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How Does Digital Transformation Impact the ESG Performance of Chinese Multinational Enterprises (MNEs) – Evidence from Listed Chinese Multinational Enterprises (CMNEs)

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Abstract

Increasing attention has been paid to the sustainable development and enterprises' ESG practice. As important players on the global economic stage, Chinese multinational enterprises (CMNE) have attracted wide public attention to their ESG performance and are constantly exploring effective ways to improve it. In a digital era, can the digital transformation contribute to the ESG performance of the MNEs?

In order to provide suggestions for MNEs on how to improve their ESG performance, this paper uses data from 110 listed CMNEs samples from year 2016 to 2021 to test whether digital transformation can contribute to their ESG performance. The results from the empirical study lead to the following robust conclusions: First, digital transformation can postively impact MNEs' ESG performance. Second, this impact is achieve by improving two mediators: innovation and the risk control capacity. Third, there exists heterogeneity and diminishing marginal effects in this impact.

Based on the conclusions above, this paper holds that in order to improve their ESG performance, MNEs should plan their digital transformation wisely to drive thier innovation and risk control ability. Meanwhile, policies should encourage MNEs to integrate digital technology into their business and management, creating a good external environment for the digital transformation of MNEs.

Key words: Digital Transformation, ESG Performance, Chinese Multinational Enterprise, Corporate Social Responsibilities

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As proposals for green consumption and environmental protection emerged over the past few decades, countries all over the world have been expediting the development of sustainability (Wang, 2019). After the United Nations General Assembly put forward the concept of "sustainable development", relevant strategies were subsequently established, which brought the theories into practice. In this context, enterprises, an essential part of the economy, are also reshaping their business strategies to answer the call of sustainable development, while investors are paying increasing attention to the long-term development and sustainability when evaluating them, resulting in the rise of the term "ESG investing".

ESG investing focuses on green and responsible investment, which evaluates enterprises based on their performance in three aspects: Environmental (E), Social (S), and Governance (G), and have become a benchmark to measure the sustainability of an enterprise. ESG investing in China started late in time but developed rapidly in speed (Xie & Lv, 2022). As of 2022, the amount in ESG investing in China has exceeded 100 billion yuan, over twice that of 2020. Therefore, the enterprises' practice in the three aspects of ESG can have a direct impact on their financing.

Amid globalization, multinational enterprises (MNEs) accounts for around 1/3 of the global output, 1/2 of the world export, and 1/4 of the global employment (OECD, 2018). Their performance of ESG practice has a global effect (Buckley et al. 2017; Montiel et al. 2021), and eventually impact the global sustainable development. Chinese multinational enterprises

(CMNEs) especially, ever since the Belt and Road Initiative was put forward in 2013, have increased investment abroad (Ji & Huang, 2021), expanding their footprints around the globe.

Hence, the improvement of ESG performance of CMNEs will at least have the following three contributions: contributing to CMNEs' financing; promoting sustainable development at home and around the world; gaining the support from local people in CMNEs' host countries and improving the effectiveness of their global management. All three above will eventually lead to the growth and overseas development of CMNEs.

Digital transformation has become the key strategies for most enterprises to maintain long-term growth (Zhao, 2022). The macro-environment of China's digital economy provides sufficient conditions for enterprises to explore digital transformation. With large-scale coverage of 5G infrastructure, rapid development of artificial intelligence, and blockchain and cloud technology, MNEs can actively turn to digital transformation which will lift their ESG performance via two channels: first, it can improve their innovation level, which will improve the management and production efficiency and increase financial resource for ESG practice; second, it can improve MNEs' risk control capacity, which will promote the sustainable development of enterprises. According to the White Paper on China's Digital Economy Development and Employment released in 2021, "the scale of China's digital economy in 2020 has reached 39.2 trillion yuan, accounting for 38.6% of GDP, with a year-on-year nominal growth of 9.7%." To pursue sustainable development and improve ESG performance, it has become an inevitable trend for CMNEs to turn to digital transformation.

A deep dive into the impact of CMNEs' digital transformation on their ESG performance will provide a Chinese perspective in terms of methods to improve MNEs' ESG

performance.

Focusing on CMNEs and two themes of ESG and digital transformation, this paper uses 110 listed CMNES during 2016 to 2021 as samples, exploring the impact of their digital transformation on ESG performance, providing suggestions for MNEs to improve ESG performance. At the same time, this paper will further explore the two mediators – innovation, and internal control and risk control capacity, revealing the potential mechanisms of this impact.

Literature Review

Enterprises' ESG Performance

Many literatures have focused on the enterprises' ESG performance using the ESG rating, a comprehensive index that evaluates the sustainability of an enterprise (Linnenluecke, 2020). Another concept closely related to ESG is Corporate Social Responsibility (CSR). It is generally believed that the scope of ESG is wider as the ESG rating takes into consideration governance performance (i.e., G in ESG) which is excluded from the CSR rating (Gillan, 2021). Therefore, this paper also regards factors affecting enterprises' CSR performance as those influencing their ESG performance.

The measurements of ESG performance remains in the preliminary stage in both academia and industry, and no consensus has been reached. A few ESG measurements widely recognized include the ratings from the following agencies: Bloomberg, Refinitiv, Thomson Reuters, and Morgan Stanley Capital International (MSCI). Different ratings mainly vary in their subcategories under the three categories of ESG, since they are subject to contextual differences, for example, cultural difference. Research on ESG performance of Chinese enterprises mostly adopt the Huazheng ESG rating. (Hu, et al., 2022).

Digital Transformation and the ESG Performance of MNEs

The digital economy and digital transformation may be able to help MNEs improve their ESG performance. The digital economy refers to the new economy developed in the era of digital technologies such as artificial intelligence, chain blocks, cloud computing, and big data technologies (Qi & Xiao, 2020); the digital transformation refers to the transformation made by an enterprise to its own production, operation, and management mode, using those digital technologies (Siebel, 2019).

Currently, there are studies on how digital transformation affects the non-economic performance of general enterprises. Studies show that the digital transformation of the manufacturing enterprises can reduce the embodied carbon intensity on exports (Hu & She, 2022); meanwhile, digital transformation can promote the common prosperity within enterprises (Fang et al., 2022). According to the study of Hu et al. (2022), digital transformation can significantly improve enterprises' ESG performance. These studies all suggest that digital transformation may also have a positive impact on the ESG performance of MNEs. However, there are few literatures focusing on digital transformation in MNEs.

Scholars have also explored the impact of digital transformation on multiple dimensions of enterprises, especially on innovation and risk control capacity. In terms of innovation capacity, Svahn et al. (2017) conducted a longitudinal study on Volvo Automobile, indicating that digital transformation can bring about digital technology innovation to incumbent enterprises and help them achieve better long-term development. Chen et al. (2019) believe that digital transformation of Chinese enterprises can trigger enterprise management innovation (including work mode, human resource management, financial management and

organizational management). According to the study of Fu et al. (2021), the digital transformation of an enterprise's operation process will significantly promote its innovation performance. For MNEs, Wang et al. (2023) propose that digital transformation of high-tech MNEs is positively correlated with their innovation level. In terms of corporate risk control capacity, existing studies (Li & Qian, 2022) argue that digital transformation can improve the internal control capacity of enterprises, and that the digital economy can cushion the inhibiting effect on enterprises' risk control capacity, which results from the diversified development of enterprises (Xu et al., 2022).

Research shows that the two dimensions above will have an impact on the ESG performance of enterprises. Through innovation, enterprises can form a collaborative network with other economic entities, bridging the information gap that raises the cost of ESG practice, facilitating enterprises to take up responsibilities for the environment, and thus improve their ESG performance (Subramaniam & Youndt, 2005; Peattie & Ratnayaka, 1992). Also, the risk control and internal control capacity of MNEs are closely linked to their sustainability level. The higher the risk control capacity is, the higher the risk tolerance is and the more sustainable enterprises' development is (Peng & Jiang, 2022).

Other Factors Impacting the ESG Performance of MNEs

At present, there is limited research on the influencing factors of ESG for MNEs. For general enterprises, Sun et al. (2019) hold that strong factors that improve enterprises' ESG performance include solvency, profitability and reasonable capital structure. Hu et al. (2022) argue that the digital transformation can promote enterprises' ESG performance. In research on factors affecting ESG performance of MNEs, factors studied include financial performance

(DasGupta, 2022), market competition (Martins, 2022), national identity (Amor-Esteban, 2018) and interference of state organizations (Ioannou, I., 2021), but most of these studies focus only on MNEs from western countries (Du et al.,2022) and there has been no study discussing how digital transformation affects MNEs' ESG performance.

Innovation Point

To sum up, there exist two gaps in the current research on the digital transformation and ESG performance of MNEs: (1) Few literatures studies the ESG performance of MNEs whose home countries are developing countries; (2) Studies that explore the influencing factors of MNEs' ESG performance are still limited. (3) Few studies have explore the mechanisms of how the influencing factors impact enterprises' ESG performance.

The innovation points of this paper are as follows: (1) This paper uses MNEs from China (a developing country) as samples to study the impact of digital transformation on their ESG performance. (2) This paper explores digital transformation as an influencing factor of the ESG performance of MNEs. (3) This paper not only study the impact itself, but also the mediators in the impact to reveal the mechanism.

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Theories and Hypotheses

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Digital Transformation and MNEs' ESG performance

The Stakeholder Theory holds that, to succeed, an enterprise needs to be responsive to its all stakeholders (Freeman & Liedtka, 1997, Freeman et al., 2005), including owners, employees, government, customers, suppliers, etc. In the global environment mentioned above, compared to non-MNEs, MNEs are organized over a larger spatial span and have wider distribution channels, thus dealing with needs from more stakeholders (George et al., 2022).

Improving ESG performance means better meeting the needs of all stakeholders. However, three problems arise from this process. First, due to the externalities of ESG practice, for example, when enterprises cater for needs from environment and social welfare, its input does not bring direct economic return, which may lower the average input-output ratio, waste the company's resources, and eventually bring "negative effects" to the enterprise itself (Friedman, 2007; Garcia & Orsato, 2020). Therefore, to bear the cost of their ESG practice, enterprises should have a considerable capital base. Second, compared to non-MNES, MNEs have stakeholders geographically dispersed. When conducting ESG practices, MNEs face problems like resource constraints, poor technical means, and information asymmetries with stakeholders, which add to their cost to improve ESG and require higher capabilities in data collection and data processing. Third, in the face of uncertainties like geopolitical factors, trade barriers, and increased international regulation (George et al., 2022), MNEs are exposed to greater risks than non-MNEs, which disturb their risk control capacity and worsen their corporate governance, thus affecting the ESG performance.

Digital transformation can address the three problems above and help companies better respond to the needs of various stakeholders, i.e., promote the ESG performance of multinational companies. First, digital transformation can embed digital information technologies into MNEs' daily management and production, enhancing their innovation capacity, solving the first and second problems: innovation will lead to the improvement of production technology, which eventually improves the productivity and profitability and increases enterprises' overall resources and resources available for ESG practice; meanwhile, enterprises' technology and innovation capacity also means the upgrading of management

technology that leads to higher management efficiency, thus reducing the cost of balancing needs from all stakeholders and ESG practice. Digital transformation can solve the third problem for MNEs: introducing information technology, digital transformation can help reduce information asymmetry and transaction costs, hedging against risks and enhancing enterprises' risk control capacity; the use of information technology can also improve enterprises' information transparency, improving governance level and ESG performance.

Accordingly, this paper proposes the following hypothesis:

H1: Digital transformation will improve MNEs' ESG performance.

How Does Digital Transformation Impact MNE's ESG Performance

This paper proposes two channels through which digital transformation can improve the ESG performance of MNEs.

Innovation Capacity

First, digital transformation of MNEs can improve MNEs' ESG performance by driving innovation capacity. Digital transformation drives MNEs' innovation capacity, which will increase the productivity of MNEs and allow them to have more resources to invest in ESG practices and sustainability strategies; at the same time, by driving innovation capacity, digital transformation will also reduce the cost of enterprise operation and ESG practice, which will have a positive effect on their ESG performance.

Wang et al. (2023) suggest that digital transformation of high-tech MNEs has a positive relationship with innovation capacity; a large number of other empirical studies show that digital transformation of enterprises can effectively promote green innovation (Song et al., 2022; Wang et al., 2022).

Innovation can then enlarge enterprises' resources available for ESG practice and reduce relevant costs, thus improving MNEs' ESG performance.

Innovation will grant MNEs' products or services differentiation, a competitive advantage, and increase productivity and management efficiency, eventually expanding the overall resources available to the MNE as well as the resources invested in ESG practice (Hu et al., 2022).

Innovation brough about by digital transformation will change the amount, speed, and type of data that MNEs collect, store, and use (Anderson, 2008; Mayer-Schonberger & Cukier, 2013; Thomas & Leiponen, 2016): IoT devices, satellites, and mobile devices can be used to collect new information of all types, while cloud technologies enable MNEs store abundant data. Green innovation reduces the cost and raise the efficiency for MNEs in green production, leading to better environmental performance (Peattie K& Ratnayaka M, 1992).

Therefore, this paper proposes the hypothesis below:

H2: Digital transformation can contribute to MNEs' ESG performance by driving innovation capacity.

Internal Control and Risk Control Capacity

Second, digital transformation can enhance MNEs' ESG performance by improving MNEs' internal control and risk control capability. CMNEs grow up in the emerging market. As they increase investment in Belt and Road countries amid their market expansion, they face uncertainties in other emerging markets such as policy and competition (Zhang et al., 2022). In this context, risk control is vital for their sustainable development. Faced with multifaceted risks, digital transformation of MNEs is conducive to perfecting data platforms, improving data

transmission efficiency, enhancing corporate market monitoring and internal information transparency (Xiao et al., 2021), providing complete data for internal control and risk control.

For example, in terms of enterprise management, digital transformation, especially the application of big data and blockchain technology, makes enterprises' activities recordable and traceable, which increases enterprises' internal oversight capability and improves internal governance. In terms of market development, enterprises can coordinate communication within the entire supply chain through blockchain technology, keep abreast of suppliers' supply and market conditions, accurately grasp market dynamics and opportunities, and reduce the risks of operating in the global market. In MNEs' global operations, their internal control and risk control capacity are highly linked to the level of their sustainability. Stronger internal control and risk control capacity will bring better performance in investment vitality, operational performance and shareholders' interests, while weaker internal control and risk control capacity will lead the enterprises to operate conservatively, which may hinder their long-term development and sustainability (Peng & Jiang, 2022).

Therefore, this paper proposes the hypothesis:

H3: Digital transformation can contribute to MNEs' ESG performance by improving their internal control and risk control capacity.

Empirical Study Design

Sample Selection

The sample used in this paper comes from the enterprises listed in Shanghai and Shenzhen Exchange that have had overseas direct investment events during 2016-2021. The specific sampling rules are as follows: (1) Obtain the list of listed companies with overseas

direct investment events in each year between 2016 and 2021[1]. (2) Exclude companies with ST and *ST, companies that have been delisted due to bankruptcy, and companies listed for less than three years; (3) Exclude listed companies whose business scope includes financial industries; (4) Arrive at the top 200 listed companies based on the total assets of overseas subsidiaries (total assets were calculated as of December 31, 2021).

To arrive at a balance panel data, this paper arrived at 110 final samples from the 200 initial samples, among whom 23 are technology companies and 87 are non-technology companies. The final balanced panel data are a total of 660 observations from 110 CMNEs during 2016-2021.

Variable Design, Data Collection and Data Preparation

Dependent Variable

The dependent variable in this paper is enterprise ESG performance (ESG). In the benchmark regression analysis, the measure of the independent variable is the ESG rating from Huazheng ESG Rating System; in the robustness test, the measure of this variable is replaced by the ESG rating from Bloomberg. Both datasets are obtained from Wind database.

Independent Variable

The independent variable in this paper is the level of digital transformation ($Digital$). In the benchmark regression analysis, it is measured by the logarithm of the frequency of words related to digital transformation, obtained from enterprises' annual reports; in the robustness test, it is measured by another two metrics: (1) the text frequency calculated based on another method; (2) the proportion of the amount of digital transformation assets in the enterprise's

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[1] Source: CSMAR

intangible assets.

Control Variables

Referring to the general practice of previous studies on listed enterprises (Xiao et al., 2021; Liu et al., 2022), this paper includes a series of control variables in the model to control for other factors that may have an impact on enterprises' ESG performance, including enterprise size ($size$), enterprise age (age), operating income growth rate ($growth$), liability ratio ($lever$), the proportion of independent directors ($indep$), the situation of CEO duality ($dual$), equity concentration ($top1$) and board size ($board$). The metrics are all obtained from the CSMAR database.

Mediators

In the exploration of mechanisms, this paper uses the number of inventions and patents to measure enterprises' innovation capacity ($innovation$) and the internal control index to measure internal control and risk control capacity ($riskcontrol$). Data are sourced from Chinese Research Data Services (CNRDS) and DIB Database, respectively.

Econometric Model

Benchmark Regression

Based on the results of the Hausman test, this paper adopts the random effects model for panel data regression analysis, and the econometric model is as follows. The explanation of the variables in the regression model are shown in Table 4-1.

$$ESG_{it} = \beta_0 + \beta_1 Digital_{it} + \sum j\, \beta_j Controls_{it} + \mu_{it} + \varepsilon_{it}$$

Mediation Effect

In the examination of mediation effect, this paper uses stepwise regression to test the

two mediator variables with the following econometric model:

$$ESG_{it} = \beta_0 + \beta_1 Digital_{it} + \sum j\, \beta_j Controls_{it} + \mu_{it} + \varepsilon_{it}$$

$$Mediator_{it} = \alpha_0 + \alpha_1 Digital_{it} + \sum j\, \alpha_j Controls_{it} + \mu_{it} + \varepsilon_{it}$$

$$ESG_{it} = \gamma_0 + \gamma_1 Digital_{it} + \gamma_2 Mediator_{it} + \sum j\, \gamma_j Controls_{it} + \mu_{it} + \varepsilon_{it}$$

Table 4-1 Variables in the Econometric Model

Variable Name	Meaning of the Variable
Dependent Variable ESG_{it}	Enterprises' ESG performance
Independent Variable $Digital_{it}$	The level of digital transformation
Mediator Variable $Mediator$	Enterprises' innovation capacity ($innovation$); Enterprises' internal control and risk control capacity ($riskcontrol$)
Control Variables $Controls$	Enterprise size (size), enterprise age (age), operating income growth rate (growth), liability ratio (lever), the proportion of independent directors (indep), the situation of CEO duality (dual), equity concentration (top1) and board size (board)
μ_{it}	Random effects
ε_{it}	Error term

Results and Analyses of the Empirical Study

Descriptive Statistics

Table 5-1 shows the descriptive statistics of the dependent variable, independent explanatory variable and control variables. The sample consists of 110 CMNEs, including 23 technology CMNEs and 87 non-technology CMNEs, with a total of 660 observations over 6 years from 2016 to 2021. As shown in Table 5-1, the mean value of the dependent variable, ESG performance, is 75.91, the standard deviation is 5.769, the minimum value is 52.1, and the maximum value is 90.4, which indicate a considerable fluctuation among that the ESG

performance of MNEs; meanwhile, the mean value of ESG performance of technology MNEs is higher than that of non-technology ones. The mean value of the independent variable, the level of digital transformation, is 3.263, while the standard deviation is 1.085. The mean value of digital transformation of technology MNEs (3.940) is significantly higher than that of non-technology ones (3.083), but the fluctuation of the former is also higher than that of the latter. In addition, the descriptive statistics of the control variables that reflect the general corporate finance are similar to the values in relevant literature (Hu et al. 2022; Xiao et al. 2021; Liu et al. 2022), indicating that the data collection in this paper is accurate. The histogram of the independent variable (Figure 5-1) appears to be a normal distribution.

Since a number of independent and control variables are taken into consideration, it is necessary to test for multicollinearity. This paper examines the the correlation coefficients between the independent variable and control variables, and conducts a VIF test, the results of both showed no multicollinearity among those variables.

Table 5-1 Descriptive Statistics of Variables

Variable	Observation	Mean	Std Dev	Min	Median	Max
ESG	660	75.910	5.769	52.10	76.430	90.400
ESG (technology =1)	138	76.920	6.253	52.10	77.730	90.400
ESG (technology =0)	522	75.640	5.610	52.99	76.320	90.150
digital	656	3.260	1.085	0	3.26	6.160
digital (technology =1)	138	3.940	1.105	1.10	3.81	6.160
digital (technology=0)	518	3.083	1.006	0	3.178	5.677
growth	660	0.331	2.441	-0.592	0.122	58.840
top1	660	0.359	0.148	0.058	0.344	0.774
size	660	24.240	1.233	21.020	24.020	28.020
age	660	3.211	0.213	2.708	3.219	3.689
lev	660	0.532	0.167	0.014	0.555	0.916

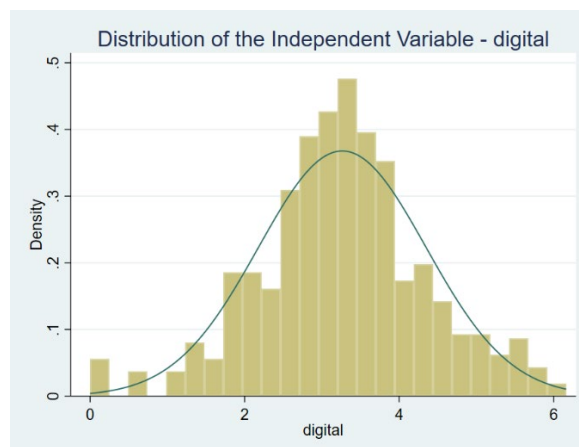|						
indep	660	0.390	0.075	0.231	0.364	0.800
dual	645	0.276	0.447	0.000	0.000	1.000
board	660	2.148	0.209	1.386	2.197	2.773

Figure 5-1 Histogram of the Independent Variable

Benchmark Regression Analysis

Prior to regression analysis, F-test, L-M test, and Hausman test are successively conducted, whose test results supported the random effects model for panel data regression. The regression results are shown in Table 5-2.

First, this paper only regresses ESG performance on digital transformation, the result of which shows that digital transformation has a positive effect on the ESG performance of MNEs: with one unit increase in the level of digital transformation comes 0.99 points of the ESG performance improvement. This conclusion is statistically significant at the 99% confidence level but so far, only 0.9% of the variance for the dependent variable is explained by the independent variable. Then, more control variables are added into the regression model. The result supports the positive effect that is statistically significant at the 99% confidence level, and all the variables combined can now explain 14.84% of the variance in the dependent variable. The final regression result shows that, ceteris paribus, each unit increase in the level of digital transformation brings about 0.74 points increase in the ESG performance of

enterprises. The amount of positive impact is similar to previous studies (Hu Jie et al., 2022). Other control variables with significant coefficients include firm size, liability ratio, operating income growth rate, and the situation of CEO duality. The results validate H1: Digital transformation will improve MNEs' ESG performance. Also, ceteris paribus, the larger and more mature the MNE, the higher the MNE's ESG performance.

Heterogeneity Analysis

Since there are significant differences in the degree of digital transformation between technology and non-technology MNEs, in order to investigate whether digital transformation plays the same role for MNEs in those two different industries, this paper conducts a heterogeneity analysis and provides differentiated insights for strategy design of ESG practice in different industries.

The results of the grouped regressions on the sample are shown in Table 5-3. For non-technology MNEs, the positive impact of digital transformation on ESG performance is still significant, while it is not the case for technology MNEs. The non-technology MNEs used in this paper include MNEs in industries such as manufacturing, mining, and trading, which themselves tend to have a low level of digitalization embedded in their daily operations. The technology MNEs, however, probably have already integrated digitalization into all aspects of their business operations. The results can also imply that this positive impact of digital transformation may be marginal diminishing, i.e., compared to technology MNEs, non-technology MNEs that seizes the opportunity of digital transformation can benefit more in ESG performance improvement, and therefore technology MNEs may need to explore other ways to improve their ESG performance. This conjecture of marginal diminishing effect will be

further explored in the robustness test.

Table 5-2 Results of the Benchmark Regression

Variable	ESG	ESG	ESG
digital	0.997***	0.723***	0.754***
	(0.252)	(0.245)	(0.249)
size		2.237***	2.056***
		(0.324)	(0.338)
age		0.405	0.982
		(1.898)	(1.925)
lev		-6.292***	-5.896***
		(2.040)	(2.050)
growth		-0.209***	-0.201***
		(0.0634)	(0.0637)
indep			14.180***
			(4.398)
dual			-0.642
			(0.538)
top1			0.289
			(2.184)
board			1.648
			(1.765)
Constant	72.700***	21.490**	14.670
	(0.926)	(9.675)	(10.320)
R-Sqaure	0.0097	0.1150	0.1484
Number of Observations	656	656	641
symbol_code	110	110	110

Standard errors in parentheses

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

Table 5-3 Grouped Regression - Heterogeneity Analysis

Variable	ESG – Non-Tech	ESG - Tech
digital	0.628**	-0.312
	(0.279)	(0.632)
size	1.800***	5.147***
	(0.357)	(0.988)
age	-0.434	9.143*
	(2.001)	(5.050)
lev	-4.659**	-12.500***
	(2.334)	(4.142)
growth	-0.215***	0.462
	(0.0638)	(0.418)

indep	18.85***	-22.820
	(4.464)	(16.24)0
dual	-0.537	-0.446
	(0.575)	(1.345)
top1	-3.279	5.195
	(2.650)	(3.657)
board	2.384	-4.457
	(1.792)	(6.500)
Constant	22.610**	-50.730
	(10.920)	(30.980)
R-sq	0.1586	0.2936
Observations	503	138
Number of symbol_code	87	23

Standard errors in parentheses
*** p<0.01, ** p<0.05, *
p<0.1

Robustness Test

Since there are multiple measure methods for the independent and dependent variables in this study, in order to avoid errors caused by the measurement, this section will replace the measurements for the independent and dependent variables and conduct the regressions separately to test the robustness of the conclusions from the benchmark regression; finally, in order to avoid the disturbance from the COVID-19 pandemic, this section will also exclude the post-pandemic data and conduct the regression again.

Replacing the Independent Variable

The measurement of the independent variable is first replaced by the text frequency calculated using an alternative text analysis method (Wu, F., 2021) (substitute variable 1). It is then replaced by the proportion of the amount of digital transformation assets in the enterprise's intangible assets (substitute variable 2).

The results are shown in Table 5-4. The results of regressions using both substitute independent variables are significantly positive, which proves the robustness of the results and

conclusions from the benchmark regression. Meanwhile, a quadratic term is added when using the substitute variable 2 and the coefficients of both the primary and quadratic terms are significant. This suggests that the MNEs' ESG performance will first increase and then decrease with the increase of the proportion of digital transformation assets, with the turning point being x=0.35. When the digital transformation assets of the MNE account for less than 35% of its total intangible assets, the higher the share of digital transformation assets is, the better the ESG performance is. However, when that proportion exceeded 35%, the impact turns negative. This result echoes with the conjecture of "diminishing marginal effect" in the heterogeneity test. According to the descriptive statistics of the substitute variable 2 (Table 5-5), 98% of the samples have not reached the turning point, i.e., will benefit from the positive impact; the rest 2% of the samples are all technology MNEs, i.e. whose ESG performance is not likely to benefit from digital transformation.

Replacing the Dependent Variable

The paper uses Bloomberg ESG rating as the replacement dependent variable in the regression. With control variables gradually being added, the positive impact of digital transformation remains significant at the 99% confidence level (see Table 5-6), supporting the robustness of the findings from the benchmark regression.

Table 5-4 Robustness Test 1 - Replacing the Independent Variable

Variable	ESG	ESG
Substitute Variable 1	0.0204*	
	(0.0115)	
Substitute Variable 2		9.824*
		(5.155)
Substitute Variable 2- Squared		-14.710*
		(8.903)

size	2.306***	2.426***
	(0.338)	(0.340)
age	0.806	1.000
	(1.972)	(1.983)
lev	-6.084***	-6.219***
	(2.092)	(2.097)
growth	-0.192***	-0.199***
	(0.0651)	(0.0651)
indep	11.060**	10.400**
	(4.405)	(4.400)
dual	-0.645	-0.647
	(0.547)	(0.549)
top1	0.0506	-0.673
	(2.241)	(2.237)
board	0.254	-0.303
	(1.777)	(1.760)
Constant	15.700	13.980
	(10.540)	(10.630)
R-sq	0.1369	0.1294
Number of Observations	645	645
symbol_code	110	110

Standard errors in parentheses

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

Table 5-5 Descriptive Statistics of Substitute Variable 2

	p25	p50	p75	p90	p95	p99
Substitute Variable 2	0	0.014	0.045	0.0959	0.191	0.398

Table 5-6 Robustness Test 2 - Replacing the Dependent Variable

Variable	ESG Bloomberg	ESG Bloomberg	ESG Bloomberg
digital	3.312***	2.251***	2.135***
	(0.526)	(0.481)	(0.491)
size		7.526***	7.461***
		(0.637)	(0.667)
age		-1.757	-3.053
		(3.737)	(3.809)
lev		-11.790***	-10.950***
		(3.999)	(4.037)
growth		-0.134	-0.107
		(0.124)	(0.125)
indep			-2.065
			(8.640)

dual			-0.508
			(1.055)
top1			-7.704*
			(4.301)
board			0.314
			(3.471)
Constant	17.680***	-149.300***	-140.700***
	(1.928)	(19.010)	(20.380)
R-sq	0.0009	0.1976	0.1975
Number of Observations	654	654	639
symbol_code	110	110	110

Standard errors in parentheses

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

Excluding the Disturbance from COVID-19

Due to insufficient data, this paper, for the time being, does not specifically study the impact of digital transformation on MNEs' ESG performance in the post-pandemic era. However, to exclude the unknown disturbance from COVID-19, in this section, only the pre-pandemic data (2016-2019) are used for regression. As is shown in Table 5-7, after excluding post-pandemic disturbance, the positive effect is still significant at the 99% confidence interval, hence the conclusions from the benchmark regressions are robust.

Table 5-7 Robustness Test 3- Excluding the Disturbance from COVID-19

Variable	ESG - All	ESG – Pre-Pandemic
digital	0.754***	0.734**
	(0.249)	(0.292)
size	2.056***	1.649***
	(0.338)	(0.386)
age	0.982	0.345
	(1.925)	(1.884)
lev	-5.896***	-2.306
	(2.050)	(2.389)
growth	-0.201***	-0.252***
	(0.0637)	(0.0662)
indep	14.180***	13.410**
	(4.398)	(5.246)
dual	-0.642	-0.520

	(0.538)	(0.699)
top1	0.289	-0.575
	(2.184)	(2.365)
board	1.648	1.505
	(1.765)	(1.998)
Constant	14.670	25.710**
	(10.320)	(10.930)
R-sq	0.1484	0.2138
Number of Observations	641	427
symbol_code	110	110

Standard errors in parentheses

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

A Probe into the Mechanisms – Mediation Effect

To further explore how the digital transformation improves MNEs' ESG performance, this paper proposes two mediators: innovation capability and internal control and risk control capacity. This section will test the mediation effects of these two mediating factors.

Digital Transformation Positively Impact MNEs' ESG Performance via Innovation Capacity

This paper uses the logarithm of the number of patents as the measurement of enterprises' innovation capacity, which then serves as a mediator in the stepwise regression and Sobel test. The results are shown in Table 5-8. The results of the stepwise regression indicate that innovation capacity has a full mediating effect, i.e., the effects of the digital transformation on MNEs' ESG performance must proceed through impacting the mediator innovation capacity. The results of the Sobel test also indicate a significant mediating effect. The above therefore support hypothesis H2 that digital transformation can contribute to MNEs' ESG performance by driving innovation capacity.

Digital Transformation Positively Impact MNEs' ESG Performance via Internal Control and Risk Control Capacity

To test hypothesis H3: digital transformation can contribute to MNEs' ESG

performance by improving their internal control and risk control capacity, this paper adopts the internal control and risk control capacity as a mediator, which is measured using the corporate internal control and risk control index. The results of the stepwise regression and Sobel test are shown in Tables 5-9, which both support hypothesis H3. The results of stepwise regression indicate that the variable, internal control and risk control capacity, has a partial mediating effect, i.e., the positive impact of digital transformation on MNEs' ESG performance will only be partially achieved through impacting the mediator.

Table 5-8 Mediation Effect Test 1 - Innovation Capacity

Variable	ESG	Innovation	ESG	Sobel
digital	0.754***	0.357***	0.360	-0.251
	(0.249)	(0.0562)	(0.276)	(0.225)
innovation			0.345*	0.834***
			(0.189)	(0.146)
size	2.056***	0.986***	1.807***	1.050***
	(0.338)	(0.0862)	(0.362)	(0.236)
age	0.982	-1.112*	2.110	3.169***
	(1.925)	(0.667)	(1.831)	(1.029)
lev	-5.896***	-0.720	-4.561**	-2.593*
	(2.050)	(0.460)	(2.080)	(1.554)
growth	-0.201***	-0.000557	-0.203***	-0.225***
	(0.0637)	(0.0121)	(0.0679)	(0.0856)
indep	14.180***	0.361	12.280***	13.310***
	(4.398)	(0.929)	(4.436)	(3.611)
dual	-0.642	-0.0608	-0.596	-0.305
	(0.538)	(0.115)	(0.569)	(0.485)
top1	0.289	-1.995***	-0.807	-0.421
	(2.184)	(0.521)	(2.185)	(1.495)
board	1.648	-0.648	1.677	0.246
	(1.765)	(0.404)	(1.775)	(1.264)
Constant	14.670	-14.960***	17.530*	33.900***
	(10.320)	(3.048)	(10.080)	(6.160)
Observations	641	592	592	592
R-squared				0.195
Number of symbol_code	110	105	105	

Standard errors in parentheses

Table 5-9 Mediation Effect Test 2 – Internal Control and Risk Control Capacity

Variable	ESG	risk control	ESG	Sobel
digital	0.754***	8.827**	0.697***	0.491**
	(0.249)	(4.447)	(0.244)	(0.194)
riskcontrol			0.0105***	0.0113***
			(0.00187)	(0.00220)
size	2.056***	40.860***	1.563***	1.046***
	(0.338)	(5.520)	(0.344)	(0.231)
age	0.982	70.610**	0.236	0.356
	(1.925)	(27.660)	(1.901)	(1.004)
lev	-5.896***	-133.100***	-4.058**	-1.314
	(2.050)	(35.990)	(2.036)	(1.523)
growth	-0.201***	2.874**	-0.232***	-0.289***
	(0.0637)	(1.364)	(0.0624)	(0.0837)
indep	14.180***	69.450	13.58***	15.730***
	(4.398)	(79.850)	(4.306)	(3.535)
dual	-0.642	-5.511	-0.674	-0.522
	(0.538)	(10.190)	(0.526)	(0.473)
top1	0.289	49.910	-0.127	-0.780
	(2.184)	(36.410)	(2.143)	(1.462)
board	1.648	-6.674	1.911	1.000
	(1.765)	(30.240)	(1.730)	(1.226)
Constant	14.670	-526.400***	20.960**	33.110***
	(10.320)	(159.200)	(10.210)	(6.124)
Number of Observations	641	641	641	641
R-squared				0.192
symbol_code	110	110	110	

Standard errors in parentheses

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

Conclusions and Limitations

Main Conclusions and Discussion

In recent years, China's policies have continued to provide external impetus for enterprises' ESG development, while the advent of the trend of digital transformation has provided ways and opportunities for companies to implement ESG practice. This paper uses

data from 110 listed CMNEs during 2016-2021, examines the impact of the digital transformation on MNEs' ESG performance and the mechanisms, and draws the following conclusions. First, the digital transformation can effectively promote MNEs' ESG performance, which still holds after several robustness tests. Second, this promoting effect is realized through two mediators: innovation capacity and internal control and risk control capacity. Finally, this promoting effect has a diminishing marginal feature, with non-technology MNEs benefiting more, and therefore digital transformation is an unmissable opportunity for MNEs when they are trying to improve their ESG performance.

Based on the conclusions above, this paper further proposes the following policy suggestions. From the perspective of MNEs themselves, in order to achieve sustainable and responsible development and improve ESG performance, they should catch up with the trend of the digital economy in a timely manner and plan digital transformation rationally, especially focusing on cultivating digital transformation to drive corporate innovation and improve internal control and risk control capabilities. Compared with technology MNEs, non-technology MNEs should more actively introduce emerging digital technology amid their implementation of ESG practice. From the perspective of the government, in order to maintain macroeconomic sustainability and at the same time make contributions to global sustainability through MNEs, policies and controls should encourage MNEs to deeply integrate digital technology into their operations, creating a favorable external environment for the digital transformation of MNEs.

Critique and Further Steps

This paper leaves room for improvement in the empirical methods and the research

contents.

In terms of the empirical methods, endogeneity caused by reverse causality and omitted variables may exist, both of which can violate the robustness mentioned previously. In terms of reverse causality, it can be that the digital transformation positively impacts the ESG performance of MNEs, but it can also be that MNEs with better ESG performance tend to embrace digital transformation more. If some critical variables are omitted, the statistical significance of the coefficients of the independent variables may not be credible. Due to data limitations, no suitable instrumental variable could be collected. But according to study of Hu et al. (2022), the positive impact of digital transformation remains robust and credible after addressing these two possible endogeneity issues.

In terms of research contents, more explorations can be done in the following two aspects.

First, study the impact of digital transformation on the ESG performance of MNEs' from more specific industries. Due to the different development models and global market development strategies of MNEs in different industries, digital transformation may have different levels of impact on their ESG performance, and the mechanisms can also be different. Study MNEs by industry can help MNEs better understand the impact of digital transformation and yield more specific guidance for MNEs to implement ESG practice.

Second, study the impact of digital transformation on the ESG performance of MNEs in the post-pandemic era. The COVID-19 pandemic has led to increasing attention on sustainable development and enterprises' ESG practice, in which digital technologies are more widespread and accepted by the public. Currently, relevant data on this topic from the post-

pandemic era is limited. As time passes, data availability will increase and more research can be conducted to explore the impact of digital transformation on post-pandemic ESG performance of MNEs.

References

Anderson, C. (2008). The end of theory: The data deluge makes the scientific method obsolete. *Wired magazine*, *16*(7), 16-07.

Buckley, P. J., Doh, J. P., & Benischke, M. H. (2017). Towards a renaissance in international business research? Big questions, grand challenges, and the future of IB scholarship. *Journal of International Business Studies*, *48*, 1045-1064.

Du, S. Y., Shao, X. C., Jiménez, A., & Lee, J. Y. (2022). Corporate Social Responsibility of Chinese Multinational Enterprises: A Review and Future Research Agenda. *Sustainability*, *14*(23), 16199.

Freeman, E., & Liedtka, J. (1997). Stakeholder capitalism and the value chain. *European Management Journal*, *15*(3), 286-296.

Freeman, R. E., & McVea, J. (2005). A stakeholder approach to strategic management. *The Blackwell handbook of strategic management*, 183-201.

Friedman, M. (2007). *The social responsibility of business is to increase its profits* (pp. 173-178). springer berlin heidelberg.

Garcia, A. S., & Orsato, R. J. (2020). Testing the institutional difference hypothesis: A study about environmental, social, governance, and financial performance. *Business Strategy and the Environment*, *29*(8), 3261-3272.

George, G., & Schillebeeckx, S. J. (2022). Digital transformation, sustainability, and purpose in the multinational enterprise. *Journal of World Business*, *57*(3), 101326.

Gillan, S. L., Koch, A., & Starks, L. T. (2021). Firms and social responsibility: A review of ESG and CSR research in corporate finance. *Journal of Corporate Finance*, *66*, 101889.

Ioannou, I., & Serafeim, G. (2012). What drives corporate social performance? The role of nation-level institutions. *Journal of International Business Studies*, *43*, 834-864.

Montiel, I., Cuervo-Cazurra, A., Park, J., Antolín-López, R., & Husted, B. W. (2021). Implementing the United Nations' sustainable development goals in international business. *Journal of International Business Studies*, *52*(5), 999-1030.

OECD. (2018). Multinational Enterprises in the Global Economy - OECD. https://search.oecd.org/industry/ind/MNEs-

Peattie, K., & Ratnayaka, M. (1992). Responding to the green movement. *Industrial Marketing Management*, *21*(2), 103-110.

Siebel, T. M. (2019). *Digital transformation: survive and thrive in an era of mass extinction*. RosettaBooks.

Subramaniam, M., & Youndt, M. A. (2005). The influence of intellectual capital on the types of innovative capabilities. *Academy of Management journal*, *48*(3), 450-463.

Svahn, F., Mathiassen, L., & Lindgren, R. (2017). Embracing Digital Innovation in Incumbent Firms. *MIS quarterly*, *41*(1), 239-254.

Tempini, N. (2013). Book review: big data: a revolution that will transform how we live, work, and think.

Thomas, L. D., & Leiponen, A. (2016). Big data commercialization. *IEEE Engineering*

Management Review, 44(2), 74-90.

陈春花，朱丽，钟皓，刘超，吴梦玮，& 曾昊．(2019)．中国企业数字化生存管理实践视角的创新研究．*管理科学学报，22*(10)，1-8.

方明月，林佳妮，& 聂辉华．(2022)．数字化转型是否促进了企业内共同富裕?——来自中国 A 股上市公司的证据．*数量经济技术经济研究*.

傅颖，徐琪，& 林嵩．(2021)．在位企业流程数字化对创新绩效的影响组织惰性的调节作用．*研究与发展管理，33*(1)，78-89.

胡洁，韩一鸣 & 钟咏.(2023).企业数字化转型如何影响企业 ESG 表现——来自中国上市公司的证据．*产业经济评论*(01),105-123. doi:10.19313/j.cnki.cn10-1223/f.20221104.001.

户华玉 & 佘群芝.(2022).制造业数字化转型能否降低出口隐含碳强度．*国际贸易问题*(07),36-52. doi:10.13510/j.cnki.jit.2022.07.002.

吉祥熙，& 黄明．(2021)．后疫情时代中国跨国企业管理面临的挑战和对策研究．*管理现代化*.

李想，& 钱慧敏．(2022)．数字化转型，内部控制与创新绩效．*Advances in Applied Mathematics, 11*, 6171.

柳学信，李胡扬，& 孔晓旭．(2022)．党组织治理对企业 ESG 表现的影响研究．*财经论丛，1*，100-112.

彭程 & 江慧.(2022).技术创新影响了企业跨国投资的风险偏好吗——基于中国跨国企业的微观数据．*会计之友*(05),112-118.

戚聿东，& 肖旭．(2020)．数字经济时代的企业管理变革．*管理世界，36*(6)，135-152.

宋德勇，朱文博，& 丁海. (2022). 企业数字化能否促进绿色技术创新?. *财经研究*, *48*(4), 34-48.

陶野. (2017). 跨国企业社会责任研究回顾与展望. *现代管理科学*, (12), 54-56.

王锋正，刘向龙，张蕾，& 程文超. (2022). 数字化促进了资源型企业绿色技术创新吗?. *科学学研究*, *40*(2), 332.

王福胜,郑茜月 & 张东超..数字化转型、国际化战略与企业创新. *运筹与管理*.

王遥，& 施懿宸. (2019). 推动 "一带一路" ESG 投资主流化发展. *当代金融家*, (07):47-49.

肖红军，阳镇，& 刘美玉. (2021). 企业数字化的社会责任促进效应：内外双重路径的检验. *经济管理*.

谢红军，& 吕雪. (2022). 负责任的国际投资：ESG 与中国 OFDI. *经济研究*, *3*, 83-99.

徐晨阳，陈艳娇，& 王会金. (2022). 区块链赋能下多元化发展对企业风险承担水平的影响——基于数字经济时代视角. *中国软科学*, *1*, 121-131.

袁蓉丽,江纳 & 刘梦瑶.(2022).ESG 研究综述与展望. *财会月刊*(17),128-134. doi:10.19641/j.cnki.42-1290/f.2022.17.017.

张超敏，许晖，& 单宇. (2022). 中国跨国企业如何适应新兴市场的不确定性?. *外国经济与管理*, *44*(1).

赵爱玲.(2022).数字化转型成 2022 年企业关注重点. *中国对外贸易*(02),24-25. doi:CNKI:SUN:ZKWM.0.2022-02-010.