



## The effect of Digitalization on CEO's Compensation and CEO's Compensation Performance

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**SUMMARY:** *This paper takes the CEO compensation and CEO compensation performance sensitivity of on-financial listed companies in Shanghai and Shanghai A shares from 2004 to 2023 as the study subject, designs and develops a systematic measurement system of digitalization through text analysis, and uses an empirical analysis to analyze the effect of digitalization on CEO compensation and CEO compensation performance sensitivity. The findings indicated that the corporate digitalization remarkably decreased the relationship between CEO remuneration and corporate performance, and strengthened the excess pay of CEOs. The conclusion was still stable after considering the intrinsic problem. In accordance with the mechanism analysis, the corporate digitalization can enhance CEO's salary and decrease CEO's compensation-performance sensitivity through the channel of improving corporate governance and improving CEO's holistic capabilities that can be adopted in business entity management. It was also identified that digitalization would strengthen the CEO's relative comparable salary and decrease the vulnerability of relative comparable salary and performance.*

**KEYWORDS:** *agency theory, business entity digitalization, CEO remuneration, performance sensitivity, CEO holistic capabilities*

### 1 Introduction

The digital economy has emerged as an important driving force for China's economic growth. In this macro context, the effect of the digital economy on the micro level is also expanding. More and more companies are integrating digitalization with their own businesses. The deep integration of digital-enabled technologies and the real economy not only injected strong momentum into the innovation and development of companies, but also had a subversive effect on traditional business models and operational processes. It not only created broad prospects, but also brought severe challenges [1]. For traditional companies, promoting digitalization was a key strategic move to respond to the digital economy era and leverage digital-enabled technologies to facilitate business entity development [2]. The application of digital-enabled technologies could help companies decrease costs and strengthen efficiency, maximize resource allocation, and facilitate extensive collaboration at the social level, thereby opening up a broader space for value creation. It could also drive the transformation and upgrading of products and services, thereby improving customer experience and increasing customer stickiness, thus consolidating the competitive position of companies in the market [3]. It can be observed that the implementation of digitalization has become an inherent requirement and unavoidable option for companies to seek cost reduction and efficiency strengthen, obtain

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<https://doi.org/10.65102/is20261135>

growth momentum and practice sustainable development. The digital economy had been facilitated to the national strategic level and became the core concern and development focus of governments at all levels. The country systematically facilitated the construction of the digital economy from a strategic height and continuously strengthened investment and policy support. The aim was to gather more innovative resources and provide precise services for companies implementing digitalization to support their digitalization. In addition, through the establishment of a sound digital economic supervision framework, enhance governance efficiency, to regulate the market to ensure its sound development. By contrast, it would facilitate international exchanges and cooperation, absorb global wisdom, and jointly facilitate the prosperity and progress of the digital economy. Whether it was at the national level or at the business entity level, the wave of digitalization was irreversible [4]. For companies, only by actively embracing technological change and rationally applying digitalization technologies to all aspects of business management could they seize the opportunity in the new round of industrial transformation and win the initiative for future development.

In modern corporate governance, how to formulate a reasonable incentive method to make the personal interests of management and employees corresponding to the company's interests has been discussed by many researchers. Among them, salary incentive became an important tool to motivate management because of its directness and popularity [5]. In accordance with Jensen's optimal salary contract theory, due to the separation of management rights and ownership, the information imbalance in the business entity makes it difficult for shareholders to directly supervise the efforts of managers. This lack of supervision made it easy for management to have opportunistic behavior, that is, they might make decisions that would damage the company's value in pursuit of personal interests, resulting in high agency costs and restricting the long-term development of the company [6]. To alleviate this core contradiction, the management's salary was bound to the company's performance, which could directly make the personal interests of the management corresponding to the interests of the company. The reasonable setting of the salary contract could make the management's goal corresponding to the business entity's goal, which could strengthen the enthusiasm of the management to pursue salary incentive and simultaneously strengthen the business entity's value. Therefore, how to design an effective compensation contract to minimize agency costs and maximize corporate value became an important topic in the field of corporate governance [7]. As the mainstream mechanism to deal with the principal agent problem, the core of CEO's salary incentive was whether it could successfully integrate the CEO's personal interests with the company's long-term interests. Building such an incentive-compatible system was undoubtedly the cornerstone to ensure the continuous and healthy development of companies. A high level of corporate governance could decrease the problem of entrusting agents in the business entity, and the digitalization of the business entity could enhance the extent of corporate governance. With the popularity and deepening of business entity digitalization, the problem of business entity agency was alleviated, which was bound to have an effect on the formulation of CEO compensation contracts. However, there was little literature on the effect of business entity digitalization on CEO compensation contracts [8].

The application of digital-enabled technologies to facilitate the transformation of companies could enhance the accuracy of information exposure, alleviate information imbalance, and enhance the extent of corporate governance. This made it convenient for shareholders to supervise CEOs and strengthen mutual supervision within management. The shareholders could understand the CEO's efforts more clearly and directly, so that the CEO's salary would include more monetary compensation and decrease the relationship between CEO's salary and performance. Therefore, by studying the effect of business entity digitalization on CEO compensation performance, this paper explored the specific path to strengthen CEO

compensation and decrease CEO remuneration-performance sensitivity after business entity digitalization, and put forward relevant suggestions for companies to build a scientific and effective salary incentive system.

## 2 Literature review and theoretical hypothesis

### 2.1 Literature Review

Agency theory believes that the interests of managers and shareholders do not completely overlap, and they may deviate from the business goal of maximize the wealth of shareholders. This is the agency problem, and the reduction of company value caadopted by the agency problem is the agency cost. The agency problem was widely discussed in the field of corporate governance [9]. The separation of ownership and management rights in modern companies strengthend the expenditure on supervision by shareholders, resulting in the inconsistent interests between managers and companies. The first type of agency problem between shareholders and CEOs was that shareholders tended to maximize the company's interests, while CEOs tended to maximize their personal interests. The agency problem would affect the CEO's daily operations. When making business strategies and business decisions for the company, the CEO would weigh the costs and benefits. The interests of the CEO could not always be aligned with the interests of the shareholders. For example, consider the decision about how much effort to put in. Because managers will bear the full cost of such effort, but will not fully enjoy its benefits, they will be inclined to put in less effort than the shareholders think is optimal. By contrast, since CEOs would enjoy the perks of their spending without bearing all of their costs, they would have an incentive to overspend. Therefore, the key to alleviate the agency problem is to formulate a reasonable CEO compensation and link it to the company's performance so that the interests of the CEO and shareholders are consistent.

But at present, there are very few papers on the agency problem between CEO and shareholders in China. The research on agency issues in our country mostly combined the relevant foreign theories with our country's national conditions. Since the 1980s, the state-owned companies began to reform, and the capital market started later than the developed countries, so that our country's development in both corporate governance and manager market was relatively slow. At present, due to the low proportion of CEO shares in China, the low proportion of professional managers in listed companies, and the high integration of CEO and chairman, the agency problem of companies is more serious and complicated. Liu Bin and others identified in their early research that some listed companies in China had adopted salary to motivate managers, but the CEO or senior corporate leadership of most of the companies in China still had low sensitivity to salary performance, and had high salary stickiness, that is, when the company's performance enhanced, there was salary incentive, but when the company's performance declined, there was no punishment. Therefore, it is urgent to enhance the corporate governance mechanism of companies, study the development of corporate governance in the course of digitalization, and alleviate the first type of agency problem. By studying the effect of digitalization on CEO compensation and CEO compensation performance sensitivity, the agency problem in corporate governance can be alleviated. It also provides strong evidence support for the corporate digitalization to enhance CEO compensation, and then provides correct guidance for corporate governance policies and practices. By studying the changes in CEO compensation performance sensitivity in the digital economy, it provides relevant suggestions for companies to design a more reasonable salary incentive system.

In the study of agency issues in China, many researchers studied it from different angles of theory and practice, and believed that agency theory was more suitable for China's national

conditions. The study believes that the state-owned companies in China should pay attention to the interests of the shareholders and the interests of other interested parties at the same time. At the same time, some related researches also identified that the CEO compensation of state-owned companies in China was mostly monetary salary and annual salary system. In addition, the CEO appointment was not directly decided by the directorate, so the CEO compensation and performance were less relevant. The research on CEO motivation in China's capital market also indicated diverse conclusions: Wei Gang (2000) identified that the annual monetary income of senior managers in listed companies was low, the compensation structure was unreasonable, the form was single, and the average proportion of shares was low. There were also related researches that identified that there was a beneficial relationship between company size, internal equity, proportion of unaffiliated directors, age of the holistic manager, and CEO compensation. Wang Yuetang, Zhao Ziye and Wei Xiaoyan combined the agency theory with the governance environment of Chinese listed companies. Starting from the relationship between the independence level of unaffiliated directors and company performance, they identified that increasing the proportion of unaffiliated directors and hiring unaffiliated directors with good reputation were beneficial to the development of the company. Wang Kemin and others identified that executive compensation was beneficially related to earnings management from the perspective of earnings management of listed companies. They further studied that when the CEO and the chairman were combined, they identified that the strengthen in CEO control strengthend the CEO compensation level [10].

The key to alleviate the CEO's moral hazard and adverse selection is to enhance the vulnerability of CEO's pay and performance. At present, some scholars in our country have studied the vulnerability of CEO's pay and performance of listed companies. In accordance with the principal agent theory, enhancing the manager's pay-performance sensitivity was an important means to alleviate the conflict of interest between shareholders and managers. Some related researchers have identified that the Pay-performance of CEOs sensitivity of listed companies in China was holisticly low. Lu Rui identified that the greater the power of the management, the more pronounced the executive pay, but it would not facilitate the growth of the company's performance [11]. Moreover, when the company was profitable, the management had a high pay-performance sensitivity, but when the company was losing money, it was the opposite. As for the determinants that effected the vulnerability of CEO's salary performance, Jiang Wei and others identified that the more innovation in high-tech companies, the lower the vulnerability of CEO's salary performance. The existence of hollowing out by major shareholders would also decrease the vulnerability of CEO's salary performance. Some related researches also identified that internal control in specific companies could enhance the vulnerability of executive salary performance.

Some scholars have noticed the effect of the development of the digital economy on the first type of agency problem, trying to find new ways to alleviate the agency problem. When Holistic Secretary Xi Jinping presided over the 36th collective study of the Political Bureau of the Central Committee of the People's Republic of China, he specifically proposed "accelerating the promotion of the digital economy to economic development". At the G20 Hangzhou Summit, the "digital economy" was included in the core agenda for the first time. All parties jointly adopted the first digital economy cooperation initiative with global consensus, marking the development of the digital economy entering a new stage. In this era, new digital technologies represented by big data, the Internet of Things, artificial intelligence, blockchains, virtual reality, and shared economy were formed. Various new technologies in the digital economy have an important effect on business entity management, development, and governance. By applying digital-enabled technologies to all aspects of the business entity, including production, marketing, service, management, etc., it can realize the digital connection

and integration of customers, and have a beneficial effect on the key business operations of the business entity. There were also many literature related researches on the effect of combining digitalization with daily business operations. In terms of daily operations, some related researches have identified that business entity digitizing can make the performance forecast of companies more reliable by reducing operational risks, improving the ability of business entity information collection and processing, and optimization of business entity internal control. Luo Jinhui and others identified that business entity digitizing transformation can remarkably decrease the company's real earnings management level from the perspective of business entity earnings management. In terms of the performance of the capital market of companies, the corporate digitalization can enhance the extent of stock mobility by improving information imbalance, promoting R & D investment of companies, and improving the financial stability of companies, so as to remarkably enhance the value level of companies. In terms of corporate productivity, the digitalization has remarkably enhanced the total factor productivity of companies and has become the core engine to enhance the production efficiency of manufacturing companies. It provides key support for the high-quality development of the real economy. Moreover, digitalization can remarkably enhance the investment output efficiency, production efficiency, and innovation performance of companies.

In the study of the effect of business entity digitalization on corporate governance, Chen Deqiu and others believed that in the era of digitalization, the governance system needed to return to human capital, especially entrepreneurs, as the center, and build a new corporate governance research model that encouraged and protected the human capital investment of the entrepreneur team. They also believed that the center of improving corporate governance efficiency was shifting from reducing the expenditure on entrusting agents to the optimization of management's incentive design. The corporate digitalization has an effect on corporate governance from different angles. The expansion of financing channels and the reduction of financing threshold have greatly decreased the dependence of companies on external shareholders who mainly provide material capital, so that the control power can be better controlled by the start-up team and management, and the corporate governance structure can be enhanced. The digital trend has enriched and expanded the external governance mechanism and path of the company. The large amount of data provided by big data and the Internet allows companies with strong data utilization ability to enhance the extent of corporate governance through more efficient and timely external supervision. In corporate governance, relieving the agency problem between management and shareholders has always been a hot research topic. The corporate digitalization can decrease the information imbalance between companies, make it easier for management to supervise each other, and thus enhance the corporate governance mechanism. That is, the agency problem between CEO and shareholders will be changed after the corporate digitalization, thus effecting CEO compensation and CEO compensation performance sensitivity. However, there are few related researches on the vulnerability of digitalization to CEO remuneration and CEO remuneration performance, which is also the central concern of this paper.

At present, many foreign scholars have conducted research on the driving determinants of CEO remuneration. Some related researches have identified that CEO remuneration is governed by the salary contract negotiated between the CEO and shareholders. Some related researches believe that CEO remuneration is governed by CEO power. Some related researches have identified that CEO remuneration is effected by many determinants such as the company's governance level and CEO's hard work. The reasonable setting of CEO's salary was an important tool to alleviate the agency problem between shareholders and CEO. A reasonable CEO's salary could minimize the supervision cost of the company and at the same time make the CEO have a satisfactory salary. In accordance with the classical agency theory, the core

function of the salary contract is to alleviate the conflict of interest between managers and shareholders. The fundamental way to play its role is to decrease agency costs, facilitate the interests of managers and the company to be consistent, and then encourage them to make decisions that are in line with the company's maximum value. Therefore, the effectiveness of the salary contract is the key factor that effects the manager's and the company's interests. Theoretically, the vulnerability of CEO's pay performance reflected the effectiveness of the pay contract. To a large extent, it could reflect the consistent interests of the manager and the company, and then motivate the manager to act in accordance with the company's interests. Therefore, increasing the vulnerability of CEO's pay to performance can effectively enhance the effectiveness of the pay contract.

However, the theory of management power believes that the salary contract itself is a kind of agency problem. The CEO will effect the formulation of the salary contract through his effect, namely the power of the CEO. The greater the power of the CEO, the more pronounced the salary, and the lower the sensitivity between salary and performance. The theory of management power called the part of CEO's salary that exceeded the benefits yielded under the conditions of unaffiliated market as "rent". When the rent was too high, the outsiders related to the business entity would generate "anger". The excessive anger would effect the expansion and development of the business entity. The CEO and the directors would consider the effect of anger when formulating the salary contract, thus restricting the CEO's excessive salary system. The CEO's "disguise" To decrease anger might adopt inefficient salary strategies and effect the company's interests. The CEO's power would effect the directorate 'decision on the remuneration of the executive team because the directorate often needed to communicate and cooperate with the CEO. The CEO and the directors usually had social connections, and the CEO would also have some effect in the nomination process. The CEO would usually choose to nominate the directors he was familiar with. Even the appointment of the members of the remuneration committee and the nomination committee was related to the CEO. Even if most of the members of the committee were unaffiliated directors, the unaffiliated directors would not be "completely unaffiliated" due to their connection with the CEO. By nominating familiar directors, the CEO could gradually expand his effect on the directorate, thereby increasing his power and controlling the process of salary setting, and urging managers to seek private benefits of control in the salary contract. In particular, CEOs would use opportunistic means of earnings manipulation to whitewash the company's financial performance to meet the requirements of the salary contract to maximize their short-term interests. As a result, the role of the salary contract to motivate managers to act in the interests of the company may be ineffective, and the salary contract may encourage managers to damage the value of the company's opportunism.

## **2.2 The hypotheses**

There were also many related researches that studied the driving determinants of CEO remuneration from different perspectives, such as CEO personal characteristics, company characteristics, and corporate governance characteristics. Research on personal characteristics focadopted on the CEO's ability, capabilities, and so on. Research identified that more capable managers received higher salaries, and their departure was associated with more negative market reactions. Murphy and others believed that the extent of CEO remuneration was governed by the market contest between companies for corporate leadership, and it depended on the part of CEO capabilities that could be transferred across companies and industries. The strengthen in CEO remuneration could be illustrated by the increasing significance of holistic capabilities vis-à-vis company-specific knowledge in managing modern companies. This explanation was not only corresponding to the strengthen in CEO remuneration, but also with the strengthen in the proportion of CEO available posts that were occupied by external

recruitment. Huiying Wu and others identified that the CEO's political affiliations had a beneficial effect on the company's performance and CEO remuneration, and this effect was stronger in less developed areas. In terms of company characteristics, Dai identified that the more diverse the company's export, the more pronounced the CEO's salary. Many related researches have identified that the more pronounced the company's value and financial performance, the more pronounced the CEO's salary. In terms of corporate governance, Hermalin proposed a board behavior model to link CEO behavior to a series of trends in corporate governance. The study identified that when corporate governance became stricter, the average tenure of CEOs should decrease, and the CEO's effort and salary would strengthen. Garicano and others studied the effect of communication technologies enhancements on wages and organizations. They identified that the enhancement of communication technologies allowed high-skilled managers to benefit from the formation of teams, and through leverage, they could spread knowledge to the entire team and receive high salaries, while low-skilled agents directly benefited from the organization [12]. The enhancement of communication technologies could decrease the information imbalance between the shareholders and the CEO, so that the company could decrease the expenditure on supervising the CEO and strengthen the standard of corporate governance. There were also related researches on the characteristics of the directorate. It was identified that the larger the directorate, the more pronounced the proportion of unaffiliated directors, and the lower the CEO's salary. The enhancement of the supervision ability and independence level of the directorate could decrease the possibility of the CEO abusing his power and thus limit the CEO's salary [13]. There were many related researches on the determinants driving CEO remuneration at the company level, but there was no literature on the effect of digitalization on CEO remuneration after entering the digital economy era. This was also the central concern of this paper.

The corporate digitalization may strengthen CEO salaries through aspects such as corporate governance and management capabilities. In terms of corporate governance, digitalization enhanced CEO remuneration by improving the company's information visibility. Specifically speaking, the application of digital-enabled technologies in the course of business entity digitalization can strengthen the accuracy of business entity information exposure and decrease the degree of information imbalance. This made it easier for shareholders to monitor the CEO's behavior, and it was easier for management to monitor each other. When the CEO's corporate governance environment was better, the risk of being fired due to poor performance was greater. This caadopted the CEO to receive more negative effects from his position, so he would ask for additional compensation.

In terms of management capabilities, digitalization enhanced the holistic capabilities of management, which led to higher CEO salaries. To be specific, the corporate digitalization would integrate social media, big data, or information technologies into the daily operation and management of companies. These digital strategies were common among different companies, thus increasing the holistic management capabilities of CEOs and increasing the significance of holistic management capabilities in the daily work of CEOs. This made the capabilities needed for company management work universal, and the universal management capabilities strenghtend the CEO's salary. Therefore, hypothesis 1:

H1: Business entity digitalization is beneficially related to CEO remuneration.

In accordance with the agency theory, enhancing the manager's ompensation-performance sensitivity is an important means to alleviate the conflict of interests between shareholders and managers. However, in terms of corporate governance, the corporate digitalization could decrease the information imbalance between shareholders and managers, thereby reducing the manager's pay-performance sensitivity. Specifically, in one respect, digitalization decreased the expenditure on shareholders 'supervision of CEOs. The corporate digitalization uses digital-

enabled technologies to code the structured and non-structured information of various departments and value chain links within the business entity. The data is collected, analyzed, and visualized in real time through the data center. This visualized data can decrease the expenditure on shareholders' supervision of the CEO. By contrast, digitalization could enhance the efficiency of the company's information dissemination. The digitalization enabled the company to replace the top-down linear structure with a de-centric network organizational structure, which would enhance the efficiency of information dissemination, decrease the expenditure on information dissemination in the business entity, and enhance the response speed of the business entity. This allowed the shareholders to grasp the company's information more effectively, thus reducing the information imbalance between the shareholders and the CEO. When the information imbalance between the shareholders and the CEO decreased, it was easier for the shareholders to understand the CEO's efforts, and the CEO's salary could be confirmed directly in accordance with the CEO's efforts, thus reducing the dependence of the shareholders on the manager's pay-performance sensitivity.

In terms of management capabilities, digitalization made the CEO's daily management capabilities more universal, and the unification of CEO management capabilities made it easier for CEOs to transfer between different companies, increasing the CEO's ability to seek personal gain during salary contract negotiations. CEOs tended to be more sensitive to high pay and low pay performance. Therefore, digitalization decreased the Pay-performance of CEOs sensitivity through the channel of improving the unification of CEO management capabilities. Therefore, hypothesis 2 was proposed:

H2: Business entity digitalization is negatively related to manager's compensation-performance sensitivity.

In summary, the causal path constructed for the two major mechanisms in this paper is: H1: digitalization → corporate governance (information transparency) → salary strengthen + performance sensitivity decline; H2: Digitalization → CEO Holistic Capabilities → Salary Strengthen + Decreased Performance Sensitivity. The causal path relationship is shown in Figure 1.

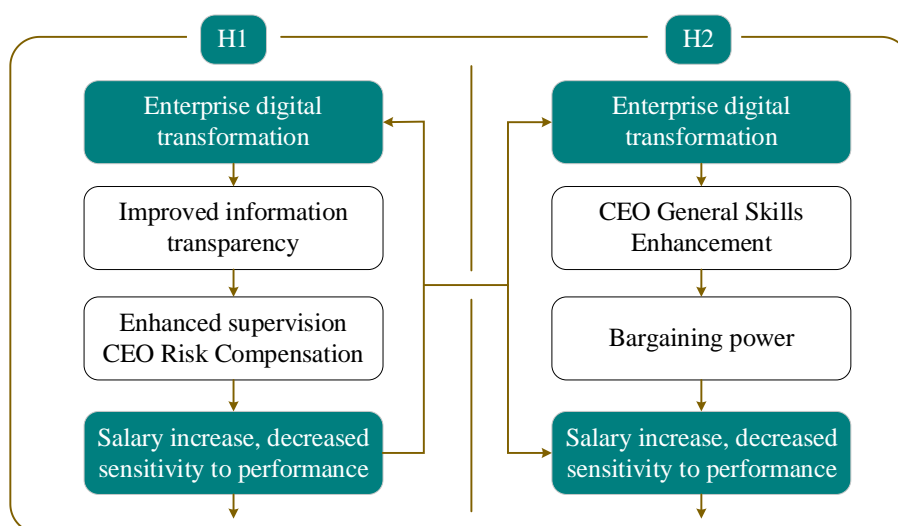


Figure 1: Causal Path Relationship

### 3 Research Design

#### 3.1 Selection of samples and data sources

This paper takes the data of non-financial listed companies in China's A-share market from 2004 to 2023 as the study subject, and screens the data as follows: (1) exclude loss-making companies such as ST and \*ST; (2) exclude companies with asset-debt ratio greater than 1; (3) exclude the observation value of missing relevant variable data. Following the above procedures, with a final sample of 44679 basic entries were yielded. The digitalization data was yielded by Python crawling the corporate annual reports of listed companies and extracting feature words. Other financial data came from the Guo Tai 'an database, the official online platforms of the Shen Zhen securities market and the Shanghai securities market. To decrease the effect of outliers, all continuous factors were Winsorized by 1% each. Figure 2 shows the sample screening process flowchart.

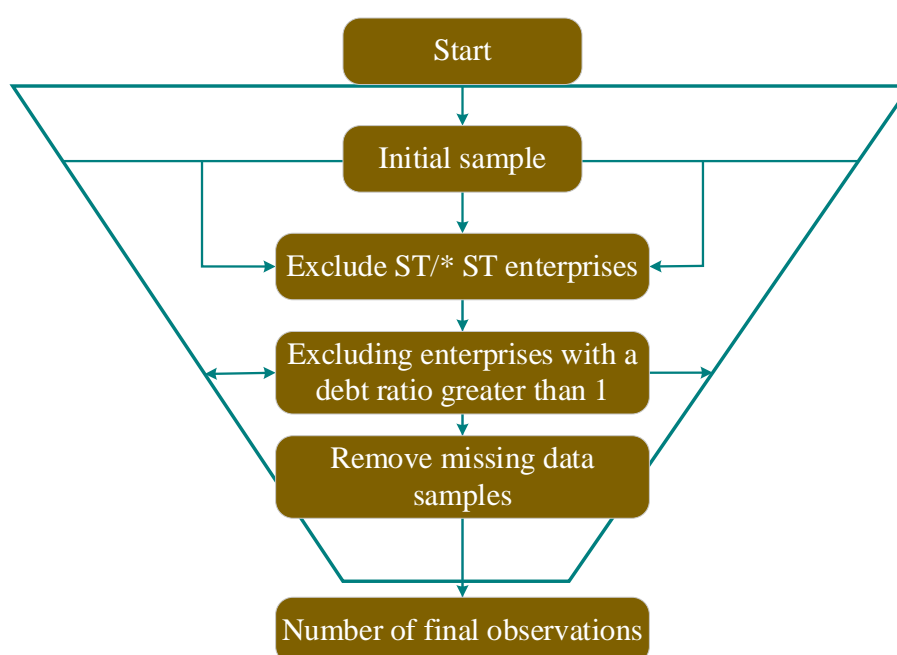


Figure 2: Sample screening process diagram

#### 3.2 Variant definition and model setting

1. CEO's salary and corporate performance: This paper uses the CEO's monetary salary to express CEO's salary (CEO<sub>pay</sub>), and measures corporate operating performance (ROA) with the net interest rate of total assets.

2. Business entity digitalization: Using the traditional approaches, the degree of business entity digitalization is operationalized by the count of times the characteristic words appear in the corporate annual report of the business entity. First, it was divided into five categories of words: AI-related technologies, block chain technologies, big data technologies, cloud computing technologies, and digital-enabled technologies application. Then, these five categories of words were adopted as the underlying technical architecture of the corporate digitalization. The frequency of the five specific characteristic words in the corporate annual report of the business entity was matched and processed by taking the quotient. Finally, the degree of digitalization of different companies was yielded.

3. Controlling factors: According to the previous studies [14], this paper controls the

following factors from three aspects: CEO's personal characteristics, company characteristics, and corporate governance characteristics: age, tenure, gender, share; revenue growth, company size, Tobin's q, asset-debt ratio; board size, board independence, top shareholder share, and whether the CEO and the chairman are held by the same person (dual). The factors are defined in Table 1.

4. Model Setting: This study examined the effect of digitalization on CEO remuneration and CEO remuneration-performance sensitivity. The test model was

$$\ln CEO_{i,t} = \theta + u_1 \ln DCG_{i,t} + u_2 \ln DCG_{i,t} * ROA_{i,t} + u_3 ROA_{i,t} + \gamma X_{i,t} + \alpha_t + \lambda_j + \varepsilon_{i,t} \quad (1)$$

Where,  $j$  represents different industries; represents the set of control factors;  $\theta$  is a constant term;  $u_1$  represents the regressor coefficient, which measures the effect of digitalization on CEO compensation;  $u_2$  is the control variable coefficient;  $\alpha_t$  is the fixed effect of the year;  $\lambda_j$  is the fixed effect of the industry; and  $\varepsilon_{i,t}$  is the disturbance term. The robust standard error of the cluster at the business entity level is adopted in the regressor. To test the effect of digitalization on CEO remuneration-performance sensitivity, the intersection of business entity digitalization (InDCG) and business entity performance (ROA) (InDCG \*ROA) was added to the model. If the intersection coefficient was beneficial, it meant that business entity digitalization strengthened CEO remuneration-performance sensitivity, and vice versa.

Table 1: Variant definition

types of factors	variable name	variable symbol	variable definition
dependent variable	CEO compensation	lnCEOpay	CEO's total monetary compensation plus 1 is taken as the log
	ROA (return on asset)	ROA	Net profit/total assets at the end of the year
	InDCG and ROA intersection term	LnDCA*ROA	Business entity digitalization * Business entity performance
unaffiliated variable	corporate digitalization	lnDCG	Add 1 to the frequency of words related to digitalization in the company's corporate annual report and take the quotient.
	CEO age	age	CEO age
	CEO tenure	tenure	Duration of CEO's tenure in the company
	CEO's gender	CEOGender	CEO's gender: 1 for male and 0 for female
	CEO's percentage of shares	CEOshare	CEO's percentage of shares in the company
	operating income growth rate	growth	(Current operating income-previous operating income)/previous operating income
	control variable	scale of company	size
Tobin's Q		tobinq	The company's market cap/the book value of the company's total assets
asset-liability ratio		Lev	Total Liabilities/Total Assets1
board size		Boardsize	The natural number of directors
board independence		IndDirectorRatio	Number of Unaffiliated Directors/Total Number of Directors
the proportion of the largest shareholder		top1	Number of shares held by the largest shareholder/total shares of the company
Two jobs in one		dual	Is the CEO and the chairman held by the same person?

## 4 Return to the findings

### 4.1 Description of statistics

Table 2 reports The outcomes of the main factors. It can be observed that the average value of  $\ln\text{CEOpay}$  is 13.34, and the minimum and maximum values are 50,000 yuan and 5.5 million yuan respectively, implying that there is a large difference in the salary of the CEOs of the sample companies. The average ROA (the net interest rate on total assets) was 0.037 (3.7%), and the standard deviation was 0.068, implying that there was a large difference in the performance of the sample companies. The average value of  $\ln\text{DCG}$  was 1.326, implying that there were an average of 11 words adopted to illustrate the corporate digitalization in the management discussion and analysis section of the corporate annual report. The maximum value was 155, implying that the degree of digitalization varied among different listed companies and was holistically low. The statistics of the control factors were corresponding to the previous literature and within a reasonable range.

*Table 2: The outcomes of the statistics*

Variable	N	Mean	SD	Min	p50	Max
$\ln\text{CEOpay}$	44679	13.34	0.902	10.49	13.37	15.53
$\ln\text{DCG}$	44679	1.326	1.412	0	1.099	5.050
ROA	44679	0.0370	0.0680	-0.299	0.0390	0.281
age	44679	49.69	6.754	33	50	66
tenure	44679	48.89	37.05	1	38.50	173
CEOGender	44679	0.934	0.248	0	1	1
$\ln\text{CEOshare}$	44679	8.519	7.800	0	11.06	19.45
growth	44679	0.166	0.408	-0.612	0.106	2.681
size	44679	22.05	1.277	18.79	21.87	26.03
tobinq	44679	1.981	1.254	0.856	1.578	8.587
Lev	44679	0.420	0.211	0.0560	0.410	0.978
Boardsize	44679	8.560	1.703	5	9	15
$\ln\text{Directo~o}$	44679	37.27	5.307	0	33.33	57.14
top1	44679	34.24	14.84	8.640	32	75
dual	44679	0.293	0.455	0	0	1

### 4.2 Findings of the benchmark return

Table 3 shows The outcomes of the return between the corporate digitalization and the CEO compensation and the CEO remuneration-performance sensitivity. From column (1), it can be observed that the loading on the unaffiliated variable, the corporate digitalization, is 0.038, which is significant at the 1% level, implying that the corporate digitalization has remarkably strengthened the CEO compensation. Hypothesis 1 is verified. The quotient of the intersection between the digitalization and the company's performance was -0.258, and it was significant at the 1% level, implying that with the digitalization of the company, the sensitivity between CEO compensation and company performance decreased.

Table 3: The outcomes of the benchmark regressions

	(1)
variable	lnCEOpay
lnDCGROA	-0.258***
	(-4.902)
lnDCG	0.038***
	(5.943)
ROA	2.405***
	(18.067)
_cons	5.299***
	(21.391)
Controls	Yes
ind	Yes
year	Yes
Entries	44679.000
r2	0.410

### 4.3 Robust Test

1. Tool variation method. This paper mainly related researches the effect of business entity digitalization on CEO remuneration. The previous paper identified that business entity digitalization would strengthen CEO remuneration and weaken the vulnerability of CEO remuneration to performance. However, the above regressions model may have reverse causality. That is, CEO with higher CEO monetary pay and less sensitivity to performance are more likely to undergo digitalization because CEOs in companies with lower compensation and performance are more likely to take risks. Lead the company to implement digitalization in an uncertain business environment. To solve the intrinsic problem, this paper uses the 2sls model to test the effect of digitalization on CEO remuneration-performance sensitivity. With reference to Huang Qunhui's research, this paper uses the natural log of the interaction between the count of fixed telephone lines per 100 people in each region in 1984 and the count of Internet access ports in the sample period, as well as the digital economic index, as the tool factors. The findings are shown in columns (1) to (3) of Table 4. columns (1) and (2) represent the first stage of 2sls. The instrument factors DEI and port post are remarkably related to the digitalization of the business entity at the 1% level of significance. DEIROA and portpostROA are also related to the intersection of digitalization and business entity performance at the 1% level of significance. The instrument factors are effective through the instrument factors 'unidentifiable, weak identification test, and over-identification test. The outcomes of the second stage indicated that the return coefficient of lnDCG was remarkably beneficial at the 1% level, and the return coefficient of lnDCROA was remarkably negative at the 5% level. This indicated that after controlling for the intrinsic problem, the beneficial relationship between the digitalization of the business entity and the CEO's salary and the negative relationship between the CEO's salary and performance sensitivity were still established.

Table 4: 2sls's Regressions

	(1)	(2)	(3)
	the firstphase	the first phase	second stage
FACTORS	lnDCG	lnDCGROA	lnCEOpay1
DEIROA	0.175 (1.49)	0.307*** (9.62)	
portpostROA	-0.000*** (-3.37)	0.000*** (8.40)	
DEI	0.087*** (6.20)	-0.006*** (-3.78)	
portpost	0.000*** (3.55)	-0.000*** (-5.02)	
ROA	-0.289 (-1.21)	0.764*** (11.67)	5.394*** (6.04)
lnDCGROA			-0.939** (-2.03)
lnDCG			1.039*** (5.19)
Constant	-2.878*** (-9.68)	-0.128*** (-5.35)	11.218*** (13.45)
Controls	Yes	Yes	Yes
Ind	Yes	Yes	Yes
Year	Yes	Yes	Yes
Entries	33,100	33,100	33,100
R-squared			-0.173

2. Shock from external events. To more effectively identify the causality between the corporate digitalization and CEO remuneration and CEO remuneration performance sensitivity, this paper further proved it by using two external events. This paper draws lessons from the practice of Qin Wenjin and others, and chooses the demonstration site of "China" as the external effect to facilitate the corporate digitalization. Since 2013, about 120 cities had been selected as demonstration cities for the implementation of the "China" project. The demonstration cities had created favorable conditions for local companies to transform into digital ones by strengthening their network infrastructure. We regarded the companies in the demonstration cities as the empirical group and operationalized the effect of digitalization by comparing the differences in CEO compensation levels and pay-performance sensitivity between the control group and the companies before and after the implementation of the policy. In this paper, we set the virtual variable (kdchina) of the China network for testing. The pilot cities of the China network are recorded as 1, and the opposite is 0. The CEO compensation was adopted as the dependent variable, and kdChina and kdchinaROA were adopted as the unaffiliated factors. The specific findings were shown in column (1) of Table 5. The findings indicated that the loading on kdChina was remarkably beneficial, and the loading on kdchinaROA was remarkably negative. This indicated that after the implementation of the China policy, the digitalization process of companies in the relevant regions accelerated, CEO compensation strengthened, and the vulnerability of CEO compensation to performance decreased, which was corresponding to the benchmark return findings.

With reference to Qiu Zixun's research, this paper adopted the big data systematic empirical

zones validated by the state in 2016, such as Guiyang, Beijing-Tianjin-Hebei, Pearl River Delta, Shanghai, Henan, Chongqing, Shenyang, Inner Mongolia, etc., as a quasi-natural experiment to facilitate the corporate digitalization. After the implementation of this policy, the differences and similarities between the effect of CEO compensation incentive in the empirical area and non-empirical area companies were compared with the main conclusions of the previous article. Specifically, the virtual variable bigdata was set in this study. If the municipality where the business entity was located was included in the big data systematic test area and started construction, the value of this variable would be 1, otherwise, it would be 0. On this basis, a double difference model was constructed with CEO compensation level as the dependent variable. The core unaffiliated factors included corporate performance, virtual factors in the big data empirical area, and the interaction between the two. The other factors were set corresponding to the main test model.

The regressions in column (2) of Table 5 indicated that after the construction of the big data pilot zone facilitated the corporate digitalization, the CEO's salary in the pilot area strengthened remarkably, while the compensation-performance sensitivity was remarkably weakened. The specific performance was that the loading on bigdata $\times$ ROA was remarkably negative at the 1% level. This finding was highly corresponding to the main empirical findings of the previous article, further supporting the conclusion that digitalization had a substantial effect on the design of executive compensation contracts.

Table 5: did findings

	(1)	(2)
	lnCEOpay	lnCEOpay
bigdataROA		-0.631***
		(-3.200)
bigdata		0.168***
		(8.228)
kdchinaROA	-0.666**	
	(-3.179)	
kdchina	0.083***	
	(3.600)	
ROA	2.498***	2.309***
	(13.965)	(18.323)
_cons	6.668***	6.427***
	(27.427)	(28.863)
Controls	Yes	Yes
Ind	Yes	Yes
Year	Yes	Yes
Entries	27154	34345
r2	0.293	0.352

3. Control the fixed effects of industry, year, and province. To further alleviate the effect of the intrinsic nature, this paper controlled the fixed effects of industry, year, and province to perform a regress again, and the findings were corresponding to the benchmark regressions.

4. Other stability tests. This paper also adopted the measurement method of lagging the illustrated variable by one period, replacing the digitalization, and excluding the abnormal fluctuation of the company's stock price during the financial crisis. The findings were still significant, implying that the conclusion was stable.

#### 4.4 Analysis of the mechanism

1. Business entity digitalization, corporate governance and CEO remuneration, CEO remuneration-performance sensitivity. As mentioned earlier, after the corporate digitalization, the application of digital-enabled technologies makes the data of companies more visible, the information visibility of companies strengthens, external supervision is more rapid and efficient, the governance level of companies strengthens, the supervision of CEOs strengthens, and the risk of being fired strengthens, which will make CEOs demand higher compensation. The enhancement of corporate governance and the strengthen of information clarity decreased the information imbalance between shareholders and CEOs. The shareholders could directly determine the CEO's salary In accordance with the CEO's efforts, which decreased the role of corporate performance in determining the CEO's salary, thus reducing the CEO's ompensation-performance sensitivity. This paper refers to the previous studies and uses information visibility (Transms) to measure the extent of corporate governance. The findings are shown in Table 6. The first column represents the effect of corporate digitalization on information visibility. The loading on corporate digitalization (InDCG) is remarkably beneficial at the 1% level, implying that corporate digitalization has indeed enhanced the company's information visibility and enhanced the extent of governance. This in turn strengthend CEO remuneration and decreased CEO remuneration-performance sensitivity.

2. Business entity digitalization, management capabilities unification, CEO remuneration, CEO remuneration-performance sensitivity. After the corporate digitalization, new media, big data, information technologies and other digital applications appeared more in the daily operation of companies, making the management capabilities universal. The holistic capabilities of CEOs were more suitable for different companies, reducing the barriers for CEOs to enter other industries and increasing the circulation of CEOs in the market. This made CEOs more advantageous in salary negotiations and made CEOs more likely to sign contracts In accordance with their own wishes during salary negotiations, namely, high monetary compensation and low pay-performance sensitivity. According to the existing literature research [15], this paper selected four indicators from the CEO's career experience: Position, Industry, Company, and Province. Through the Entropy Weight Method, it constructed the CEO Holistic Ability Index (Gen). The larger the index, the stronger the CEO's holistic ability. The findings were as shown in column (2) of Table 6. The loading on business entity digitalization (indDCG) was remarkably beneficial at the extent of 1%, implying that business entity digitalization had indeed enhanced the holistic ability of CEOs and strengthend the significance of CEO holistic capabilities in the company's operations, which in turn strengthend CEO remuneration and decreased CEO remuneration-performance sensitivity [16].

*Table 6: Analysis of the mechanism*

	(1)	(2)
	TRANS	Gen
lnDCG	0.006***	0.002***
	(5.104)	(2.600)
_cons	-1.867***	0.102***
	(-43.027)	(3.582)
Controls	Yes	Yes
Ind	Yes	Yes
Year	Yes	Yes
Entries	45451.000	39473.000
r2	0.409	0.076

## 5 Further analysis

On the basis of the previous analysis of digitalization on CEO remuneration and pay-performance sensitivity, this study further explored the effect of digitalization on CEO relative comparable pay and its sensitivity to performance. The introduction of relatively comparable salary can effectively eliminate the overall effect of external determinants such as industry characteristics and company size on the salary level, so as to more clearly identify the changes in the salary structure brought about by the digitalization itself. The relative comparable pay of a CEO is usually defined as the ratio of the actual pay of the CEO of the company to the average pay of a group of comparable companies in the same industry and size. The findings in Table 7 show that the  $\lnDCG$  coefficient is remarkably beneficial at the significance level of 1%, implying that the more pronounced the degree of digitalization of the business entity, the more pronounced the relative comparable salary of the CEO [17]. To attract and enable the CEO who can lead the digitalization, the business entity has to provide more competitive salary, which leads to the salary level being remarkably higher than the average level of the same scale companies in the same industry. The  $\lnDCROA$  coefficient was remarkably negative at the 1% significance level, implying that the corporate digitalization decreased the sensitivity between CEO's relative comparable salary and performance [18]. Since digitalization was a highly uncertain innovation activity, strict contracts could produce a "crowding effect" that inhibited managers' innovative risk-taking spirit. At this point, giving a certain degree of autonomy and salary stability (i.e., reducing sensitivity) would better encourage long-term value creation.

Table 7: Regression findings

	(1)
variable	RECEOpay
$\lnDCGROA$	-0.164***
	(-2.61)
$\lnDCG$	0.037***
	(4.81)
ROA	2.168***
	(13.88)
_cons	-6.511***
	(-17.42)
Controls	Yes
ind	Yes
year	Yes
Entries	45479.000
r <sup>2</sup>	0.1771

## 6 Research conclusion and enlightenment

This paper selected the listed companies in Shanghai and Shanghai from 2004 to 2023 as the study subject, and examined the effect of corporate digitalization on CEO remuneration and CEO remuneration-performance sensitivity [19]. The study identified that when the degree of digitalization strengthened, it would remarkably strengthen CEO remuneration and decrease CEO remuneration-performance sensitivity. After a series of robust tests, the findings were still valid. The mechanism analysis identified that the corporate digitalization would enhance the

extent of corporate governance by improving the company's information environment and increasing the information visibility of the company and the outside world. At the same time, the corporate digitalization would make more use of digital-enabled technologies in the daily operations of companies, enhance the holistic ability of CEOs, and make it easy for CEO capabilities to be applied between different companies. This would strengthen the bargaining power of CEOs in the salary contract, thus increasing CEO compensation and reducing CEO remuneration-performance sensitivity.

The policy implications of this paper are as follows: First, it is important for companies to make full use of the beneficial effect of digital-enabled technologies applications, but we cannot ignore the emerging governance challenges in the digitalization of the economy. The corporate digitalization played an important role in improving the company's performance and total factor productivity. However, the digital economy was still in the initial stage of development. It was necessary to prevent CEOs from concentrating resources and continuously increasing CEO power to satisfy their own interests, thereby reducing the Pay-performance of CEOs sensitivity. Second, in promoting the corporate digitalization and regulating relevant salary governance, the government needs to build a systematic governance framework through a combination of policy guidance, system constraints, and resource support. Establishing digital governance standards and a transparent mechanism, requiring third-party audit institutions to add digital special audit content, focusing on verifying whether companies use digital-enabled technologies to strengthen performance or cover up business risks, and incorporate the findings into the basis of executive compensation assessment. This paper identified that although digitalization decreased the CEO's ompensation-performance sensitivity, it enhanced the information environment of the business entity. The information imbalance between the business entity and the outside world was decreased. At this time, the government needed to balance the interests of all parties and strengthen the supervision of the digitalization companies, so that they could use the convenience brought by digitalization correctly and reasonably, and restrain the behavior of corporate leadership.

## Author's Profile

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