Key subordinate executive-CEO pay gap and firms' digital transformation: Evidence from China

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Abstract. The key subordinate executive-CEO pay gap is important for firm growth and business performance. The future growth of firms is what digital transformation is all about. With a sample of Chinese A-share listed companies from 2010-2021, we investigate the effect of the key subordinate executive-CEO pay gap on the firm's digital transformation. The results show that the key subordinate executive-CEO pay gap promotes the firm's digital transformation by reducing agency costs. This promoting effect is particularly noticeable in non-high-tech firms and non-duality firms. Compared with the digital technology application type of digital transformation, the key subordinate executive-CEO pay gap has a more visible incentive effect on the fundamental digital technology type of digital transformation in firms.

Keywords: executive pay gap; digital transformation; agency costs; textual analysis

1   INTRODUCTION

Digital transformation is one of the key strategies firms can use to achieve high-quality development in the age of the digital economy. Managers are able to decide how to employ facilities and information technology to foster digital transformation, which is a key role they play in the process of firms going digital (Porfírio et al., 2021)[1]. However, managers' interests are not always aligned with those of the firm's owners, given agency costs (Jensen and Meckling, 1976)[2].

Key subordinate executives are the few executives other than the Chief Executive Officer (CEO) who hold key positions in a firm's management team. In practice, only the CEO and key subordinate executives are able to make strategic corporate decisions. According to Mekhaimer et al. (2022)[3], key subordinate executives possess the capacity and incentive to influence the CEO's decision-making, elevate the firm's risk appetite, encourage long-term investment, and augment firm value. However, there is a pay gap between CEOs and key subordinate executives. This pay gap has important implications for firm decision-making and economic development. Kini and Williams (2012)[4] argue that the pay gap between key subordinate executives and CEOs pushes key subordinate executives to take bigger risks in their pursuit of being promoted to the

CEO role, which boosts the firm's research and development intensity and leverage. Zhang et al. (2020)[5] argue that the key subordinate executive-CEO pay gap can act as an incentive to promote firms' innovation output. It is essential to investigate the relationship between the key subordinate executive-CEO pay gap and digital transformation since it influences corporate pay incentives and could influence the development and execution of a firm's digital transformation strategies.

The study will investigate the question: Does the pay gap between CEOs and key subordinate executives within a firm impact digital transformation? We explore how the firms' digital transformation is affected by the key subordinate executive-CEO pay gap. The findings show that the key subordinate executives-CEO pay gap promotes digital transformation. Further research shows that the key subordinate executives-CEO pay gap reduces agency costs, which in turn promotes digital transformation.

This study makes contributions to previous research. First, we extend the research related to the economic consequences of the key subordinate executive-CEO pay gap. Previous literature has examined how the key subordinate executives-CEO pay gap affects risk-taking and firm innovation, but lacks a focus on digital transformation. Second, we will analyze and assess the differences in the impact of the key subordinate executives-CEO pay gap on firms' digital transformation across different types of firms and corporate governance structures. We also examine the role of pay gap in different types of digital transformation. These tests provide a basis for different types of firms to develop rational compensation systems as well as digital transformation strategies.

2   THEORETICAL ANALYSIS AND HYPOTHESIS

The key subordinate executives-CEO pay gap has a competitive effect, creating a competitive atmosphere that helps to stimulate competition among both the CEO and key subordinate executives. Tournament theory states that in a job promotion tournament, the winner of a promotion to a higher level is able to earn additional rewards, i.e., executives must earn additional pay by winning the competition (Lazear and Rosen, 1981)[6]. In order to win the promotion tournament, key subordinate executives will continuously focus on the digital transformation process and actively participate in digital transformation activities that are closely related to the firm's performance. In such a competitive environment, CEO, in order to maintain vested pay as well as positional power, will likewise make decisions that benefit the long-term development of the firm and promote digital transformation. The key subordinate executive-CEO pay gap also has an incentive effect. Goel and Thakor (2008) [7]showed that tournament incentives promote risk-taking by executives. In order to have more chances of being selected and promoted than other competitors, key subordinate executives may choose high-risk projects. Digital transformation activities are associated with a certain amount of risk and uncertainty of return on investment. Motivated by additional compensation as well as promotion opportunities, key subordinate executives tend to increase their risk tolerance for digital transformation. On the basis of the analysis above, we propose hypothesis H1a.

H1a: The key subordinate executive-CEO pay gap promotes firms' digital transformation.

Social comparison theory suggests that individuals evaluate themselves by comparing themselves with others around them (Festinger, 1954)[8]. If individuals in an organization perceive that there is inequity in the distribution of their pay, it will reduce personal effort and affect product quality and performance (Cowherd and Levine, 1992)[9]. Key subordinate executives, when faced with a large pay gap between them and the CEO, may develop a negative mindset that there is inequitable pay distribution and that their efforts are not being rewarded accordingly, thus reducing their motivation to work, and lowering their personal on-the-job endeavors and contributions. However, the digital transformation of a firm requires strong coordination and effective collaboration between the CEO and key subordinate executives (such as the CIO) (Benlian and Haffke, 2016)[10]. As a result, a large pay disparity could impede the progress of digital transformation. Therefore, we propose the competing hypothesis H1b.

H1b: The key subordinate executive-CEO pay gap restrains firms' digital transformation.

3   RESEARCH DESIGN

3.1   Data source and sample selection

We select Chinese A-share listed companies from 2010 to 2021 as the research sample. We exclude the following samples: companies flagged with ST or *ST; companies in the financial industry; companies with negative net equity; and companies with distorted data and missing variables. All continuous variables are winsorized at the 1% and 99% levels to prevent the impact of abnormal values. All statistics are obtained from the annual financial reports of listed companies and China Stock Market and Accounting Research (CSMAR) Database.

3.2   Variables

Dependent variable: firm's digital transformation

According to Hu et al. (2023)[11], we use text analysis to construct indicators to measure the degree of the firm's digital transformation. We download the annual reports of A-share listed companies from the official disclosure website and use Python to extract text information. Finally, we count the frequency of keywords related to digital transformation in annual reports. To obtain get the proxy variable (Digit), we take the natural logarithm plus one to the keyword frequency of digital transformation.

Independent variable: the key subordinate executives-CEO pay gap

Key subordinate executives are the four most highly paid non-CEO executives in the firm's rankings (Cheng et al. ,2016)[12]. We use GAP as a proxy variable for the key subordinate executives-CEO pay gap. Referring to Zhang et al. (2020)[5], we define the

GAP as the natural logarithm of the pay gap between the CEO of the firm and the mean pay of the top four senior subordinate executives.

Control variables

We control for a series of firm-level control variables (Size, Lev, ROA, Growth, Manhold, SOE, CEOAge, Boardsize, Top10). The definitions of the main variables are presented in Table 1.

Table 1. Variable definitions.

Variable	Definition
Digit	Ln (the digital transformation keyword frequency in firm's annual report +1)
DigAsset	Digital intangible assets/total intangible assets
GAP	Ln (the gap between CEO pay and the average pay of the top four paid key subordinate executives)
Agency	Management expenses/operating income
Size	Ln (total assets)
Lev	Total debts/total assets
ROA	Net profit/total assets
Growth	Growth rate of operating income
Manhold	Executives' shareholding/total shares of the firm
SOE	Equals to 1 if the firm is a state-owned firm, and 0 otherwise
CEOAge	Ln (CEO's age)
Boardsize	Ln (the number of board of directors)
Top10	Shareholding ratio of top ten shareholders

3.3   Research model

To test the relationship between the key subordinate executive-CEO pay gap and the firm's digital transformation, we construct model (1):

$$Digit = \alpha_0 + \alpha_1 GAP + \sum \alpha Controls + \sum Industry + \sum Year + \varepsilon \qquad (1)$$

where Digit indicates the extent of the firm's digital transformation. GAP represents the pay gap between key subordinate executives and the firm's CEO. Controls denotes a set of control variables. Industry and Year denote industry and year fixed effects, respectively. We cluster the standard errors of model (1) at the firm level.

4   EMPIRICAL ANALYSIS

4.1   Descriptive statistics

The main variables' descriptive statistics are displayed in Table 2. The mean value of Digit is 1.742, with a standard deviation of 1.253, indicating that over half of Chinese

listed companies have adopted digital transformation. There is a large variation in the pay gap between CEOs and key subordinate executives across various companies, as seen by the standard deviation of GAP of 1.040.

Table 2. The descriptive statistics of main variables.

Variable	N	Mean	Standard Deviation	Min	Max
Digit	15703	1.742	1.253	0.000	5.485
GAP	15703	12.070	1.198	8.102	15.250
Size	15703	21.680	1.040	19.080	25.600
Lev	15703	0.340	0.182	0.018	0.859
ROA	15703	0.049	0.066	-0.475	0.248
Growth	15703	0.217	0.350	-0.608	2.439
Manhold	15703	0.383	0.357	0.000	1.361
SOE	15703	0.125	0.331	0.000	1.000
CEOAge	15703	3.901	0.134	3.466	4.220
Boardsize	15703	2.226	0.241	1.609	2.890
Top10	15703	0.643	0.144	0.242	1.000

4.2   Baseline regression results

Column (1) of Table 3 presents the regression results for GAP and Digit, in column (2) we further control for industry and year fixed effects, and in column (3) we further add a series of control variables. The coefficient of GAP in column (3) of Table 3 is 0.0344, and the coefficients of GAP in columns (1)-(3) are all significantly positive at the 1% level, suggesting that the key subordinate executive-CEO pay gap contributes to facilitating firms' digital transformation. The results of the baseline regression support hypothesis H1a.

Table 3. Baseline results.

Variables	(1) Digit	(2) Digit	(3) Digit
GAP	0.0892***	0.0411***	0.0344***
	(6.15)	(3.25)	(2.71)
Size			0.0793***
			(3.88)
Lev			0.0462
			(0.41)
ROA			-0.2209
			(-0.99)
Growth			0.0372
			(1.30)
Manhold			0.0880*
			(1.72)

SOE			0.0128
			(0.22)
CEOAge			-0.2248**
			(-1.97)
Boardsize			-0.0120
			(-0.19)
Top10			-0.2831**
			(-2.15)
Constant	0.6653***	1.2453***	0.6444
	(3.77)	(8.14)	(1.05)
N	15,703	15,703	15,703
Industry FE	No	Yes	Yes
Year FE	No	Yes	Yes
Adj.R^2	0.0072	0.2893	0.2944

Notes: Robust standard errors are clustered at the firm-level in parentheses. *, ** and *** denote significant at the 10%, 5% and 1%, respectively. The same below.

4.3   Robustness tests

Several robustness tests are carried out to check the reliability of the main results. First, we redefine the firm's digital transformation using the ratio of digitized intangible assets to the total intangible assets of the firm (DigAsset) (Qi et al., 2020)[13] and re-estimate model (1). Second, we re-estimate model (1) with the independent variable lagged one year (LGAP) to reduce the possibility of reverse causality. Third, control variables of CEO characteristics are added. We further control for CEO's gender (CEOGender), CEO's educational background (CEOedu) and CEO's shareholding (CEOShare) in model (1) to exclude the interference of CEO's characteristics on the findings. Fourth, propensity score matching (PSM) is used to reduce endogeneity. We select Size, Lev, ROA, Growth, SOE, Boardsize, and Capital (fixed assets/total assets) as covariates. We match the covariates 1:1 with put-backs and re-estimate model (1) using the matched sample. Finally, we use the Heckman approach to address the endogeneity problem.

The coefficients of GAP in Table 4 are all significant, demonstrating the reliability of our findings.

Table 4. Robustness tests.

Variables	(1) Replace the dependent variable DigAsset	(2) Lag one year independent variable Digit	(3) Add other control variables Digit	(4) PSM Digit	(5) Heckman Second Digit
GAP	0.0058**		0.0306**	0.0360***	0.0482***
	(2.18)		(2.41)	(2.85)	(3.88)
LGAP		0.0463***			
		(3.05)			
CEO-Gender			-0.0933		

					(-1.34)
CEOedu					0.1623***
					(4.62)
CEOShare					0.0266
					(0.69)
IMR					2.1019***
					(7.07)
Controls	Yes	Yes	Yes	Yes	Yes
N	15,703	12,046	15,703	15,479	13,201
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Adj.R^2	0.2574	0.2861	0.2978	0.2914	0.2854

5   FURTHER ANALYSIS

5.1   Mechanism test

The pay gap induces executives to strive for promotion to become CEOs as well as higher pay, thus contributing to reducing agency costs and mitigating agency problems (Lazear and Rosen, 1981)[6]. According to Cheng et al. (2016)[12], key subordinate executives who are competing for CEO roles typically have a greater interest in the firm's long-term worth than the CEO does. Key subordinate executives are more likely to make decisions that align with the long-term value of the firm. The key subordinate executive-CEO pay gap can reduce agency costs and increase firm innovation (Zhang et al.,2020)[5]. Therefore, the key subordinate executives-CEO pay gap is also likely to reduce agency costs, motivate key subordinate executives to take risks and make decisions that will benefit the firm in the long run, and eventually help digital transformation. Regression model (2) is developed as,

$$Digit = \beta_0 + \beta_1 GAPxAgency + \beta_2 GAP + \beta_3 Agency + \sum \beta Controls + \sum Industry + \sum Year + \varepsilon \tag{2}$$

We use the managerial expense ratio (Zhang et al.,2020)[5] to measure agency costs and generate the dummy variable (Agency). Agency equals 1 if the firm's agency costs are higher than the entire sample year-industry median value, and 0 otherwise. The coefficient of GAPxAgency in Table 5 is 0.0051 and significantly positive. This suggests that the key subordinate executive-CEO pay gap promotes executives' hard work by reducing the firm's agency costs and mitigating the agency problem, which in turn promotes the firm's digital transformation.

Table 5. Mechanism test.

Variables	(1) Digit
GAPxAgency	0.0051*

	(1.82)
GAP	0.0287**
	(2.27)
Agency	0.7637**
	(2.33)
Size	0.0937***
	(4.60)
Lev	0.1449
	(1.27)
ROA	0.0465
	(0.20)
Growth	0.0494*
	(1.70)
Manhold	0.0913*
	(1.79)
SOE	0.0009
	(0.02)
CEOAge	-0.2245**
	(-1.97)
Boardsize	-0.0204
	(-0.33)
Top10	-0.2502*
	(-1.92)
Constant	0.2474
	(0.40)
N	15,703
Industry FE	Yes
Year FE	Yes
Adj.R^2	0.2967

5.2   Heterogeneity analysis

To explore the different impacts of the key subordinate executive-CEO pay gap on the firm's digital transformation, we divide the sample into multiple sub-samples based on whether the company is a high-tech enterprise, corporate governance structure, and the type of digital transformation.

First, considering the more severe agency problems that exist in non-high-tech firms, we expect the role of the key subordinate executive-CEO pay gap in driving digital transformation to be more pronounced in non-high-tech firms. Second, duality, a structure of governance where the CEO of a firm also chairs the board of directors, enhances the CEO's authority and lessens the risk that important subordinate executives may challenge the CEO's status and authority. Thus, when the CEO is not the same person as the chairman, the key subordinate executive-CEO pay gap is more effective in facilitating the firm's digital transformation. Finally, we consider the heterogeneity of types of digital transformation. Referring to Wu et al. (2021)[14], we classify the types of

digital transformation into fundamental digital technologies (LnDTTech) and digital technology applications (LnDTApply).

Table 6 shows that the positive effect is more noticeable in non-high-tech, non-duality firms. The key subordinate executive-CEO pay gap contributes more significantly to a firm's fundamental digital technology transformation.

Table 6. Heterogeneity tests.

Variables	(1) Non- high-tech Digit	(2) High-tech Digit	(3) Non-duality Digit	(4) Duality Digit	(5) LnDTTech	(6) LnDTApply
GAP	0.0550***	0.0130	0.0556***	-0.0091	0.0272**	0.0199*
	(3.71)	(0.82)	(3.57)	(-0.47)	(2.39)	(1.74)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
N	8,019	7,682	9,448	6,178	15,703	15,703
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adj.R^2	0.2749	0.3110	0.2983	0.2979	0.3504	0.1594

Notes: LnDTTech denotes the natural logarithm of keyword word frequency plus one for keywords related to the fundamental digital technology in the firm's annual report. LnDTApply denotes the natural logarithm of keyword word frequency plus one for keywords related to the application of digital technology in the firm's annual report.

6   CONCLUSIONS

We examine the impact of the CEO pay gap and key subordinate executives on the digital transformation of firms using data from China's A-share listed companies from 2010 to 2021. The finding suggests that the key subordinate executives-CEO pay gap promotes the digital transformation of firms, which supports the tournament theory. Further research shows that the key subordinate executives-CEO pay gap promotes firms' digital transformation by reducing agency costs. This promoting effect is more noticeable in non-high-tech and non-duality firms. Meanwhile, the key subordinate executive-CEO pay gap has a more significant incentive effect on firms' fundamental digital technology-based transformation compared to digital technology application-based transformation.

Firms should set up their executive compensation plans sensibly and gradually widen the disparity in pay between the CEO and important subordinate executives. This will allow the compensation to fully fulfill its incentive function, ignite executives' passion for their work, and lessen both sides' shortsightedness, all of which will improve the firm's the core competitive advantage. Firms without a CEO who also serves as a director, as well as non-high-tech firms, should take full use of the incentives provided by a differentiated pay plan to propel digital transformation. The various incentives for various forms of digital transformation resulting from executive pay gaps should be taken into account to advance the process of digitalization. Increased focus on the incentive function of the pay disparity between the CEO and key subordinate executives is necessary to develop the digital transformation of foundational digital technologies.

The regulatory authorities should strengthen the supervision on the disclosure of all executive compensation information of listed companies, increase the information transparency of executive compensation.

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