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The Impact of Human Resource Slack on Digital Transformation in all China A-Share Listed Corporations: A Study of Mechanisms Based on Ownership

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ABSTRACT

The rapid development of China's digital economy has brought about the need for corporations to undergo digital transformation, and both manpower reserves and innovation capabilities play a role in the continuation of a digital transformation. This paper analyses the data of listed corporations on the Shenzhen and Shanghai stock exchanges over a period of 16 years from 2009, with a total of 28,619 samples, and measures the degree of digital transformation of corporations by their comprehensive performance in terms of 'words' and 'deeds', and it takes the degree of human resource slack as an independent variable, whilst adding ownership as a moderating variable to validate the difference between state-owned corporations and non-state-owned corporations in digital transformation. The robustness and endogeneity of the model are also examined, adding insights from different perspectives for Chinese corporations in the process of digital development.

Keywords: Human resource slack, Digital transformation, Ownership

INTRODUCTION

The digital economy refers to the economic activities of producing, managing and exchanging goods and services based on digital technologies such as the Internet, big data and artificial intelligence [1]. Since 2005, the digital services of global corporations have become the fastest-growing segment of international trade, reaching an annual average of 8.1% [2]. Digitisation levels in advanced economies increased by an average of 6% during COVID-19, with a significant increase in the adoption of digital technologies [3]. The significant increase in enthusiasm for digital transformation among Chinese corporations can be seen in the 12-fold increase in articles about digital transformation in China between 2019 and 2023 [4].

Human resource slack is closely related to the sustainability of corporations, as it enhances environmental performance by promoting sustainable innovation, and moderate human resource slack helps corporations to adopt sustainable business strategies. At the same time, human resource slack is closely linked to the social and economic sustainability of a corporation. For example, by providing additional training and development opportunities, human resource slack can help to increase employee skills and satisfaction, thereby enhancing long-term competitiveness [5].

Chinese corporations face many challenges in digital transformation, including implementing a corporate digital strategy and human resource management configuration. Professional and abundant talent resources are the core kinetic energy to drive corporate digitalization [6]. Accenture's study shows that Chinese corporations are weak on the issue of talent as a core requirement of digitization, with only about 33% of them agreeing that talent strategy is a key focus for the digital development of their corporations, compared to the global average of 52%.

Theory and Hypotheses

Theoretical Foundation

The resource-based theory perspective views a corporation as a collection of resources whose effective utilization can contribute to the growth of the corporation [10]. Resources cover all tangible and intangible assets owned or controlled by the corporation, and the value of tangible assets such as human resources depends mainly on the quantity, quality, skills, experience and knowledge of employees. This theory states that the value, scarcity, inimitability and irreplaceability of corporate resources are the key to sustained competitive advantage [11], and human resource slack possesses these characteristics. This theory extends to dynamic capabilities, emphasizing the need for corporations to adapt to rapidly changing environments through learning and innovation continuously and to reconfigure their resource base to maintain competitive advantage [12].

Redundancy theory suggests that organizations that design a certain amount of resource redundancy can improve their ability to cope with internal and external uncertainty and promote knowledge sharing and innovation [13]. Although this may increase costs in the short term, redundancy also plays a key role in facilitating organizational learning, increasing decision alternatives, and improving organizational flexibility [14]. The theory questions the traditional view of redundancy as wasteful, and by providing a buffer for system stability, adaptability, and innovation, redundancy confers resilience on organizations in the face of uncertainty and the changing environments in corporations [15].

H1: Corporate human resource slack has a significant positive effect on digital transformation.

H2: There is a moderating role for ownership in the path of human resource slack affecting digital transformation.

Research Design

Sample Data

Hu et al. listed A-share corporations in Shenzhen and Shanghai stock exchanges, while the Beijing Stock Exchange opened in September 2021, which was mainly positioned to serve innovative SMEs, and thus was not mature and representative enough, so it was excluded from the inclusion of the A-share data of the Beijing Stock Exchange [20].

Wu et al. studied digital transformation, while this paper excludes listed corporations identified as ST (Special Treatment) and PT (Particular Transfer) category [21]. These corporations often face financial problems or significant risks, and their financial data and operating conditions cannot accurately reflect the normal impact of human resource slack on digital transformation.

Furthermore, Wu et al. excluded corporations which are based on the finance industry because they have a unique business model, risk management system, and the impact of their human resource slack on digital transformation may be significantly different from that of other industries.

Guo et al. sets a research period of 2009-2022, in which the data of the explanatory variables, mediating variables and control variables are all from 2009-2021, and the data of the explanatory variables are lagged by a period from 2010-2022, so as to eliminate the problem of bidirectional causal endogeneity at the data level [22].

Model Setting

Main Regression Model Construction

With regard to the heteroskedasticity problem of the model, this paper estimates the robust standard error of the model. The regression formula for collapsing human resource slack on digital transformation is as follows:

$$DIG_{i,t+1}=\alpha_0+\alpha_1 HRSlack_{i,t}+\alpha_n control+\sum_{m=1}^{M} Industry_m+\sum_{t=1}^{T} Year_t+\varepsilon_{i,t}$$

DIG is the explanatory variable digital transformation. $\alpha_0$is the constant term of the regression model, $\varepsilon_{i,t}$ is the error disturbance term, $\sum_{m=1}^{M} Industry_m$is the industry control,$\sum_{t=1}^{T} Year_t$is the year control,$\alpha_n$(n=1,2,3…) is the regression coefficients corresponding to the control variables， and control includes all the control variables.

Construction of the Moderating Effect Model

In the study of this paper, the moderating variable is the nature of property rights, which is a dummy variable. When analyzing its moderating effect, it is necessary to include the explanatory variable human resource slack, the moderating variable nature of property rights, and the interaction term of the two into the model at the same time, and collate the model formula as follows:

$$DIG_{i,t+1}=\omega_0+\omega_1 HRSlack_{i,t}+\omega_2 SOE_{i,t}+\omega_3 HRSlack*SOE_{i,t}+\omega_n control+\sum_{m=1}^{M} Industry_m+\sum_{t=1}^{T} Year_t+\varepsilon_{i,t}$$

This By discerning whether the coefficient of $\omega_3$in the above model shows significance to judge whether the moderating effect is established or not, if its result is significant then the moderating effect is established, and the direction of its regression coefficient is the same as the direction of the main effect means that it shows positive moderation, and the direction of the opposite direction means that the moderating effect is negative moderation.

Variable Setting and Selection

Explained Variable

Voss et al. state that human resource slack is the difference between the level of human resources that a corporation actually has and the minimum necessary level [23]:

$$HRslack_{it}=HR_{it}-HR(min)_{it}$$

Datta et al. point out that the ratio of employee labour productivity as a degree to operating income or assets is commonly used as a measure in human resource slack studies [24]. Carnes et al. take the number of manpower or cost of a corporation as a measure of the number of studies using the growth rate of operating income per capita, and do not include the cost factor in their analysis [25]. Most studies have only considered the concept of the number of employees, but the inclusion of employee compensation has not been included, which creates a significant measurement bias endogeneity problem. Overall, the measurement of HR needs to include the number of employees and the level of employee compensation, on which basis it can be concluded that the measurement of HR is a function of the number of employees and compensation as resource input, and operating profit that eliminates the scale effect as output, which is expressed as follows:

$$HR_{it}=E_{it}(NUM_{it},SALARY_{it})$$

E_{it} is a function of profit to human capital, NUM_{it} is the staff size variable, $and\ ALARY_{it}$ is the employee compensation variable.

In this paper, the two indicators are considered to be of equal weight, and their values are normalised to calculate the standardised numerical mean of the number of employees and employee compensation. In order to eliminate the comparability problem brought about by the market size and asset size of the corporation, this paper adjusts the profit to the return on total assets， and profit is measured as net profit/total corporate assets:

$$HR_{it}=\frac{\ln(NUM)_{it}+\ln(SALARY)_{it}}{ROA_{it}}$$

In order to reflect the heterogeneity of human resource slack, it is necessary to take account of two perspectives: the educational qualifications of the employees and the type of work they do. The calculation of HR is extended as:

$$HR\_type_{dit}=\frac{\ln(NUM)_{dit}+\ln(SALARY)_{dit}}{ROA_{dit}}$$

$type_{dit}$ contains all the academic classifications (below speciality, undergraduate, postgraduate) and occupational classifications (production, finance, management, marketing). $Type_{dit}$ is a dummy variable, where dit stands for classification, and its value is assigned to 1 when there is one of them, and 0 when it is not.

Some scholars take the average level of human resources in the industry as a reference for corporations to achieve the optimal level of necessity and measure the human resource slack of corporations by the difference between their human resource levels and the average level of human resources in the industry [26], [27]. However, this approach has drawbacks: firstly, the variability between human resource sizes in different industries cannot be eliminated. Second, the managers of corporations when compared with other industries, and then the human resource slack of corporations themselves, will be subject to omitted variable intervention. Third, there are obvious differences in the economic development of different regions in China.

To address the shortcomings of previous measurements, this paper takes the level of human resources of the corporation itself as the dependent variable, and the mean level of human resources of the industry to which the corporation belongs as the independent variable, and regresses this model by using a fixed-effects model, and constructs the regression model with the following formula:

$$HR_{it}=\beta_0+\beta_1\times HR(optimal)_{imt}+ind_m+prov_p+\varepsilon_{it}$$

β_0 is constant, β_1 is the regression coefficient, i in $HR(optimal)_{imt}$ is individual corporation, t is the year, m is industry, ind_m is industry control, $prov_p$ is province control, and ε_{it} is the error term. After calculation, this paper can extract the ε_{it}, which is the net value of the corporation in human resources after different industries and different regions are impacted by the industry's human resources:

$$\varepsilon_{it}=HR_{it}-\left(\beta_0+\beta_1\times HR(optimal)_{imt}+ind_m+prov_p\right)$$

The ε_{it} is the human resource slack.

Explanatory Variables

Wu & Zhao [28] estimate the measurement of digital transformation, but this paper mainly uses the text analysis method.

This paper combines what corporations say in the text and what they do with the financial data to comprehensively assess the level of digital transformation of corporations from two perspectives: words and deeds. From the perspective of 'saying', the corporations' descriptions of digital transformation in their annual reports reflect their strategic intentions and commitments. By extracting keywords from the annual report, such as 'intelligence', 'software', 'system', 'information platform', 'data', 'software', 'software', 'software' and 'data', we can determine the level of digital transformation of an enterprise. The'data', the use of textual analysis can reveal the level of importance and specific plans of corporations for digital transformation. Textual descriptions may be exaggerated or inaccurate, and corporations may emphasise their digital strategies in their annual reports, but their actual investment is insufficient. Therefore, from the perspective of 'doing', this paper collates the fixed and intangible asset items in the notes of corporate financial reports, which include the following items in the subject names, such as 'Electronic equipment', "computer", "data equipment" and other terms of fixed assets, as well as the inclusion of "intelligent", "software", "software", "software", and other terms of fixed assets', 'software', 'system', 'information platform', 'data' and other keywords. and intangible assets containing keywords such as 'intelligence', 'software', 'system', 'information platform', 'data', and so on. The combination of the two can more accurately convey the true status of a corporation and enhance the credibility of the information.

Wu and Zhao measure the digital transformation of corporations by means of aggregation and de-emphasis, from the annual reports of listed corporations to obtain the corresponding keywords appearing in a word frequency list at the same time and also from the annual reports of listed corporations in the financial schedules there is the proportion of digital investment in intangible assets which accounts for the year's total assets for the extraction and calculation, and then through the single-sample T-test and K-mean cluster analysis and other operations to retain the keywords. Because of the large value of total word frequency and the heteroskedasticity that can result from ex-size effects, this paper calculates the proportion of the value of digitised 'words' in corporations using the total number of word frequencies and the total number of word frequencies in corporate texts in the current year, as well as the proportion of corporate intangibles that are digitised.

Some of the keywords, the final calculation of the total word frequency, and taking into account the larger value which will lead to the problem of heteroskedasticity, and the need to eliminate the bias brought about by the scale effect, this paper uses the total number of word frequency and the total number of word frequency of the current year's text of the enterprise to calculate the proportion of the value of the corporate digital 'words', while the ratio of intangible assets in the digital aspect of the enterprise. At the same time, the proportion of intangible assets of the corporation with digitalisation is used to measure the 'line' of the corporation's digital transformation, and the entropy weighting method is used for the two indicators to extract the final composite score for measuring the final digital transformation of the corporation (dig). The following entropy weighting method is adopted for the calculation:

$$S\_X=\frac{X-X_{min}}{X_{max}-X_{min}}$$

S_X is the normalised value, X is the original value of the metric, $X_{min}$is the minimum value, *and* X_{max} is the maximum value. The entropy redundancy calculation is as follows:

$$d=1+\left\{\frac{1}{ln(n)}\sum_{i=1}^{n}\left[\frac{S\_X}{\sum_{i=1}^{n}S\_X}ln\left(\frac{S\_X}{\sum_{i=1}^{n}S\_X}\right)\right]\right\}$$

n is the total number of objects being evaluated, d is the information entropy redundancy of each indicator, and the weights are calculated according to the following formula:

$$w_j=\frac{d_j}{\sum d_j}$$

The weight w_j of the jth indicator is equal to the ratio value of the information entropy redundancy of the j indicator to the overall information entropy redundancy being calculated. Finally, the entropy weighting method score is calculated by weighting and summing the value of the corresponding j indicator with the corresponding weight value w_j.

Moderating Variables

For ownership, refer to Liu et al. [29], Li [30], Fang [31], Liu [32], Li [33] and other studies. The difference in ownership determines the differences in various aspects, such as the corporation's business objectives, management mechanism, resource allocation methods, and the ability to adapt to changes in the external market. In this paper, ownership is set as a dummy variable, which equals 1 when the type of corporation is non-state-owned and 0 when the opposite is true.

Control Variables

The selection of control variables is based on the financial and non-financial perspectives of a corporation, and the internal and external perspectives of listed companies. Based on previous research, the financial perspective includes total assets as a measure of corporate size, the debt-to-asset ratio as a measure of debt-servicing ability, and the total asset turnover rate as a measure of operating ability. The non-financial perspective includes the size of the board of directors, the proportion of independent directors, and whether the chairman of the board also serves as the CEO. From the perspective of external corporate control, the innovation level and economic development level of the province where the corporate is located are selected as control variables.

Study Results and Discussion

Descriptive Statistical Analysis

Table 1 Results of Descriptive Statistical Analysis of Full

Variables	Minimum	Maximum	Mean	S.D	CV
digew	0.007	0.979	0.121	0.198	1.628
HRslack	-0.266	0.198	-0.0034	0.094	-26.60
SOE	0	1	0.274	0.446	1.629
Size	19.74	25.55	22.12	1.214	0.055
lev	0.048	0.864	0.388	0.197	0.508
Tat	0.110	2.284	0.608	0.368	0.605
Bsize	1.792	2.708	2.227	0.170	0.076
Indep	0.333	0.571	0.376	0.053	0.140
Dual	0	1	0.331	0.470	1.423
Top1	0.085	0.722	0.337	0.144	0.428
Balan	0.038	2.896	0.796	0.624	0.784
Rd p	8.426	13.81	12.17	1.148	0.094
Gdp_p	10.18	12.12	11.28	0.444	0.039

There are no significant characteristics from the results of the digital transformation , as the negative mean value of the human resource slack indicates that most corporations are relatively insufficient in human resource allocation; the statistical results of an adaptive capability in dynamic capability ranges from -1.384 to -0.081, with a mean value of -0.656 and a standard deviation of 0.328, and the negative mean values indicate that most corporations face a greater challenge in adapting to changes in the external environment and adjusting to the allocation of their internal resources. The mean value of the corporate ownership variable is 0.274 indicating that private corporations account for the majority of the sample while the proportion of state-owned corporations is low. This distributional feature implies that Chinese corporations exhibit a clear binary structure in terms of corporate ownership, and the coefficient of variation in the descriptive statistics, which is as high as 1.629, demonstrates the strength of this differentiation phenomenon, revealing the far-reaching effects of the property rights structure on the behaviour of

Regression Analysis

Table 2 Benchmark regression results for human resource slack affecting digital transformation corporations in the Chinese market.

Indep	-0.009
	(-0.393)
Dual	0.004*
	(1.958)
Top1	-0.010
	(-1.016)
Balan	0.005**
	(2.020)
Rd_p	-0.001
	(-0.919)
Gdp_p	0.034***
	(10.283)
_cons	-0.340***
	(-7.670)
Sample	28619
R-squre	0.284
Industry fixed effects	Control
Year fixed effects	Control
F-test	18.006***
LM test	44315.517***
Hausmann test	227.735***

The results of an F test, LM test and Hausmann test in model are all significant at 1% level, and the regression coefficient of human resource slack is 0.053, while the paths are all significant at 1% level, indicating that the independent variable has a significant positive effect on the dependent variable.

The regression results of asset size and total asset turnover show that they have a significant effect on these explanatory variables. The effect of the gearing ratio shows no significance relative to the other factors, implying that highly indebted corporations have not limited their incentives to investing digitally due to their debt levels, while low indebted corporations have not taken advantage of a digital transformation due to a freer flow of funds. The significant negative correlation of the board size suggests that the larger the board size the more likely corporations are to face rising agency costs on digital transformation. The regression coefficient of board independence on digital transformation does not reach the level of significance, showing that independent directors have a certain monitoring role, but have limited influence when it comes to decision-making; the significance of two concurrent positions suggests that a governance structure in which the CEO is appointed at the same time as the chairman of the board of directors means that he is able to play a better role in advancing the digital transformation of the corporation. The significance of the level of economic development indicates that the province has a significant positive impact on the explanatory variables concerned. The coefficient of the level of innovation in the province of affiliation is -0.001 and does not reach a significant level, and this non-significant result indicates that although the level of innovation can theoretically support the diffusion of corporate technology and knowledge, it does not have a significant impact on the actual advancement of digital transformation in corporations.

Comparative Analysis of Levels Under Different Corporate Ownerships

Table 3 Independent samples t-test results for grouping under corporate ownership

	Mean value		**Standard deviation**		
SOE	**Non-state corporations**	**State-owned corporations**	**on-state corporations**	**State-owned corporations**	**t**
digew	0.127	0.106	0.206	0.174	8.027***
HRslack	0.012	-0.046	0.088	0.096	48.493***

p<0.1p<0.05***p<0.*

After analysing the different dimensions of digital transformation, human resource slack of Chinese corporate firms in comparison between SOEs and non-SOEs, the independent samples t-tests show significant differences

between the two types of firms on all key indicators. Non-state corporations are significantly ahead of state-owned corporations on digital transformation, human resource slack, while state-owned corporations show higher mean performance on innovative capacity. Specifically non-state corporations have higher means for digital transformation (M = 0.127) than state-owned corporations (M = 0.106), with a t-value of 8.027 ($p < 0.01$) indicating that non-state corporations are more proactive in utilising digital technologies.

Table 4 Benchmark regression results of the mechanism of the regulatory effect of corporate ownership

	digew
HRslack	0.038**
	(2.543)
SOE	0.001
	(0.347)
HRslack×SOE	0.050**
	(2.039)
Sample	-0.346***
	(-7.775)
N	28619
R-squre	0.284
Industry fixed effect	Control
Year fixed effects	Control
Control variable	Control
F test	18.000***
LM test	44340.311***
Hausmann test	227.872***

p<0.1p<0.05***p<0.01*

The results in the table conclude that the optimal model is a fixed-effects model, and the analysis results show that the regression coefficient of HRslack×SOE is equal to 0.050>0, and presents a significance at the 5% level, which indicates that the moderating effect is established and positive, i.e., the positive performance of the corporate ownership of state-owned corporates is more obvious. from the results of Figure 1, when the grouping is high, that is, corporate ownership for state-owned corporates when the positive slope of the red straight line is more obvious, when the grouping is low, that is, corporate ownership for non-state-owned corporates when the positive slope of the blue straight line is obviously lower than the slope of the red straight line.

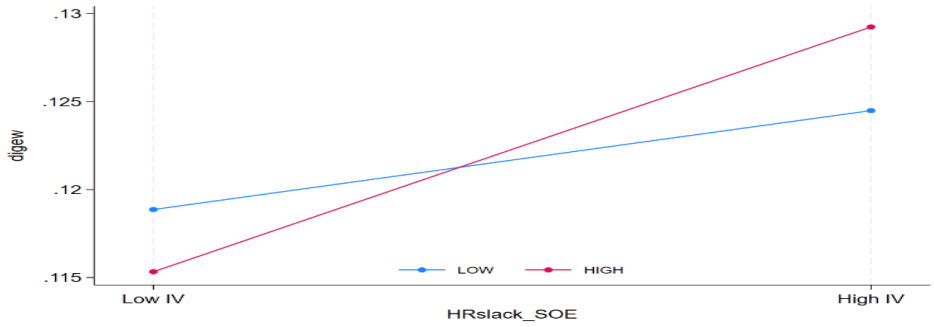

Figure 1 Simple Slope Plot of the Regulatory Effect Mechanism of Corporate Ownership

Robustness Tests

Endogeneity test

Table 5 System GMM Model Regression Results

	(1)
	digew
L.digew	1.909***
	(2.838)
HRslack	1.412**
	(2.177)
_cons	10.492***
	(2.683)

Sample size	23348
Industry fixed effects	Control
Year fixed effects	Control
Control Variables	Control
AR[2]	-0.242
AR[2] p	0.809
Sargan	5.003
Sargan p	0.416
Hansen	2.953
Hansen p	0.707

p<0.1p<0.05***p<0.01*

This paper attenuates the omitted variable endogeneity problem by using a systematic GMM model and it uses instrumental variables for a two-stage regression model to eliminate the two-way causal endogeneity problem.

The test found that the regression coefficient of lagged digital transformation on current digital transformation is >1.9, which has a significant positive effect. The regression coefficient of human resource slack on digital transformation is > 1.4, and the results indicate that abundant human resources for corporations enhance the ongoing process of corporate digital transformation. The result of AR (2) serial correlation test is <-0.2, which indicates that there is no second-order serial correlation in the model. The Hansen statistic > 2.9 indicates that the instrumental variables used in the model are valid and not over-identified.

The instrumental variable is the number of higher education schools in the province where the corporation is located, and the correlation perspective shows that the number of instrumental variables tends to be positively related to human resource slack within the province.

The results show a significant positive effect of human resource slack on digital transformation with a regression coefficient of > 0.6. The Hausman test shows 14.29, $p < 0.01$, which suggests that there is an endogeneity problem in the model and supports the use of the TSLS（two stage least square）. The $p < 0.01$ for the non-identifiable test indicates that the instrumental variables of the model are effectively identified. The weak instrumental variable test has a statistic > 30, indicating that the instrumental variables are strongly correlated.

Table 6 Summary of regression results after adjustment of data

	(1)	**(2)**	**(3)**
	digew	**digew**	**digew**
HRslack	0.058***	0.050***	0.030**
	(4.143)	(3.775)	(2.338)
SOE	0.001	-0.000	0.005*
	(0.455)	(-0.018)	(1.687)
HRslack×SOE	0.062***	0.043*	0.084***
	(2.602)	(1.666)	(3.271)
_cons	-0.381***	-0.321***	0.061
	(-7.661)	(-6.868)	(1.118)
Sample size	28619	25681	23389
R-squre	0.285	0.282	0.250
Industry fixed effects	Control	Control	Control
Year fixed effects	Control	Control	Control
Control Variables	Control	Control	Control

The regression coefficients of the total effect after treatment using a bilateral shrinkage tail at the 5% level is 0.058 show continued significance. Many corporations accelerated their digitalisation process during COVID-19 due to the restrictions of the external environment, such as digital layout in telecommuting, online sales, etc., coupled with the effects of economic instability and changes in supply and demand in the labour market, hence the exclusion of the 2020 sample. The regression coefficients of human resource slack on digital transformation after the exclusion is 0.050, all of which remain significant.

The four municipalities (Beijing, Shanghai, Tianjin, and Chongqing) have unique advantages in terms of their level of economic development, the attractiveness of scientific and technological innovation resources and talents, and policy differ from those of other provinces, so excluding the sample of the four municipalities can control the effects on geography, policy, and resources to a certain extent. The regression coefficients of the total effect are 0.030, although the coefficients have decreased, the direction and significance are generally consistent.

Adjustment of Model

When describing the statistics, it was found that the data distribution of corporate digital transformation had strong volatility. The normality test of its data found that its skewness value was equal to 3.185, the kurtosis value was equal to 12.802, while its skewness value exceeded 3. The kurtosis value exceeded 10, which indicated that the data had a skewed distribution. To correct and test this skewness, we mainly used a quantile regression model to set three quantiles of 25%, 50% and 75% to test it.

Table 7 Summary of Quantile Regression Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Quartile	**0.25**	**0.50**	**0.75**	**0.25**	**0.50**	**0.75**	**0.25**	**0.50**	**0.75**
	digew	**digew**	**digew**	**digew**	**digew**	**digew**	**digew**	**digew**	**digew**
HRslack	0.023***	0.029***	0.032***	0.020***	0.023***	0.027***	0.027***	0.036***	0.042***
	(23.334)	(15.380)	(4.340)	(24.405)	(15.775)	(5.029)	(24.636)	(16.486)	(4.875)
SOE							0.002***	0.003***	-0.003
							(4.337)	(3.043)	(-0.814)
HRslack×SOE							0.027***	0.040***	0.066**
							(6.881)	(5.102)	(2.162)
_cons	-0.158***	-0.272***	-0.862***	-0.157***	-0.274***	-0.844***	-0.168***	-0.282***	-0.867***
	(-23.506)	(-20.890)	(-16.954)	(-23.127)	(-18.843)	(-16.408)	(-25.138)	(-21.432)	(-16.843)
Sample	28619	28619	28619	28619	28619	28619	28619	28619	28619
Industry fixed effects	Control	Control	Control	Control	Control	Control	Control	Control	Control
Year fixed effects	Control	Control	Control	Control	Control	Control	Control	Control	Control
Control Variables	Control	Control	Control	Control	Control	Control	Control	Control	Control

p<0.1p<0.05***p<0.01*

The regression coefficients of human resource slack on digital transformation at the 25%, 50% and 75% quartiles were 0.023, 0.029 and 0.032 ($p < 0.01$), respectively, showing that the positive driving effect of human resource slack is always significant regardless of the digitisation level of the corporation. Significance of ownership is also shown through moderating effects

HETEROGENEITY ANALYSIS

The academic qualifications of the employees of the listed corporations and the type of work of the employees were classified according to two perspectives. The academic classification contains below specialism, undergraduate and postgraduate, and the occupational classification contains production, finance, sales and technology.

The results show that there are differences in the impact of human resource slack on corporate digital transformation across education levels. The effect of human resource slack at the graduate level on digital transformation is not significant, and its regression coefficient does not reach the level of significance; human resource slack at the undergraduate level has a significant positive effect on digital transformation, with a regression coefficient of 0.035; human resource slack at the specialist level has a non-significant effect on digital transformation, with a regression coefficient close to 0; and the effect of human resource slack at the sub-specialist level on digital transformation is significantly negative, with a regression coefficient close to 0. The effect of human resource abundance at the specialist level on digital transformation is significantly negative, with a regression coefficient of -0.076.

Corporations should weigh the advantages and limitations of different levels of human resources in the use of different levels of talent. Managers usually think that highly educated talents have strong theoretical and innovative ability which means highly educated talents require higher salary costs, while undergraduate students are a kind of compromise advantage in the current enterprise, and is the corporate human resource management of the 'best fit strategy'. Although people with specialised degrees and below has an advantage in terms of human costs, their lack of technological adaptability and innovation reduce their marginal benefits in digital transformation, and this type of deployment is only suitable for tasks with low innovation needs.

We assessed the human resource slack of corporations by occupation types across four categories: production, sales, marketing, and technology, and analyzed its effect on corporate digital transformation.

The results indicate that human resource slack in production had the most significant impact on digital transformation, with a regression coefficient of 0.093. This finding may strongly align with the need for process

optimization and automation in the production sector. Additionally, human resource slack in the finance department also showed a positive significance, with a regression coefficient of 0.049, reflecting a high demand for digital applications in data analytics. The regression coefficient for the technology department was 0.029, suggesting that the abundance of staff in this department plays a crucial role in promoting digitization. Conversely, the regression coefficient for marketing was less than 0, indicating a negative effect. This might be attributed to the fact that the marketing department's tasks are primarily focused on customer communication, sales management, and other activities that require flexibility and personal insight, where digital transformation may restrict the opportunities for marketing staff to significantly contribute.

DISCUSSION

Abundant human resources enable corporations to implement an 'insurance strategy' in digital transformation, meaning they can switch between conservative and aggressive tactics. This allows corporations to invest more heavily in new technologies for digital projects while maintaining some redundancy in the conservative approach to safeguard against potential failures. This strategy not only mitigates the impact of failure but also offers an alternative method.

State-owned enterprises (SOEs) and private enterprises (PTEs) demonstrate significant differences in their digital transformation journeys. Specifically, state-owned corporations benefit from superior resource integration and risk resistance due to their policy and resource advantages. In contrast, private corporations excel in transformation speed and adaptability, thanks to their flexible decision-making processes and market orientation. This regulatory framework highlights the differing approaches to resource acquisition and usage among corporations of various ownership types, broadening the theoretical study on property rights and resource allocation, and offering a new theoretical framework for understanding how corporations can select the optimal digital transformation path based on their property rights characteristics.

CONCLUSION

According to the research findings, human resource slack provides a strong impetus for the digital transformation of corporations. When corporations possess abundant human resources, it becomes easier for them to cultivate a talent pool with diverse skills and innovation capabilities tailored to digital needs. This not only allows corporations to access continuous technical and innovative support throughout the transformation process but also ensures the flexibility and sustainability of their digital strategy. By enhancing their dynamic capabilities, corporations can effectively and consistently convert their human resource abundance into a sustainable driver of digital transformation, making the process smoother and more productive. While human resource slack does not guarantee success directly, it acts as a complement and driver of dynamic capabilities that enable corporations to allocate resources flexibly, adapt to market changes, and foster technological innovation, thus gaining a significant competitive advantage in the sustainability of their digital transformation.

Based on the findings of this study, several recommendations can be proposed: first, corporations should recognize the key role of human resource slack in driving digital transformation and leverage it as a strategic pillar to boost corporate competitiveness. This can be achieved by recruiting diverse talent and establishing a digital learning platform, among other initiatives; second, by implementing a scientific resource redundancy mechanism, corporations can utilize human resource slack to create a risk buffer.

SHORTCOMINGS AND SUGGESTIONS

Although this paper has produced some research results in revealing the mechanisms that influence human resource slack during corporate digital transformation, it still has the following shortcomings:

First, this study has not fully considered external environmental factors affecting the digital transformation of corporations. Given the limited scope of the study, it has failed to fully incorporate the influence of external environmental variables such as policy support, industry competition, and technological infrastructure, which may have resulted in an incomplete analysis of the mechanisms of corporate digital transformation.

Second, there are limitations in the data sources of this study. The focus was on listed companies in China, and the sample data primarily comes from publicly available annual reports of listed companies and related data platforms, a limitation that may affect the generalizability of the study's conclusions and underrepresent unlisted SMEs, which share a similarly strong need for digital transformation.

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