities, horizontal compensation discrepancies, especially in relation to industry standards, have garnered heightened scrutiny. In competitive sectors such as technology, executives assess their remuneration against that of counterparts in other companies, impacting retention, mobility, and strategic choices [8]. This dimension, despite its significance, remains inadequately examined in empirical study.

2.3 Ownership Concentration and Corporate Governance

Ownership concentration is a fundamental aspect of corporate governance that influences monitoring efficacy and managerial motivations. La Porta et al. [9] assert that enterprises with concentrated ownership structures demonstrate enhanced monitoring systems, hence diminishing agency costs and augmenting performance. Excessive ownership concentration may cement powerful shareholders, leading to managerial intervention and diminished autonomy [10]. This dual effect indicates that ownership concentration may either enhance or diminish the efficacy of CEO compensation as an

incentive mechanism. In China, ownership structures are notably intricate due to the presence of state-owned enterprises (SOEs) alongside privately owned companies. Research demonstrates that ownership concentration in Chinese enterprises varies considerably and greatly influences CEO conduct and organizational results [11]. Consequently, it is imperative to regard ownership concentration as a moderating variable in the compensation–performance nexus.

2.4 Research Gap

Despite previous research significantly enhancing the comprehension of the correlation between CEO remuneration and corporate success, notable deficiencies persist in the literature. Initially, a significant portion of the current research has primarily concentrated on CEO remuneration, frequently neglecting the wider executive team. This limited viewpoint constrains the capacity to comprehensively assess the collective influence of top management on organizational performance, as strategic decisions are generally taken collaboratively rather than solely by the CEO [4].

Secondly, there is an absence of thorough integration among various aspects of compensation difference. Although several studies investigate vertical compensation disparities within organizations and others analyze horizontal variations across industries, there have been limited efforts to integrate these viewpoints into a cohesive analytical framework. Consequently, the comprehensive incentive consequences of compensation frameworks may not be sufficiently comprehended [8].

The moderating influence of ownership concentration remains inadequately examined, especially in emerging markets like China, characterized by diverse corporate governance frameworks. The disparity in ownership structures, particularly between state-owned and privately owned enterprises, indicates that ownership concentration may profoundly affect the efficacy of executive remuneration systems [11]. This study formulates an integrated methodology that concurrently examines executive remuneration, compensation disparities, and ownership concentration to mitigate these limitations. By including these factors into a dynamic analytical model, the study offers a more thorough comprehension of the interaction between incentive structures and governance processes in affecting business performance.

2.5 Control-theoretic Framing for Conceptual

The conceptual foundation of this study is grounded in a control-theoretic framework. Within this perspective, executive compensation is viewed as a policy instrument that directs firm performance toward a target level under governance constraints. Instead of being treated merely as a static explanatory factor, compensation is modeled as a time-varying control input that shapes the dynamic path of firm performance. Ownership concentration functions as a structural parameter that influences the strength and effectiveness of this control mechanism. This approach allows the analysis to extend beyond descriptive governance discussions and develop formal insights into optimal policy design, equilibrium conditions, and system stability [12,13].

2. Methods

This section outlines the methodological framework utilized to analyze the correlation among executive remuneration, compensation disparities, ownership concentration, and business performance. The

research employs a comprehensive methodology that merges empirical panel data analysis with a control-theoretic framework to elucidate both static correlations and dynamic interactions. The empirical component employs firm-level data to assess the direct and moderating impacts of compensation variables, whereas the analytical component frames these relationships within a dynamic system in which compensation serves as a policy instrument and firm performance develops over time. This dual approach facilitates a more thorough comprehension of the functioning of incentive structures across different governance contexts.

Figure 1 summarizes the conceptual architecture inherited from previous studies and adapted for this study. Compensation inputs affect firm performance directly, whereas ownership concentration moderates the strength of that effect.

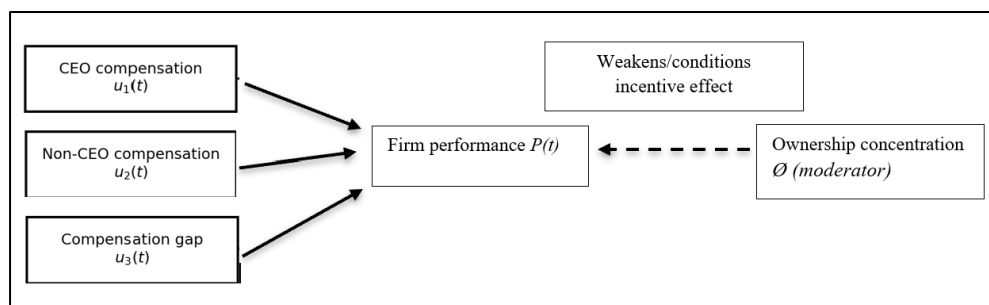


Figure 1. Conceptual model linking executive compensation variables to firm performance with ownership concentration as moderator.

Meanwhile, control-system representation of executive compensation as a dynamic policy instrument influencing firm performance under ownership concentration constraints. **Figure 2** presents the control-system interpretation used in the mathematical sections. Desired performance is compared with observed performance; the controller selects compensation intensities; the firm-performance block evolves according to a differential equation; and ownership concentration reduces the effective control gain.

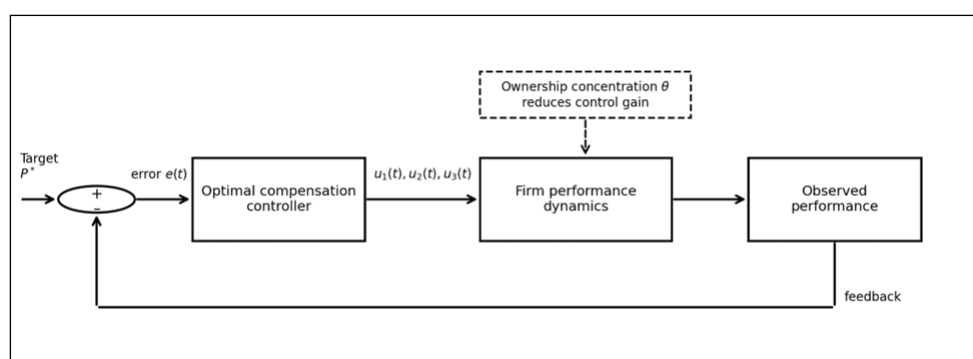


Figure 2 Control-system diagram for the compensation–performance dynamic.

The study utilizes 6,750 firm-year observations from 847 publicly traded technology firms in China. The models assess business performance utilizing market and accounting metrics and examine the impacts of CEO remuneration, non-CEO compensation, the CEO–non-CEO disparity, the non-CEO–employee disparity, and the CEO–industry disparity. Robustness approaches encompass fixed-effects estimation, substitution of performance proxies, generalized method of moments, instrumental

variables, and propensity score matching. The mathematical model presented below does not supplant such tests; instead, it offers a dynamic mechanism aligned with the observed empirical indicators and moderation patterns.

2.1. Variables and interpretation in the dynamic model

Let $P(t)$ represent firm performance at time t . Let $u_1(t)$, $u_2(t)$, and $u_3(t)$ signify, respectively, the intensity of CEO compensation incentives, non-CEO compensation incentives, and compensation-gap incentives. Let $\theta \in [0, 1]$ represent ownership concentration. In this article, θ is seen as exogenous throughout the control horizon, aligning with the thesis's characterization of ownership concentration as a rather stable governance attribute. The parameter α represents baseline performance generation, $\delta > 0$ denotes the natural dissipation or adjustment rate of performance, $\beta_i > 0$ signifies gross control gains, $\eta > 0$ quantifies the gain-reducing effect of concentrated ownership, and $r_i > 0$ indicates quadratic incentive-cost weights.

2.2. Optimal control model

2.2.1 State dynamics

The firm-performance dynamics are specified as a linear control system:

$$dP/dt = \alpha - \delta P(t) + (\beta_1 - \eta\theta) u_1(t) + (\beta_2 - \eta\theta) u_2(t) + (\beta_3 - \eta\theta) u_3(t), \quad P(0) = P_0 \quad (1)$$

The expression $\beta_i - \eta\theta$ represents the net incentive gain. Consequently, ownership concentration immediately diminishes the efficacy of each compensation mechanism. This structure reflects the thesis finding that increased focus diminishes the favorable correlation between compensation and performance.

2.2.2. Objective functional

The firm chooses controls over a finite horizon $[0, T]$ to maximize discounted performance net of incentive cost:

$$J(u_1, u_2, u_3) = \int_0^T e^{-\rho t} [qP(t) - 1/2(r_1 u_1(t)^2 + r_2 u_2(t)^2 + r_3 u_3(t)^2)] dt. \quad (2)$$

Here, $\rho > 0$ denotes the discount rate, while $q > 0$ represents the shadow value of firm performance. The quadratic control cost inhibits excessively unbounded incentives and ensures that the optimization problem is strictly concave in the control vector.

2.2.3. Admissible controls

The permissible control set is $U = \{u(t) = (u_1, u_2, u_3): u_i(t) \text{ is measurable, } 0 \leq u_i(t) \leq \bar{u}_i \text{ for } t \in [0, T]\}$. The limits denote regulatory, budgetary, and internal governance limitations. Within these parameters, the controls may be construed as policy intensities rather than actual monetary values.

2.2.4. Hamiltonian and first-order conditions

Define the current-value Hamiltonian by

$$H = qP - 1/2(r_1u_1^2 + r_2u_2^2 + r_3u_3^2) + \lambda[\alpha - \delta P + \sum_{i=1}^3 (\beta_i - \eta\theta)u_i] \quad (3)$$

The adjoint equation and interior first-order conditions are

$$d\lambda/dt = (\rho + \delta)\lambda - q, \quad (4)$$

$$u_i^*(t) = ((\beta_i - \eta\theta)\lambda(t))/r_i, \quad i=1,2,3, \quad (5)$$

with projection onto $[0, \bar{u}_i]$ when the internal expression contravenes a control limit. Equation (5) elucidates the principal control discovery of the paper: concentrated ownership diminishes optimal incentive intensity by decreasing the effective gain $\beta_i - \eta\theta$.

2.2.5. Equilibrium analysis

For stable controls or prolonged stationary policies, let $\lambda^* = q/(\rho + \delta)$, derived from the stationary form of Equation (4). Inserting Equation (5) into Equation (1) yields

$$dP/dt = \alpha - \delta P(t) + \lambda^* \sum_{i=1}^3 ((\beta_i - \eta\theta)^2/r_i). \quad (6)$$

The associated steady state is

$$P^* = \alpha/\delta + (\lambda^*/\delta) \sum_{i=1}^3 ((\beta_i - \eta\theta)^2/r_i). \quad (7)$$

2.2.6. Lyapunov stability analysis

To examine the stability of the stationary state under constant optimal controls, consider the error state $x(t) = P(t) - P^*$. Subtracting Equation (7) from Equation (6) results in $\dot{x}(t) = -\delta x(t)$. Examine the Lyapunov function

$$V(x) = 1/2 x^2. \quad (8)$$

Its time derivative along trajectories is

$$dV/dt = x \dot{x} = -\delta x^2 = -2\delta V(x). \quad (9)$$

Because $\delta > 0$, V is positive definite and $\dot{V}$ is negative definite. Hence the equilibrium is globally asymptotically stable.

2.2.7. Formal propositions, theorems and proofs

Proposition 1. Condition for Positive Net Incentives.

For each control channel i , compensation incentives enhance firm performance if and only if $\beta_i - \eta\theta > 0$.

Demonstration. Examine Equation (1). The marginal effect of $u_i(t)$ on dP/dt is expressed as $\partial \dot{P} / \partial u_i = \beta_i - \eta\theta$. The incentive effect is positive when $\beta_i - \eta\theta > 0$ and non-positive in all other cases.

Proposition 2. Comparative-static impact of ownership concentration.

Assume optimal interior controls and that $\beta_i - \eta\theta > 0$ for $i=1,2,3$. The steady-state performance level P^* diminishes as ownership concentration θ increases.

Demonstration. Differentiate Equation (7) concerning θ :

$$\partial P^* / \partial \theta = -(2\eta\lambda^* / \delta) \sum_{i=1}^3 ((\beta_i - \eta\theta) / r_i).$$

Under the sustained circumstances $\eta > 0$, $\lambda^* > 0$, $\delta > 0$, $r_i > 0$, and $\beta_i - \eta\theta > 0$, the summation term is unequivocally positive. Therefore, $\partial P^* / \partial \theta < 0$, indicating that increased ownership concentration diminishes the steady-state performance derived from incentives.

Theorem 1. Existence and uniqueness of the equilibrium state.

Assuming α is finite, δ is greater than zero, and controls are bounded, the dynamic system described in Equation (1) possesses a unique stable state P^* .

Demonstration. By setting $\dot{P}=0$ in Equation (1), one obtains a linear algebraic equation in P : $\delta P = \alpha + \sum_{i=1}^3 (\beta_i - \eta\theta) u_i$. Given that $\delta > 0$, dividing by δ results in a unique solution. Under the fixed optimal parameters in Equation (5), this solution corresponds exactly to Equation (7).

Theorem 2. Global asymptotic stability with respect to stationary optimum controllers.

Assume the controls are maintained at their stationary optimal settings and $\delta > 0$. The equilibrium P^* is globally asymptotically stable.

Proof. Define $x(t)$ as $P(t)$ minus P^* . The closed-loop error dynamics are represented by $\dot{x} = -\delta x$. Select $V(x) = x^2/2$. Thus, $V(x) > 0$ for $x \neq 0$ and $V(0) = 0$. Furthermore, $\dot{V} = x \dot{x} = -\delta x^2 < 0$ for all $x \neq 0$. According to Lyapunov's direct technique, the equilibrium exhibits global asymptotic stability. Given that the scalar linear system possesses an explicit solution $x(t) = x(0)e^{-\delta t}$, the convergence is also exponential.

Theorem 3. Optimal control law for the interior. If the admissible set is non-binding and the Hamiltonian exhibits strict concavity in the control vector, the singular interior optimal control fulfills Equation (5).

Demonstration. The Hamiltonian in Equation (3) is separable and absolutely concave in u , as $\partial^2 H / \partial u_i^2 = -r_i < 0$ for all i . The first-order requirement $\partial H / \partial u_i = -r_i u_i + \lambda(\beta_i - \eta\theta) = 0$ results in $u_i^* = ((\beta_i - \eta\theta)\lambda) / r_i$. Strict concavity ensures the uniqueness of the interior maximizer.

3. Results

The control model replicates the primary empirical trajectory of the investigation. Proposition 1 posits that compensation incentives exert a beneficial influence when the net gain is positive; this aligns with the thesis findings indicating that both CEO and non-CEO remuneration are substantial positive indicators of business performance. The same rationale elucidates why the disparity in salary between non-CEO employees may enhance performance: when the vertical gap serves as an incentive, the corresponding control coefficient remains positive. The approach elucidates why certain compensation-gap metrics are statistically deficient. If a channel's effective gain is minimal, positive gross incentives may be counterbalanced by governance frictions or diminished salience. In this scenario, $\beta_i - \eta\theta$ approaches zero, resulting in a diminished performance response, which aligns with the thesis conclusion that the CEO–non-CEO gap and the CEO–industry gap lacks statistical significance. Proposition 2 and Equation (10) codify the moderation hypothesis empirically demonstrated in the thesis. As ownership concentration increases, the efficacy of each compensation route diminishes. Concentrated owners may exert more rigorous supervision, influence incentive structures, or favor short-term control over managerial autonomy. These mechanisms diminish the additional advantages of compensation-driven motivation.

This explanation aligns with the documented empirical evidence that ownership concentration diminishes the positive correlation between CEO compensation and business performance, attenuates the non-CEO compensation channel, and also mitigates the advantageous impact of the non-CEO–employee disparity. In control theory, θ diminishes system gain, thereby decreasing performance sensitivity to compensating inputs.

The Lyapunov theorem offers a valuable and meaningful interpretation. Under fixed optimal incentives, the system approaches a singular long-term performance level. Consequently, the compensation-governance framework influences not just immediate results but also the rate and degree of convergence in corporate performance. A greater δ enhances convergence, but a greater θ diminishes the target performance level at which the system stabilizes.

4. Discussion

This study's findings provide robust empirical and theoretical evidence that executive compensation serves as an effective incentive mechanism, while its effectiveness is contingent upon governance structure, especially ownership concentration. In accordance with existing literature based on principal-agent theory, both CEO and non-CEO compensation demonstrate substantial positive impacts on firm performance, validating that financial incentives synchronize managerial behaviour with organizational goals [1-2,11]. This outcome aligns with the empirical evidence presented in the thesis, indicating that both CEO and non-CEO compensation substantially improve firm performance in the Chinese technology industry.

The control-theoretic formulation enhances this interpretation by demonstrating that compensation functions as a dynamic control input that perpetually aligns firm performance with a targeted trajectory.

The empirically found positive coefficients correlate to positive net control benefits, so supporting the theoretical mechanism that underpins incentive effectiveness. This dynamic perspective enhances conventional governance literature by integrating concepts from optimal control theory, wherein policy instruments are modified over time to attain system stability and optimal results [15-16]. The significance of salary disparities, however, is more complex. The substantial positive impact of the non-CEO–employee wage disparity corroborates tournament theory, which posits that pay dispersion incentivizes individuals to enhance their effort to attain elevated positions [17-18]. The minimal relevance of the CEO–non-CEO and CEO–industry disparities indicates that not all types of inequality result in effective incentives. From the standpoint of equity theory, significant or misaligned compensation differences might diminish collaboration and perceived equity, consequently undermining organizational unity [6,19]. Moreover, horizontal comparisons among enterprises may have limited impact on internal performance if external benchmarking is neither salient nor relevant [20-21]. The data indicate that executives do not exhibit uniform sensitivity to various forms of wage discrepancies.

Ownership concentration serves as a significant moderating variable in this investigation. The empirical findings indicate that increased ownership concentration diminishes the beneficial impact of compensation incentives on firm performance, aligning with established corporate governance theories that propose concentrated ownership improves monitoring while potentially limiting managerial discretion [9,8]. In emerging markets like China, where ownership arrangements differ markedly among enterprises, this moderating effect is especially pronounced [22-23]. The results align with previous empirical research indicating that concentrated ownership might diminish the effectiveness of incentives by enhancing shareholder intervention and control [24-25].

From a control-theoretic standpoint, concentrated ownership diminishes the effective control gain of compensation incentives, thereby restricting their capacity to impact firm performance. This offers a formal elucidation of the thesis finding that ownership concentration diminishes the favourable correlation between executive salary and firm performance. The equilibrium study suggests that heightened ownership concentration diminishes the steady-state level of company performance, so validating the notion that governance arrangements influence long-term organizational results.

Furthermore, the Lyapunov stability analysis provides further theoretical insight by illustrating that the system converges to a singular and stable equilibrium, irrespective of fluctuations in compensation intensity and ownership structure. This suggests that although ownership concentration may diminish the efficacy of incentives and lower long-term performance, it does not disrupt the dynamics of company performance. Rather, it modifies the trajectory and equilibrium point at which the system approaches. The combination of empirical evidence with control theory offers a more robust and thorough elucidation of the functioning of compensation systems under governance limitations. It illustrates that executive compensation is not only a fixed factor in business performance but a dynamic policy tool whose efficacy is significantly influenced by institutional frameworks. This integrated method enhances the pay study by providing a formal analytical framework for comprehending heterogeneity in compensation-performance linkages across enterprises and governance contexts, especially within China's developing technology sector.

5. Conclusion

This study elaborates on the concept by articulating the compensation–performance relationship as a control mechanism. CEO remuneration, non-CEO compensation, and compensation disparities are

treated as control variables; firm performance is the variable state; ownership concentration diminishes the effective benefits of those controls. The optimum-control and Lyapunov analysis indicates that compensation is advantageous solely when its net control gain is positive, and that ownership concentration diminishes both optimal incentives and steady-state performance. These theoretical assertions align with the thesis proof from the enumerated technological companies in China.

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