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Digital Technology for Good: Path and Influence—Based on the Study of ESG Performance of Listed Companies in China

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Abstract: The relationship between digital technology and enterprise management is becoming increasingly close. Whether the application of new digital technology can guide enterprises and even the social economy to good governance is an urgent problem to be solved. This paper selects the data of listed companies from 2011 to 2020 as a sample to empirically test the impact of digital transformation on ESG performance. The methodology is as follows: (1) Using the least squares method to do the main regression test. (2) Using Heckman's two-step method, Lag 1 and 2, instrumental variable method: two-stage regression, PSM-OLS and PSM-DID estimation, robust analysis to do endogenous treatment to ensure that the main regression test is persuasive. (3) Using mediating effect to test the mechanism of action. (4) Using the least squares method for further research. The results show that: (1) Digital transformation is conducive to ESG performance. (2) In industries with high monopolies, digital transformation is not conducive to ESG performance. (3) Further analysis shows that due to the influence of peer effect, the concept of technological goodness is transmitted through network relationships to support other enterprises in the market. This study provides a new perspective for studying the influencing factors of enterprise ESG performance and also provides a theoretical reference for enterprises to use digital technology to achieve good governance. The scope of our research, the purpose of which is to help enterprises manipulate technology better, focuses on the effect on enterprises brought by digital technology.

Keywords: digital transformation; the environment; society; corporate governance

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1. Introduction

In order to explore the relationship between digital transformation and ESG to demonstrate the concept of science and technology to the good, this paper first introduces the current changes in the concept of enterprise evaluation and the background of the concept of ESG and the development of digital transformation. Nowadays, it is the time when the concept of ESG and digital transformation intersect. As the frontier of today 's scientific and technological development, whether its technological promotion can drive the progress of enterprise society, ESG provides a proper observation window. The concept of Science and Technology for Goodness believes that science and technology promote the development of human society in a good direction; at the same time, the economic foundation determines the superstructure. As a micro-component of the modern economy, the relationship between ESG performance and the degree of digital transformation of enterprises provides micro-evidence for supporting the concept of technological goodness, which is also the motivation of this paper and the purpose of this paper.

With the deepening of reform in the Chinese economic field, the development goal of Chinese enterprises has changed from a 'rapid growth' orientation to a 'quality first' orientation, which requires traditional enterprises to overcome the shortcomings of 'high carbon, high pollution, low persistence and lack of sense of responsibility' in the past, and transform the enabling effect brought by science and technology to enterprises into positive

energy to promote the whole society to be good. Therefore, the standard to measure whether an enterprise is excellent is no longer limited to the financial indicators, such as the profit growth rate at the end of the accounting year, but also takes into account the internal non-financial information and the social benefits created by the enterprise [1,2]. Aiming at how to scientifically measure the comprehensive performance of enterprises, the academic community has gradually formed a standard for evaluating the operating status of enterprises from three aspects of environment, society and governance (ESG) [3,4]. Since the concept of ESG was first proposed by the United Nations Environment Programme Financial Initiative (UNEP FI) in 1992, the system has made great contributions to the scientific evaluation of the development of enterprises, correctly guided a number of first-class international enterprises to achieve transformation (such as Amazon, Google, etc.), and created great intangible value for society and related parties [5,6]. Therefore, the company's ESG performance has gradually become an important indicator for investors to evaluate the sustainable development ability of enterprises. Based on this, how to improve the ESG performance of enterprises has gradually become a hot topic in academic research.

At present, the digital economy is booming. According to the white paper on the development of China's digital economy, the total amount of China's digital economy industry has reached 39 trillion yuan, accounting for nearly 40% of the country's total GDP, and it is still developing at high speed, far exceeding other forms of economic development. It can be said that the digital economy is increasingly closely related to all aspects of modern enterprise management, and its impact on enterprises is becoming more and more profound. As a technological change that has a profound impact on today's society, whether it can play a 'technological good' role depends on the specific behaviour of enterprises. Positive behavior mainly includes the following aspects.: First, The digital transformation of enterprises empowers the manufacturing process of enterprises through digital technology and realizes the precise control of the whole process of procurement-storage-reclaiming production-final product warehousing-sales, which makes it possible to realize the idealized JIT production mode and greatly promotes the innovation process of the green production mode of enterprises [7]; Second, in terms of improving corporate governance, the embedding of blockchain technology has greatly reduced the possibility of fictitious transactions on the Internet, because the information is basically open, transparent and real-time visibility to all participants. Therefore, the high-speed information flow in the Internet era has improved the degree of information disclosure in the market, compressed the speculative profit exposure caused by information asymmetry, and forced managers to focus on the work that can effectively improve the enterprise's value-creation ability, thereby improving the internal governance efficiency of the enterprise [8]; third, in terms of improving social responsibility, the 'information effect' of digital transformation also encourages enterprises to earnestly fulfill their social obligations [9].

The negative behavior has the following aspects: First, digital transformation has spawned the platform economy (such as Alibaba, Jingdong Mall, etc.). Although such enterprises still play a positive role in promoting the development of the market from the current point of view, the unique characteristics of the platform economy also increase the possibility of becoming a monopoly in the future [10], which will form information barriers and hinder the improvement of corporate social governance. In addition, the unique 'interconnection' characteristics of digital transformation are likely to form a network relationship [11]. When the core enterprises in the network play an active 'technological goodness' effect, whether they can drive other affiliated enterprises to implement goodness behavior is an urgent problem to be solved.

Consequently, the current paper seeks to make the following contributions to the existing literature: (1) It enriches the research on the influencing factors of enterprise ESG performance and demonstrates that digital transformation is an important factor affecting enterprise ESG performance. (2) The influence mechanism is explored, and the black box of the effect of digital transformation on ESG performance is opened. (3) This paper further explores the network effect of digital transformation on the ESG performance

of enterprises and analyzes the effect of digital transformation on the ESG performance of other enterprises in the network. (4) In practice, it provides theoretical guidance for enterprises to use digital transformation to improve their ESG performance.

2. Literature Review, Theoretical Analysis and Research Hypothesis

2.1. Literature Review

2.1.1. ESG Performance and Influencing Factors of Corporate Social Responsibility

The ESG concept is derived from the theory of corporate socially responsible investing and was realistic in 2006 with the signing of the United Nations Principles for Responsible Investment (UNPRI). Regarding the research on its influencing factors, only Liu et al. conducted research in this field and found that corporate party organization governance has a significant positive impact on improving corporate ESG performance [12]. Foreign research on this aspect is even rarer. Most scholars focus on the influencing factors of corporate social responsibility performance. In fact, the two are similar concepts. The research on the influencing factors of corporate social responsibility mainly focuses on macro factors and micro factors. On the macro level, Flammer believes that the fulfillment of corporate social responsibility comes from the fierce competition in the market. In order to win the competitive advantage and obtain good social impact, enterprises must obtain the favor of all sectors of society by fulfilling social responsibility [13]. Liang et al. found that the legal systems of different countries have a greater impact on the fulfillment of corporate social responsibility under their constraints [14]. The results show that the fulfillment of corporate social responsibility in civil law countries is better than that in other law countries. Li Shitian et al. believed that the Confucian culture's idea of 'Caring others like caring yourself' helps senior executives to pay more attention to the social benefits of corporate behavior, thus promoting enterprises to actively fulfill their social responsibilities [15]. On the micro level, Nian Rongwei et al. used the 2013 revision of the block stock trading rules as a quasi-natural experiment and found that increased stock liquidity can significantly improve the degree of corporate social responsibility [16]. McGuinness et al. found that when the proportion of women at the top of an enterprise increases, it helps the enterprise to actively fulfill its social obligations [17].

As far as the current research results of scholars are concerned, most of them pay attention to the influence of 'soft factors' (such as culture, system, manager background, etc.) on the fulfillment of corporate social responsibility, but lack of research on the relationship between 'hard factors' such as technological innovation and the fulfillment of corporate social responsibility, and lack of direct research on ESG performance. The research in this paper fills the gap in this area.

2.1.2. Technological Goodness and Digital Transformation of Enterprises

Technological goodness originated from technological ethics, first by Paul. In 2013, Paul proposed that enterprises should take into account both competitive advantages and comprehensive social benefits in R&D technology [18]. They should not develop high-performance and high-polluting technologies to reduce R&D costs and should not use scientific and technological means to exploit legal loopholes to obtain market monopoly [19,20].

At the forefront of the current development of science and technology, digital technology is becoming more and more closely related to the daily operation of enterprises, and the research results related to the implementation effect of digital transformation of enterprises are also being followed up. In terms of scientific and technological innovation, An Tongliang et al. found that digital transformation can significantly improve the level of enterprise management, innovate traditional human resource management through network management mode, greatly improve the efficiency of enterprise human capital utilization, and then accelerate the process of enterprise scientific research and innovation [21]. In terms of enterprise performance, Slater et al. believed that because the digital transformation of enterprises improves the data processing ability and information collection ability of enterprises, the senior management of enterprises can more accurately predict the

future business situation so as to improve the accuracy of enterprise goal setting and improve enterprise performance [22]. In terms of environmental protection, Zhong Tingyong et al. found that the digital transformation of enterprises can optimize the supply chain system of enterprises, reduce the circulation of raw materials and semi-finished products in the production process to reduce energy consumption, and can empower enterprises to further improve the production efficiency of green innovation ability to reduce energy consumption, so as to achieve carbon emission reduction [23].

According to the current research results of scholars, the effect of digital transformation is mostly positive. These positive effects mainly focus on improving the information processing ability of enterprises and improving the management efficiency of enterprises and also have made great achievements in improving environmental protection. However, few scholars pay attention to the relationship between the digital transformation of enterprises and the improvement of corporate social responsibility, ignoring the important role of scientific and technological progress in promoting the development of social morality. This paper makes up for the gap in this regard.

2.2. 'Digital Technology for Good' Effect

The concept of 'science and technology for goodness' was first proposed by Paul. Miller proposed in 2013 that its core connotation is: science and technology can not only promote economic development and industrial change but also enable society to achieve sustainable development, which is embodied in the four dimensions of long-term development, innovative development, shared development and fair development at the enterprise level. Based on the above four dimensions, this paper believes that the impact of enterprise digital transformation on enterprise ESG performance is as follows:

In terms of long-term development eidos, the endowment effect theory of managers' careers holds that the environment in which managers are located and their specific experiences in the environment will gradually form part of managers' endowment and ultimately affect their subjective judgment [24,25]. The long-term development of eidos first needs to ensure the survival of the enterprise, and the survival of the enterprise directly depends on whether the members of the enterprise can fulfill their obligations according to the rules and regulations formulated by the senior management of the enterprise and whether the enterprise must apply for bankruptcy because of insolvency. Therefore, strengthening the internal control of enterprises and curbing the potential cost rise is the fundamental guarantee for enterprises to improve the possibility of future survival. Relevant research shows that digital transformation has an impact on managers' business behavior, such as strengthening managers' internal control ability [26] and strengthening managers' cost adjustment ability to reduce the cost stickiness of enterprises [27]. Based on the viewpoints of the above scholars, it is not difficult to see that enterprises can significantly strengthen the management's awareness of sustainable development through the implementation of digital transformation, and the enhancement of this eidos is bound to drive subordinate employees to pay more attention to things that are conducive to the survival of enterprises in the long run so that the eidos of long-term development has become the consensus of the whole enterprise.

In terms of the eidos of innovative development, the theory of dynamic capabilities holds that in the face of an uncertain environment, only when enterprises have the ability to adjust their resource allocation according to the actual situation and quickly adapt to the new environment can they win in the competition with other enterprises [28]. Innovation, according to its literal meaning, is to create things that never existed before, and the reason why enterprises need to spend many resources on innovation activities is to enable enterprises to survive in the fierce market competition. Therefore, from the perspective of enterprise survival, innovation activities are actually the process of enterprises actively adapting to their own environment. Digital transformation transforms the way of transmitting information inside and outside the enterprise from paper announcements, oral transmission and analog signal transmission to digital information real-time interconnec-

tion [29,30]. Therefore, the traditional business environment of enterprises is undergoing tremendous changes. In order to adapt to this change, enterprises must actively adjust their resource allocation methods. In this process, the traditional innovation mode with innovative production tools as the core is gradually replaced by the innovation mode with improved enterprise communication and cooperation as the core, which also stimulates the innovation potential of enterprises to a certain extent [31,32].

In terms of the eidos of shared development, the value co-creation theory holds that in today's increasingly convenient human interaction, the value creation process of enterprises is no longer dominated by the output products of enterprises but also includes consumers in the value creation process, making the identity of producers and consumers frequently exchanged [33]. The platform economy created by digital transformation is gradually breaking the inherent boundaries between consumers and producers in the past, further expanding the scope of value creation and freeing the production process from geographical and identity boundaries [34]. In the current extensive enterprise practice, the alternating emergence and integration of digital technology and platform economy are gradually helping traditional manufacturing enterprises break through the barriers of "intelligent upgrading and industrial integration" and "ecosystem architecture", which greatly saves the obstacles among enterprises, consumers and other participants in the process of communication. At the same time, it can facilitate the sharing of a production material among multiple entities, greatly improving the efficiency of production materials usage and reducing the idle cost of related assets [35]. For example, recently launched in the Guangdong-Hong Kong-Macao Greater Bay Area, the Baidu Intelligent Cloud Industrial Internet Platform in Guangzhou has successfully connected more than 300 benchmarking enterprises in more than 22 industries, such as automobile, electronics, energy and power, equipment manufacturing, steel, chemical industry, water affairs, etc., by using AI algorithm combined with Internet technology. The production process of the whole supply chain is transparent so that some consumers have the opportunity to participate in the production process of the product. Baidu and local entrepreneurs expect that the completion of the platform will save more than 10 million yuan per year for the whole supply chain, which greatly promotes the formation of a local shared development atmosphere.

In terms of the eidos of equitable development, the idea of common prosperity is the supreme pursuit of human development and an urgent requirement for current economic development. It requires that development should be the joint efforts of all and that the fruits of development should be shared by all. At present, digital technology has penetrated all aspects of people's daily activities, such as consumption, employment, and financial credit [36]. Jin et al. used the data of third world countries in Asia as a sample to empirically test the poverty reduction effect of inclusive finance [37] (a product of the combination of traditional finance and digital technology). Zhang Zhengping et al. found through empirical tests that digital finance helps to improve the financing channels of SMEs and thus improves the operating efficiency of enterprises [38]. From the research results of the above scholars, it is not difficult to see that the inclusive effect of digital technology is obvious. Its unique 'information effect' (facilitating communication between different individuals) bridged the information gap between different social classes and between oligopolistic enterprises and small and medium-sized enterprises and promoted the development of social equity. Because the internal operations of enterprises are also more open and transparent [39], the systems of enterprises will inevitably tend to be fair. Under the joint supervision of all sectors of society, the business philosophy of enterprises will also become increasingly fair.

Based on the above analysis, we propose the hypothesis:

H1. *Digital transformation is conducive to ESG performance.*

2.3. The Distortion Effect of Monopoly on 'Digital Technology to Goodness'

Simply from the technical level, digital technology is neutral in value orientation; that is, it does not have the role of protecting specific subjects. However, the specific application of digital technology is implemented by people, so even if it is a technical means, it is inevitably embedded in complex social networks [40,41]. Most of the current scholars' research affirms the positive role of digital transformation in enterprise development [42–44], but to a certain extent, it ignores the risks borne by enterprises due to digital transformation. In the process of transformation, the introduction of digital technology requires a lot of cash investment, which not only squeezes out other investments that can get returns in the short term but also makes it difficult to directly attribute the possible returns to the investment of digital transformation. Therefore, in the short term, its economic empowerment effect is not significant [11]. Therefore, for many SMEs, it is better to rely on large platforms and take the collective transformation route than to transform independently [45,46], this phenomenon also aggravates the existing problems of algorithm discrimination [47] and data security [48] and promotes the monopoly advantage of online platform owners. From the perspective of market competition, the purpose of obtaining a monopoly advantage is to obtain a strong position in the competition process. According to the resource-based theory in the theoretical system of competitive advantage, monopoly enterprises can use their unique resources to crowd out potential competitors in the market and obtain monopoly profits. At present, not all enterprises can successfully implement a digital transformation. Even with successful transformation, the specific distribution of digital resources is also uneven; for example, in China, digital resources will be largely concentrated in the BAT (Baidu, Ali, Tencent) enterprises, so such enterprises can easily manipulate this special resource (digital resources) to further grab monopoly profits.

In terms of algorithm discrimination, monopoly enterprises that master online platforms can easily make enterprises in the platform bow to them by integrating platform resources so that monopoly enterprises can leverage the market structure of the entire industry by virtue of online platforms. The recent incident of Alibaba blocking SF Express and purchasing "ELEME" Takeout is a typical representative of this behavior. The specific method is as follows: according to the online data performance of potential competitors, by changing the execution parameters of the algorithm, the 'non-partner' enterprises are intentionally shielded so that such enterprises lose the online market. In terms of data security, although according to the existing laws and regulations ('Anti-Unfair Competition Law of the People's Republic of China', 'Guiding Opinions on Promoting the Healthy Development of Platform Economic Norms'), the platform needs the user's informed consent before obtaining the relevant data of the service object. However, according to the current implementation status, the service terms given by most platforms are ambiguous on key issues. It is not known to what extent online platform users can recognize the potential risks [49]. Taking Alibaba as an example, its platform basically arranges all the processes of products except the production process until they are sent to consumers, including even lending services. In these services, consumers are basically required to agree to their terms of service. If they do not agree, they cannot receive the next service. Therefore, to a certain extent, consumers' consent to the terms of service is 'passively voluntary' rather than 'completely voluntary'. This is obviously contrary to the current concept of protecting consumer data.

To sum up, it is not difficult to see that monopoly enterprises are likely to consolidate their monopoly position by using digital technology their hands, which is not conducive to the improvement of overall social benefits. Based on this, Hypothesis 2 is put forward:

H2. *In industries with high monopoly degrees, digital transformation is not conducive to ESG performance.*

2.4. The 'Spillover' Effect of 'Digital Technology to Good'

Peer effect believes that in addition to being affected by their own characteristics, corporate behavior is also affected by behaviors and characteristic information of peer enterprises. In general, Enterprise behavior is more and more significantly affected by similar behavior and characteristic information of enterprises in the same industry. In the context of the digital economy era, the rapid transmission of information has broken the information barriers between market participants, especially for enterprises in the same industry and the same platform, which can communicate more frequently with each other and accelerate the process of mutual learning [50]. Taking Tencent as an example, China's leading online game company launched the game's health agreement system (the system 'restricts' the main paying group of Tencent's chess games-adult user groups through the 'time limit-performance-reward-growth' system setting). After that, companies in the same industry with which it has a cooperative relationship (such as Tianmei, Photon, Aurora, Cube, etc.) are also actively exploring a good game operation system to help users balance entertainment and life. This initiative not only did not make Tencent suffer losses in the game field but also increased the user viscosity because of a set of growth systems. In addition, because of the various products of performance awards (such as Himalayan FM coupons), etc., it also activated the partner's user activity, which can be described as a win-win situation.

In the case of the same region, new geoeconomics believes that the agglomeration of industries or economic activities in the same region can bring convenience to information transmission and thus reduce the production cost of the entire industrial chain as a whole [51]. The digital transformation will further strengthen the positive impact of the agglomeration effect [52] and further accelerate the information transmission between enterprises in the same region. Due to the strong links between enterprises brought about by information technology, the behavior between different enterprises will also be enhanced. Besides, the change of core enterprise behavior under each link will have a stronger guiding effect on the behavior of the rest of the enterprise, and the spillover effect of enterprise behavior improvement will also be strengthened [53]. The 'goodness effect' brought by digital technology to core enterprises will be transmitted to other enterprises faster to create a better regional 'goodness' atmosphere. At the same time, 'good' enterprises get better government (policy, talent, capital and other aspects) support because of their good behavior in promoting social development, regional governance and environmental protection. They can also get the support of consumers, investors and other aspects, which sets a good example for the formation of the concept of science and technology ethics.

In addition, institutional investors also have similar information spillover effects. Yang et al. found that the heterogeneous information of different enterprises invested by the same institutional investors flows among themselves so that these enterprises share the social resources behind the common institutional investors [54]. Correspondingly, these enterprises will also be affected by the preference of common institutional investors. Du et al. (2021) found that the ownership of common institutions is conducive to the synergistic supervision and governance effect of institutions; that is, when multiple enterprises are held by the same institution, it is conducive to optimizing the core business objectives of these enterprises, reducing the unnecessary competition friction between enterprises, so that enterprises can put more energy into longer-term business objectives, thus weakening their motivation to implement earnings management [55]. From the research results of the above scholars, it is not difficult to see that institutional investors can play a 'spillover' effect of 'digital technology good' in broadening the channels of social capital sources of shareholding enterprises and optimizing business decisions. That is: When an enterprise under its control achieves good results due to digital transformation and thus pays more attention to corporate social responsibility to improve its ESG performance, this kind of act of kindness will be passed on to other enterprises that are held shares to reap the spillover effect of technological kindness.

Based on this, this paper puts forward the following hypothesis:

H3. *Under the same industry, the same region or common institutional investors, technology has a spillover effect.*

3. Research Design

3.1. Data Sources

This paper selects the data of Shanghai and Shenzhen A-share listed companies as the initial research sample, and the data are processed as follows: first, eliminate the abnormal and missing data samples; second, the application of enterprise digital technology is a long-term strategic behavior. This paper only retains samples for at least three consecutive years, that is, companies listed before 2018. Third, excluding financial industry enterprises. Fourth, in order to avoid the influence of sample outliers on the conclusion, this paper winsorizes all continuous variables at the 1% and 99% quantiles. The original data are from the CSMAR database, and the relevant enterprise annual report data are from the official websites of the Shenzhen Stock Exchange and Shanghai Stock Exchange. The number of data used in this article is 9767.

3.2. Model Setting and Variable Definition

To test the competitive hypothesis, this paper constructs the following basic regression model:

$$ESG_{i,t} = \alpha_0 + \alpha_1 Lndigital_{i,t} + \sum \alpha_j Controls_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \quad (1)$$

In the above model, $ESG_{i,t}$ is the Bloomberg ESG information disclosure index, $Lndigital_{i,t}$ represents the degree of digital transformation of enterprise i in t period, and $Controls_{i,t}$ represents a series of control variables; μ_i represents the individual fixed effect that controls enterprise i does not change with time, δ_t represents the fixed effect of control time; $\varepsilon_{i,t}$ denotes the random perturbation term.

3.2.1. Variable Being Explained

ESG performance can be reflected by ESG rating level and score. However, there is no unified evaluation standard and reference index at home and abroad. Referring to the research of Wang et al. [56], this paper selects the Bloomberg ESG information disclosure index as the measurement index of the ESG performance of listed companies.

3.2.2. Explanatory Variables

Digital transformation is inseparable from keywords such as artificial intelligence technology, blockchain technology, cloud computing technology, big data technology, and the Internet of Things. By combing the current literature on the digital transformation of enterprises and referring to the methods of Qi Huaijin et al. (2020), the proportion of intangible assets related to the digital economy in the year-end intangible assets disclosed in the notes to the financial reports of listed companies in the total intangible assets is used as a proxy variable [57]. Specifically, when the intangible assets details include 'software', 'network', 'client', 'management system', 'intelligent platform' and other keywords related to digital technology and related patents, mark the details as 'digital technology intangible assets', and then add up the intangible assets of multiple digital technologies of the same company in the same year, and calculate its proportion of intangible assets in the current year, which is the proxy variable of enterprise digital technology level. Due to the 'right-skewed' nature of the data, this paper takes the natural logarithm after adding 1. The purpose of using this explanatory variable is to quantify the degree of digital transformation of enterprises so as to use the least squares method to explore the quantitative relationship between it and enterprise ESG performance, thus providing an example for the hypothesis proposed in this paper.

3.2.3. Control Variable

To ensure research accuracy, this article controls for other factors that may affect the performance of an enterprise ESG. Including company scale (Size),which is measured through the company's natural logarithm of year-end total assets; asset-liability ratio (Lev), which is measured through the company's Year-end total liabilities/year-end total assets; operating income growth rate, which is measured through the company's Operating income of this year/operating income of the previous year-1; book-to-market ratio, which is measured through the company's Total year-end assets/market value; return on total assets (roa), which is measured through the company's net profit/average balance of total assets; shareholding ratio of the largest shareholder (fsh1), which is measured through the company's proportion of the largest shareholder; proportion of independent directors (Dlzb), which is measured through the company's number of independent directors/Board of Directors; whether it is the 'Big Four' audit (Big4), the measurement of which is special and it means when the company is audited by the Four Accounting Firms (DTT, E&Y, PWC, KPMG),the value takes 1 otherwise 0; listing years (Lnage), industry and year and other factors. The purpose of setting control variables is to avoid the influence of missing variable errors.

The definition of variables is shown in Table 1:

Table 1. Variable definition.

Variable Type	Variable Name	Variable Symbol	Variable Declaration
variable being explained	ESG rating	*ESG*	Bloomberg ESG Disclosure Index
explanatory variables	digital transformation	*Lndigital*	Digital word frequency of listed companies
control variable	company scale	*Lnsize*	Natural logarithm of year-end total assets
	assets-liability ratio	*Lev*	Year-end total liabilities/year-end total assets
	operating income growth rate	*Growth*	Operating income of this year/operating income of the previous year-1
	Cash flow ratio	*Cashflow*	Net cash flow from operating activities divided by total assets
	book-market ratio	*Mb*	Total year-end assets/market value
	rate of return on total assets	*Roa*	Net profit/average balance of total assets
	proportion of the largest shareholder	*Fsh1*	proportion of the largest shareholder
	proportion of independent directors	*Dlzb*	Number of independent directors Board of Directors
	Is it a' Big Four' audit	*Big*4	Whether four audit firms
	listed years	*Lnage*	Ln (current year − listing year + 1)
	year	*Year*	Year of sample
	industry	*Indu*	CSRC 2012 industry classification, manufacturing take two codes, other industries with categories

4. How the Statistical Analysis Display Demonstrates Each Hypothesis

Three hypotheses are proposed in this paper: H1: Digital transformation is induced to ESG performance; H2: in industries with high monopoly degree, digital transformation is not monopolized to ESG performance; H3: under the same industry, the same region or common institutional investors, technology has a spillover effect. In order to test these three hypotheses, this paper adopts the most commonly used method in the field of economic management research: using econometric theory to construct the OLS model. The method of testing the coefficients of the variables constructed in this paper to determine their quantitative relationship is analyzed to provide data support for the three hypotheses. H2 and H3 are proposed on the basis of H1. The purpose is to reveal the heterogeneous impact of digital transformation on enterprise ESG performance more comprehensively so as to provide theoretical guidance for enterprises to make better use of digital technology to improve ESG performance and for the government to formulate relevant policies.

Taking the test of H1 as an example, according to the OLS model designed in this paper, the data is input into the STATA software(Version number: 17.0 MP—Parallel

Edition; Creator: William Gould; Location: College Station, TX, USA), and the code is written according to the model to perform the regression operation. In order to ensure that the results will not be occasional errors due to the selection of OLS methods, this paper further implements the other five OLS regression methods to ensure that the results are general conclusions, which solves the problem of reliability of regression results at the technical level. Furthermore, at the data level, this paper continues to write the programs of Heckman Two-Step Method, Lag 1 and 2, Instrumental Variable Method: Two-Stage Regression, PSM-OLS and PSM-DID Estimation in STATA software. At the same time, seven popular robustness tests are used to perform regression on the data cleaned according to the corresponding methods. The results of the main regression did not receive the impact of the problem from the data level. Therefore, the regression results ensure that the hypothesis derived from the theoretical logic is also valid in practice. It should be noted that data analysis tests are not the logical deduction itself but the result of logical deduction.

5. Empirical Test and Result Analysis

5.1. Descriptive Statistic

Table 2 is the descriptive statistical analysis results of the main variables in this paper. Horizontally, the mean value of the variable is closer to its median value, indicating that the sample is close to the normal distribution. In terms of the ESG score level of the explained variableenterprise, the mean value is 7.18, and the median is 8, indicating that the ESG rating of the sample company performs well. For the explanatory variable-the maximum and minimum values of the degree of digital transformation of enterprises are 4.615 and 0, respectively, indicating that there are significant differences in the degree of digital transformation of listed companies in the research sample. For the control variable-company size, the difference between the maximum and minimum values is more obvious in all control variables, with a maximum value of 28.624 and a minimum value of 19.552, indicating that there is a significant difference in the size of each company in the study sample, while the descriptive statistics of other control variables are within a reasonable range. *N* means the number of samples.

Table 2. Descriptive statistical analysis of variables.

	N	Mean	p25	Median	p75	Max	Min
ESG	9767	20.601	16.529	19.835	23.14	40.496	1.24
Lndigital	9767	1.151	0.000	0.693	1.946	4.615	0
Lnsize	9767	23.114	22.158	22.985	23.901	28.624	19.552
Lev	9767	0.477	0.320	0.488	0.631	0.987	0.051
Growth	9767	0.368	−0.027	0.131	0.41	8.588	−0.765
Cashflow	9767	0.056	0.015	0.054	0.096	0.246	−0.178
Mb	9767	0.67	0.464	0.679	0.889	1.148	0.112
Roa	9767	0.042	0.015	0.037	0.07	0.205	−0.36
Fsh1	9767	0.369	0.242	0.356	0.486	0.744	0.088
Dlzb	9767	0.375	0.333	0.364	0.429	0.571	0.313
*Big*4	9767	0.114	0.000	0	0	1	0
Lnage	9767	2.832	2.639	2.89	3.091	3.434	1.099

5.2. Basic Regression Analysis

Table 3 shows the results of multiple regression of managerial overconfidence in the digital transformation of enterprises. In order to control the influence of heteroscedasticity, this paper also reports the regression results of Robust standard error and clustered robust standard error at the company level, with and without control variables. The results show that in the regression equation without control variables, the regression coefficient of *Lndigital* is 0.0125 without controlling heteroscedasticity in column (1), which is significant at a 1% level; in the case of Robust standard error, the regression coefficient of *Lndigital* is 0.0125, which is significant at the 1% level. In column (3), the regression coefficient for *Lndigital* is

0.0125, significant at the 1% level, using firm-level clustering robust standard errors. In the regression equation with control variables, the regression coefficient of *Lndigital* is 0.0109 without controlling heteroscedasticity in column (4), which is significant at the 1% level. In the case of Robust standard error, the regression coefficient of *Lndigital* is 0.0109, which is significant at the 1% level. In column (6), the regression coefficient for *Lndigital* is 0.0109, significant at the 5% level, using firm-level clustered robust standard errors.

Table 3. Basic regression results.

	(1)	(2)	(3)	(4)	(5)	(6)
	Uncontrolled Heteroscedasticity	**Robust Standard Errors**	**Robust Standard Error of Company Level Clustering**	**Uncontrolled Heteroscedasticity**	**Robust Standard Errors**	**Robust Standard Error of Company Level Clustering**
Lndigital	0.0125 ***	0.0125 ***	0.0125 **	0.0109 ***	0.0109 ***	0.0109 **
	(0.0025)	(0.0026)	(0.0059)	(0.0023)	(0.0024)	(0.0050)
Lnsize				0.0734 ***	0.0734 ***	0.0734 ***
				(0.0030)	(0.0030)	(0.0065)
Lev				−0.0642 ***	−0.0642 ***	−0.0642
				(0.0183)	(0.0187)	(0.0390)
Growth				−0.0034	−0.0034	−0.0034
				(0.0027)	(0.0027)	(0.0040)
Roa				−0.0718	−0.0718	−0.0718
				(0.0519)	(0.0494)	(0.0703)
Cashflow				0.1140 ***	0.1140 ***	0.1140 *
				(0.0429)	(0.0435)	(0.0606)
Mb				0.0055	0.0055	0.0055
				(0.0075)	(0.0079)	(0.0138)
Fsh1				0.0757 ***	0.0757 ***	0.0757 *
				(0.0178)	(0.0188)	(0.0437)
Dlzb				0.0412	0.0412	0.0412
				(0.0469)	(0.0465)	(0.0936)
Big4				0.1420 ***	0.1420 ***	0.1420 ***
				(0.0090)	(0.0096)	(0.0218)
Lnage				0.0933 ***	0.0933 ***	0.0933 ***
				(0.0082)	(0.0088)	(0.0200)
_cons	2.8000 ***	2.8000 ***	2.8000 ***	0.9390 ***	0.9390 ***	0.9390 ***
	(0.0248)	(0.0245)	(0.0549)	(0.0722)	(0.0735)	(0.1620)
Industry	control	control	control	control	control	control
Year	control	control	control	control	control	control
N	9767	9767	9767	9767	9767	9767
R^2	0.150	0.150	0.150	0.302	0.302	0.302
adj. R^2	0.146	0.146	0.146	0.298	0.298	0.298

Note: In parentheses is the standard error of regression coefficient, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5.3. Endogenous Treatment

Considering the endogenous problems caused by the correlation between digital transformation and error terms, the following endogenous treatment is carried out.

5.3.1. Heckman Two-Step Method

There may be sample selection bias in this paper. Some enterprises have carried out digital transformation but have not disclosed it in the annual report, which leads to the fact that some samples cannot be observed, so the regression samples cannot represent the whole, resulting in the problem of sample selection. To avoid the impact of this problem on the basic regression results, this paper uses the Heckman two-stage method to test. The results are shown in Table 4. In the first stage, a probit regression model is constructed to

calculate the inverse Mills ratio (*Imr*) to test whether the common characteristic variables of listed companies will affect the digital transformation dummy variable (Treat). The 2014 informatization policy dummy variable (*Inform*) is selected as the exclusive constraint variable because the policy affects the digital transformation of enterprises (Tan Zhidong et al., 2021 [58]); in the second stage, *Imr* is added to the model (1) as a control variable to test the influence of possible selective errors on the research conclusions. The regression results show that the *Imr* coefficient is −0.480, significant at the 1% level, and the sample has a selection bias. The variance inflation factor (VIF) of *Lndigital* is 1.34, indicating that the *Lndigital* coefficient is not sensitive to the exclusive constraint and the collinearity problem is small. Therefore, the Heckman two-stage regression results are relatively robust. Finally, after controlling for *Imr*, the coefficient of digital transformation is still significantly positive, as shown in Table 4, indicating that the conclusion is still valid after considering sample selection bias.

Table 4. Heckman two-stage method regression results.

	(1)	(2)
	Treat	***ESG***
Lndigital		0.0111 **
		(0.0049)
Lnsize	0.0735 **	0.0584 ***
	(0.0304)	(0.0074)
Lev	−0.121	−0.0503
	(0.202)	(0.0391)
Growth	0.0181	−0.0067
	(0.0199)	(0.0041)
Roa	0.2280	−0.1770 **
	(0.3950)	(0.0720)
Cashflow	−0.6630 **	0.2580 ***
	(0.3150)	(0.0673)
Fsh1	0.2570	−0.0422
	(0.2100)	(0.0430)
Mb	−0.2860 **	0.0380 **
	(0.1401)	(0.0155)
Dlzb	−0.0943	0.0676
	(0.4780)	(0.0926)
*Big*4		0.1430 ***
		(0.0215)
Lnage	−0.0790	0.1120 ***
	(0.0921)	(0.0202)
Inform	0.5390 ***	
	(0.0809)	

Table 4. *Cont.*

	(1)	(2)
	Treat	***ESG***
Imr		−0.4800 ***
		(0.0967)
_cons	−1.2840 *	1.6790 ***
	(0.6880)	(0.2280)
Year	control	control
Industry	control	control
N	9779	9748
R^2	0.1407	0.304
adj. R^2	0.302	0.299

Note: Column (1) is a binary choice model; its goodness of fit is Pseudo R^2; others are shown in Table 1 (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$).

5.3.2. Lag 1 and 2

The impact of digital transformation may be dynamic. The use of lagged explanatory variables can not only further examine the long-term effects of digital transformation on ESG performance but also reduce the endogenous problems caused by the two. The regression results of *Lndigital* lagging one and two periods are shown in Table 5. Even if the explanatory variable *Lndigital* coefficient lagging two periods is 0.0117, the results are significant at the 5% level. Therefore, the conclusion of this paper holds.

Table 5. Regression results of lagged explanatory variables (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$).

	(1)	(2)
	ESG	***ESG***
L.lndigital	0.0120 **	
	(0.0049)	
L2.lndigital		0.0117 **
		(0.0050)
Lnsize	0.0745 ***	0.0745 ***
	(0.0065)	(0.0065)
Lev	−0.0697 *	−0.0770 *
	(0.0391)	(0.0396)
Growth	−0.0035	−0.0040
	(0.0041)	(0.0041)
Roa	−0.0401	−0.0240
	(0.0694)	(0.0695)
Cashflow	0.1190 **	0.1180 *
	(0.0604)	(0.0611)

Table 5. *Cont.*

	(1)	(2)
	ESG	***ESG***
Mb	0.0087	0.0113
	(0.0139)	(0.0140)
Fsh1	0.0296	0.0350
	(0.0412)	(0.0414)
Dlzb	0.0576	0.0652
	(0.0937)	(0.0944)
*Big*4	0.1470 ***	0.1470 ***
	(0.0216)	(0.0216)
Lnage	0.0896 ***	0.0866 ***
	(0.0199)	(0.0206)
_cons	0.9570 ***	0.9720 ***
	(0.1630)	(0.1660)
Year	control	control
Industry	control	control
N	9686	9464
R^2	0.302	0.299
adj. R^2	0.297	0.294

5.3.3. Instrumental Variable Method: Two-Stage Regression

In order to alleviate the endogenous problems caused by measurement errors, this paper uses the mean value of digital transformation in the same industry and region as an instrumental variable for two-stage regression. The results are in Table 6. The Hausman test statistic was 137.90 (p = 0.000). The null hypothesis was rejected at the 1% level, and the endogenous explanatory variable *Lndigital* was considered. The weak instrumental variable test statistic F value was 906.956 (p = 0.0000), rejecting the weak instrumental variable hypothesis. Finally, because there is only one instrumental variable, there is no over-identification problem. In the second stage, the coefficient of *Lndigital* is 0.025, which is significant at the 1% level, indicating that this conclusion is still valid after alleviating endogenous problems.

Table 6. Regression results of the instrumental variable method (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$).

	(1)	(2)
	First	**Second**
Lndigital		0.0250 ***
		(0.0080)
Lndigital_ind	0.8010 ***	
	(0.0270)	
Lnsize	0.0160	0.0820 ***
	(0.0120)	(0.0030)

Table 6. *Cont.*

	(1)	(2)
	First	**Second**
Lev	0.0600	−0.1020 ***
	(0.0770)	(0.018)
Growth	0.0210 *	−0.0030
	(0.0120)	(0.0030)
Roa	−0.2780	−0.1590 ***
	(0.2170)	(0.0510)
Cashflow	−0.1580	0.1700 ***
	(0.1820)	(0.0430)
Mb	−0.1410 ***	0.0030
	(0.0320)	(0.0080)
Fsh1	0.0100	0.0210
	(0.0760)	(0.0180)
Dlzb	−0.6530 ***	0.0710
	(0.2000)	(0.0470)
*Big*4	0.0790 **	0.1350 ***
	(0.0380)	(0.0090)
Lnage	0.0720 **	0.1210 ***
	(0.0330)	(0.0080)
_cons	−0.1960	0.7870 ***
	(0.3010)	(0.0710)
Industry	control	control
Year	control	control
N	9766	9766
R-squared	0.2526	0.289
adj. R^2	0.2480	

5.3.4. PSM-OLS and PSM-DID Estimation

Following the research methodology of Wu [59] et al. (2021), this paper argues that companies should gradually promote digital transformation rather than accomplish it overnight, so the disclosure of the first digital transformation can be regarded as a quasi-natural experiment. At the same time, in order to avoid 'false' digital transformation, disclosure of fewer than 3 years and discontinuous disclosure of samples, this paper argues that the enterprise did not really implement digital transformation. In order to solve the problem that the digital transformation is not a random distribution, which leads to the biased estimation of the difference-in-differences model, this paper attempts to use the Mahalanobis distance of the propensity score method (PSM) to perform 1:1 matching. The selected matching covariates include enterprise size, asset-liability ratio, operating income growth rate, total asset profit rate, enterprise age and other characteristic variables. The matching samples are obtained, and the OLS and difference-in-differences methods are used again to estimate, making the empirical design closer to random distribution.

The balance test of PSM in Figure 1 shows that there is no significant difference between the mean values of each variable before and after matching. Figure 2 shows the common support test graph. The comparison of the kernel density function graph before

and after matching shows that the two lines after matching are very similar, indicating that the matching effect is good and meets the common support test.

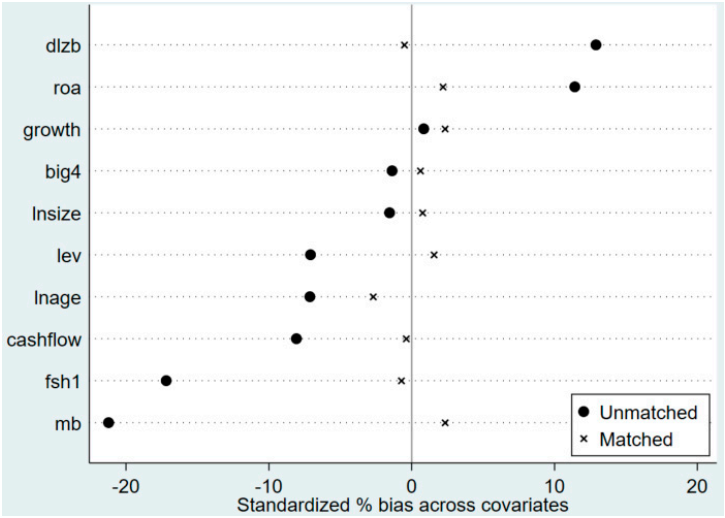

Figure 1. Balance test of PSM.

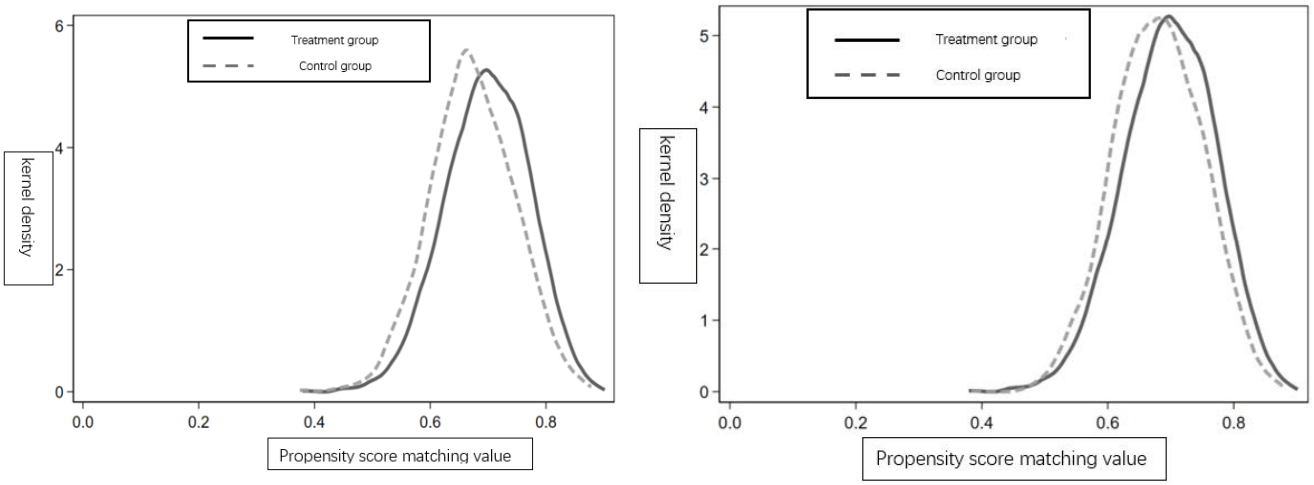

Figure 2. Common support test diagram; (**a**) Kernel density map of propensity score before matching; (**b**) Kernel density map of propensity score after matching.

Using the sample weight is not empty, the sample to meet the common support hypothesis, frequency weighted regression after three matching samples to re-OLS and DID estimation. In the frequency-weighted regression, due to the frequency weighting based on the weight, the samples actually participating in the regression will be copied according to the weight; that is, the regression samples will increase. The estimated results are as follows according to Table 7: the coefficients of the digital transformation (*Lndigital*) in columns (1), (2) and (3) and the coefficients of the quadratic difference term (*DID*) in columns (4), (5) and (6) are significantly positive, indicating that the matched estimation results are consistent with the basic regression, which can eliminate the influence of endogeneity. The results of digital transformation and ESG performance are still robust.

Table 7. PSMOLS and PSM-DID regression (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$).

	PSM-OLS			PSM-DID		
	(1)	(2)	(3)	(4)	(5)	(6)
	Samples with Non-Empty Weights	Samples Satisfying the Common Support Hypothesis	Frequency Weighted Regression	Samples with Non-Empty Weights	Samples Satisfying the Common Support Hypothesis	Frequency Weighted Regression
Lndigital	0.0153 ***	0.0113 ***	0.0285 ***			
	(0.0034)	(0.0022)	(0.0019)			
DID				0.0418 ***	0.0350 ***	0.0543 ***
				(0.0093)	(0.0062)	(0.0072)
Lnsize	0.0724 ***	0.0747 ***	0.0796 ***	0.0710 ***	0.0729 ***	0.0788 ***
	(0.0043)	(0.0029)	(0.0021)	(0.0043)	(0.0029)	(0.0021)
Lev	−0.0924 ***	−0.0652 ***	−0.1310 ***	−0.0914 ***	−0.0631 ***	−0.123 ***
	(0.0267)	(0.0183)	(0.0137)	(0.0266)	(0.0183)	(0.0138)
Growth	0.0011	−0.0031	0.0024	0.0019	−0.0028	0.0049 **
	(0.0040)	(0.0027)	(0.0020)	(0.0040)	(0.0027)	(0.0020)
Roa	0.0039	−0.0564	−0.0841 *	0.0004	−0.0658	−0.0743 *
	(0.0768)	(0.0520)	(0.0433)	(0.0768)	(0.0520)	(0.0435)
Cashflow	0.1520 **	0.1230 ***	0.2250 ***	0.1440 **	0.1220 ***	0.2160 ***
	(0.0633)	(0.0432)	(0.0325)	(0.0634)	(0.0432)	(0.0326)
Mb	0.0316 ***	0.00578	0.0603 ***	0.0298 ***	0.00529	0.0581 ***
	(0.0113)	(0.0075)	(0.0055)	(0.0113)	(0.0075)	(0.0055)
Fsh1	0.0469 *	0.0304 *	−0.00555	0.0469 *	0.0351 **	−0.0021
	(0.0264)	(0.0177)	(0.0146)	(0.0264)	(0.0177)	(0.0147)
Dlzb	0.0776	0.0462	0.0122	0.0689	0.0336	0.00170
	(0.0701)	(0.0471)	(0.0354)	(0.0701)	(0.0470)	(0.0356)
Big4	0.1400 ***	0.1460 ***	0.1140 ***	0.1450 ***	0.1500 ***	0.1210 ***
	(0.0130)	(0.0089)	(0.0068)	(0.0129)	(0.0089)	(0.0068)
Lnage	0.0658 ***	0.0882 ***	0.0571 ***	0.0650 ***	0.0884 ***	0.0596 ***
	(0.0125)	(0.0081)	(0.0063)	(0.0125)	(0.0081)	(0.0063)
_cons	1.0210 ***	0.9470 ***	0.9400 ***	1.0540 ***	0.9860 ***	0.9540 ***
	(0.1060)	(0.0725)	(0.0535)	(0.1060)	(0.0727)	(0.0538)
Industry	control	control	control	control	control	control
Year	control	control	control	control	control	control
N	4515	976	15653	4515	9751	15653
R^2	0.312	0.301	0.370	0.312	0.301	0.363
adj. R^2	0.302	0.296	0.367	0.302	0.297	0.361

5.3.5. Robust Analysis

In order to ensure the conclusion of the above regression analysis is true and reliable, the robustness test is carried out by the following methods. The specific instructions and results are as follows. ① Change the dependent variable measurement method. Referring to Liu Xuexin [12] et al. (2022), the explanatory variables are replaced by the 2011–2020 Huazheng ESG rating. Column (1) in Table 8 shows that the coefficient is positive, which further proves the conclusion of this paper. ② Replace digital transformation indicators. Based on Wu Fei's [59] (2021) practice of evaluating the level of digital transformation of enterprises, this paper collects keywords on five aspects of artificial intelligence technology, blockchain technology, cloud computing technology, big data technology and digital technology application in the annual report of listed companies from 2011 to 2020 through Python crawler function, and summarizes the corresponding word frequency to obtain the degree of digital transformation of enterprises. ③ Only manufacturing enterprises are retained. Compared with other industries, manufacturing listed companies have higher digital technology requirements. The depth and breadth of their digital technology are far

from comparable to other industries. Manufacturing listed companies can better reflect the actual digital technology of enterprises than other industries. ④ Increase control variables. Increase the duality and marketization index to control the impact of external factors on ESG performance. ⑤ Retain only non-high-tech industries. The application of digital technology in high-tech industries is higher; excluding high-tech industries can control the impact of industry factors. ⑥ Excluding highly polluting industries and further mitigating the impact of special industries on ESG performance. ⑦ Exclude the impact of the carbon emissions trading pilot policy. Listed companies in the pilot areas of carbon emission trading rights will also have an impact on ESG performance. By using the triple difference method, other policy impacts can be excluded during the digital transformation. The final robust regression results are shown in Table 8, and the regression coefficients of digital transformation level (*Lndigital*) are significantly positive in several cases. Therefore, the above robustness regression further ensures the conclusion of this paper.

Table 8. Robust regression (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	HZESG	***ESG***	***ESG***	***ESG***	***ESG***	***ESG***	***ESG***
Lndigital	0.0188 *	0.0145 **	0.0196 **	0.0103 ***	0.0114 ***	0.0207 ***	
	(0.0101)	(0.0057)	(0.0076)	(0.0026)	(0.0032)	(0.0046)	
DDD							0.0466 ***
							(0.0063)
Lnsize	0.1550 ***	0.0673 ***	0.0650 ***	0.0694 ***	0.0883 ***	0.0692 ***	0.0719 ***
	(0.0130)	(0.0067)	(0.0088)	(0.0033)	(0.0041)	(0.0056)	(0.0030)
Lev	−0.563 ***	−0.0652	−0.0542	−0.0728 ***	−0.128 ***	−0.000780	−0.0591 ***
	(0.0808)	(0.0400)	(0.0491)	(0.0207)	(0.0277)	(0.0341)	(0.0185)
Growth	−0.0223 *	−0.0051	−0.0086	−0.0006	−0.0014	−0.0060	−0.0031
	(0.0121)	(0.0043)	(0.0066)	(0.0029)	(0.0034)	(0.0062)	(0.0027)
Roa	0.8820 ***	−0.0898	−0.0105	−0.0678	−0.2030 **	−0.1210	−0.0688
	(0.2290)	(0.0732)	(0.0908)	(0.0566)	(0.0823)	(0.0898)	(0.0489)
Cashflow	−0.5270 ***	0.1380 **	0.1870 **	0.1200 **	0.0883	0.1760 **	0.1230 ***
	(0.190)	(0.0629)	(0.0809)	(0.0471)	(0.0599)	(0.0838)	(0.0433)
Mb	0.0546	0.0147	0.0459 ***	0.0122	−0.0363 ***	0.0373 ***	0.0064
	(0.0333)	(0.0146)	(0.0168)	(0.0089)	(0.0127)	(0.0126)	(0.0079)
Fsh1	0.0802	0.0265	0.0801	−0.0111	0.0199	0.0954 ***	0.0811 ***
	(0.0781)	(0.0417)	(0.0569)	(0.0190)	(0.0264)	(0.0321)	(0.0187)
Dlzb	0.3500 *	0.0550	−0.1370	0.1050 **	0.2780 ***	−0.1810 **	0.0285
	(0.207)	(0.0946)	(0.118)	(0.0513)	(0.0655)	(0.0781)	(0.0463)
*Big*4	0.2080 ***	0.1480 ***	0.1490 ***	0.1320 ***	0.1270 ***	0.1550 ***	0.1410 ***
	(0.0393)	(0.0222)	(0.0306)	(0.0103)	(0.0119)	(0.0189)	(0.0095)
Lnage	0.3530 ***	0.0910 ***	0.1180 ***	0.0897 ***	0.0809 ***	0.1320 ***	0.0941 ***
	(0.0361)	(0.0197)	(0.0261)	(0.0091)	(0.0119)	(0.0145)	(0.0087)

Table 8. *Cont.*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	HZESG	***ESG***	***ESG***	***ESG***	***ESG***	***ESG***	***ESG***
Duel				−0.0472 ***			
				(0.0070)			
Market				0.0101 ***			
				(0.0016)			
_cons	2.5980 ***	1.0940 ***	1.1140 ***	1.0210 ***	0.5850 ***	0.9960 ***	0.9800 ***
	(0.3190)	(0.1660)	(0.2090)	(0.0806)	(0.1010)	(0.1280)	(0.0736)
Industry	control	control	control	control	control	control	control
Year	control	control	control	control	control	control	control
N	9767	8563	5706	8215	4702	3478	9767
R^2	0.141	0.288	0.284	0.288	0.344	0.283	0.305
adj. R^2	0.135	0.283	0.278	0.282	0.336	0.273	0.301

5.4. Influencing Mechanism Analysis

According to the four dimensions and characteristics of technological excellence, digital transformation promotes ESG performance by reducing managers' short-sighted behavior, improving innovation capabilities, increasing information transparency, and enhancing governance capabilities.

5.4.1. Reduce Managerial Myopia Behavior

"Technology for goodness" is a long-term development of eidos. Digital transformation can increase managers' rational decision-making thinking and reduce managers' short-sighted behavior, thus promoting the long-term development of enterprises. According to the 'digital technology to good' effect discussed in the third part of the theoretical mechanism and hypothesis, the digital transformation of enterprises is conducive to the formation of long-term development concepts of enterprises. The cognitive managerial theory holds that the direct cause of managers' overconfidence or myopia lies in their own cognitive bias. Dou Wei et al. found that overconfident managers will more easily believe in the future profit commitment of enterprises with inflated profits, which aggravates the investment risk of the enterprises they manage [60]. According to the theory of the managerial endowment effect, the cognition of enterprise managers will change on the basis of the experience generated by their interaction with their own environment. The powerful information effect of digital technology broadens the information source channels of enterprise managers, which increases the opportunities for managers to obtain new endowments to a certain extent. Therefore, it will enable managers to examine the development of enterprises with a longer-term perspective in the future so as to overcome their original short-sighted behavior.

In terms of measuring managerial myopia, this paper refers to the measurement method of Hu Nan et al. [61] and uses the word frequency analysis method to calculate the MD & A document size, the total number of MD & A words, the total number of MD & A words, and the total number of MD & A sentences through the annual report of listed companies. Based on the above calculation results, the managerial myopia index is calculated.

Columns (1) and (2) in Table 9 report the regression results of the mediating effect without adding control variables. The results show that *Lndigital* is −0.0045 for *Myopia*, which is significant at the 1% level, so there is a significant negative correlation between digital transformation and managerial *Myopia*. The regression coefficients of *Lndigital* and *Myopia* to ESG were 0.0165 and −0.0783, respectively, which were significant at 1% and

5% levels. Therefore, the mediating effect is established. Columns (3) and (4) report the regression results of the mediating effect of adding control variables, and the results are consistent with the above.

Table 9. The mediating role of managers' myopia (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$).

	(1)	(2)	(3)	(4)
	Myopia	***ESG***	***Myopia***	***ESG***
Lndigital	−0.0045 ***	0.0165 ***	−0.0042 ***	0.0148 ***
	(0.0007)	(0.0027)	(0.0007)	(0.0025)
Myopia		−0.0783 **		−0.0836 **
		(0.0390)		(0.0366)
lnsize			−0.0041 *	0.0431 ***
			(0.0022)	(0.0073)
lev			−0.0089 *	0.0457 **
			(0.0050)	(0.0186)
growth			−0.0012	−0.0040
			(0.0008)	(0.0028)
roa			−0.0792 ***	0.179 ***
			(0.0158)	(0.0504)
cashflow			0.0020	0.238 ***
			(0.0136)	(0.0452)
mb			0.0079 ***	0.0946 ***
			(0.0018)	(0.0073)
fsh1			0.0123 **	0.0607 ***
			(0.0056)	(0.0185)
dlzb			−0.0056	0.166 ***
			(0.0153)	(0.0498)
big4			−0.0061 **	0.211 ***
			(0.0027)	(0.0099)
lnage			0.00534 **	0.127 ***
			(0.0023)	(0.0088)
_cons	0.0763 ***	2.991 ***	0.0752 ***	2.540 ***
	(0.0054)	(0.0220)	(0.0110)	(0.0414)
Industry	control	control	control	control
Year	control	control	control	control
N	9559	9559	9559	9559
R^2	0.096	0.108	0.105	0.241
adj. R^2	0.092	0.103	0.100	0.236

5.4.2. Enhancing Innovation Capacity

Digital transformation improves the eidos of innovative development. According to the 'digital technology for good' effect discussed in the third part of the theoretical mechanism and hypothesis, digital transformation is conducive to the formation of enterprise innovation and development eidos. First of all, in terms of technological tool innovation, traditional manufacturing production processes generate massive amounts of information.

However, due to the lack of a good production process information entry system and an instant personnel communication system, such information is more difficult to be effectively utilized. For example, product production quality information, product production design information, and consumer product preferences are often obtained through rough estimation methods and are difficult to adapt to consumers' escalating requirements for product quality, resulting in distortions in the distribution of production resources. It is difficult to efficiently adapt to real-time random changes in the market. However, the use of big data technology not only realizes the collection and precise utilization of massive data [62] but also changes the characteristics of closed production in traditional manufacturing enterprises. This change also provides an opportunity for enterprises to create products that are more in line with market expectations and obtain innovation dividends [21], which greatly improves the efficiency of enterprise innovation resource allocation.

This paper uses R&D intensity (R&D investment/operating income) as a measure of innovation capability. Columns (1) and (2) in Table 10 report the regression results of the mediating effect without adding control variables. The results show that *Lndigital* is 0.0761 for *Lnrd*, which is significant at the 1% level, so there is a significant positive correlation between digital transformation and enterprise innovation ability. The regression coefficients of *Lndigital* and *Lnrd* for ESG are 0.0043 and 0.0571, respectively. The coefficient of digital transformation is not significant, and the coefficient of enterprise innovation ability is significant at the 1% level. Therefore, the mediating effect does not hold. Columns (3) and (4) reported the regression results of the mediating effect of adding control variables. The regression coefficients of *Lndigital* and *Lnrd* to ESG were both significant at the 1% level, and the mediating effect was established in this case.

Table 10. The mediating role of innovation ability (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$).

	(1)	**(2)**	**(3)**	**(4)**
	Lnrd	***ESG***	***Lnrd***	***ESG***
Lndigital	0.0761 ***	0.0043	0.0875 ***	0.0077 ***
	(0.0155)	(0.0031)	(0.0121)	(0.0029)
Lnrd		0.0571 ***		0.0159 ***
		(0.0023)		(0.0027)
lnsize			0.776 ***	0.0637 ***
			(0.0164)	(0.0041)
lev			−0.294 ***	−0.0464 **
			(0.0970)	(0.0221)
growth			0.0287	−0.0055
			(0.0188)	(0.0037)
roa			1.477 ***	−0.0676
			(0.288)	(0.0587)
cashflow			1.464 ***	0.0942 *
			(0.257)	(0.0552)
mb			−0.179 ***	0.0079

Table 10. *Cont.*

	(1)	(2)	(3)	(4)
	Lnrd	***ESG***	***Lnrd***	***ESG***
			(0.0371)	(0.0093)
fsh1			0.0561	0.0493 **
			(0.0900)	(0.0220)
dlzb			−0.363	−0.0757
			(0.232)	(0.0534)
big4			0.116 ***	0.148 ***
			(0.0448)	(0.0117)
lnage			−0.208 ***	0.120 ***
			(0.0391)	(0.0106)
_cons	15.95 ***	1.893 ***	−0.727 *	0.932 ***
	(0.158)	(0.0498)	(0.380)	(0.0865)
Industry	control	control	control	control
Year	control	control	control	control
N	7025	7025	7025	7025
R^2	0.310	0.232	0.598	0.327
adj. R^2	0.305	0.227	0.594	0.321

5.4.3. Increase Information Transparency

Technology for the better is the eidos of shared development, that is, the use of digital transformation to explore the social value of its business activities, and presented in the enterprise strategy, business development and resource allocation so that enterprises, through the creation of social value to achieve shared development results. According to the 'digital technology to good' effect discussed in the third part of the theoretical mechanism and hypothesis, the digital transformation of enterprises is conducive to the formation of the eidos of shared development of enterprises. The synergistic effect theory holds that the various components of the entire economic society are mutually influential, competitive, and mutually reinforcing [63]. The strong information effect of digital transformation amplifies the relationship between enterprises and enterprises. The birth of Internet supply chain finance just proves this point. The foundation of financial development lies in commercial credit. The foundation of commercial credit is based on the relative symmetry of information between borrowing and financing; that is, there is no possibility that both parties can use information advantages to seek private interests. Digital technology is the key tool to solving the problem that it is difficult to thoroughly understand the credibility of each other between enterprises in the past [64]. Based on information technology, the transparency of information between enterprises is enhanced, and the mutual trust relationship between enterprises is also enhanced. It has changed the state of complete mutual distrust, which has also affected the formulation of high-level strategies of enterprises and strengthened the awareness of enterprises to create social wealth and share development results.

This paper uses information transparency to represent the development of enterprise information sharing and replaces the sharing development concept of science and technology with information sharing. For example, Yonghui Supermarket promotes the development of enterprises by sharing super species, the Yonghui life platform, sharing information and spreading sharing concept. This paper further uses analyst attention as an intermediary indicator of information transparency. Generally speaking, companies with greater analyst attention have higher information transparency.

Columns (1) and (2) in Table 11 report the regression results of the mediating effect without adding control variables. The results show that *Lndigital* is 0.0895 for *Analyst*, which is significant at the 1% level, so there is a significant positive correlation between digital transformation and corporate information transparency. The regression coefficients of *Lndigital* and *Analyst* to ESG were 0.0089 and 0.0399, respectively, which were significant at the 1% level. Therefore, the mediating effect is established. Columns (3) and (4) report the regression results of the mediating effect of adding control variables, and the results are consistent with the above.

Table 11. The mediating role of information transparency (* $p < 0.1$, *** $p < 0.01$).

	(1)	**(2)**	**(3)**	**(4)**
	Analyst	***ESG***	***Analyst***	***ESG***
Lndigital	0.0895 ***	0.0089 ***	0.0757 ***	0.0106 ***
	(0.0103)	(0.0024)	(0.008)	(0.0022)
Analyst		0.0399 ***		0.0076 ***
		(0.0024)		(0.0029)
lnsize			0.5750 ***	0.0704 ***
			(0.0103)	(0.0033)
lev			−0.6250 ***	−0.0618 ***
			(0.0640)	(0.0184)
growth			−0.0183 *	−0.0031
			(0.0096)	(0.0027)
roa			4.6500 ***	−0.0936 *
			(0.1810)	(0.0535)
cashflow			0.7840 ***	0.1110 ***
			(0.1500)	(0.0430)
mb			−0.8300 ***	0.0122
			(0.0264)	(0.0079)
fsh1			−0.505 ***	0.0336 *
			(0.0619)	(0.0177)
dlzb			−0.8570 ***	0.0531
			(0.1640)	(0.0470)
big4			−0.1170 ***	0.1470 ***
			(0.0312)	(0.0089)
lnage			−0.3910 ***	0.0913 ***
			(0.0286)	(0.0082)
_cons	2.1470 ***	2.7140 ***	−9.6330 ***	1.0190 ***
	(0.1020)	(0.0250)	(0.2530)	(0.0774)
Industry	control	control	control	control
Year	control	control	control	control
N	9767	9767	9767	9767
R^2	0.097	0.173	0.466	0.301
adj. R^2	0.092	0.169	0.462	0.297

5.4.4. Enhance Governance Capacity

Technology for good is the eidos of fair development. In the practice of science and technology to a good idea of the enterprise, through the supervision and governance path, to solve the digital transformation of data security, algorithm discrimination, consumer rights protection, market monopoly and other emerging issues, so as to develop on the basis of 'do no evil'. According to the 'digital technology for good' effect discussed in the third part of the theoretical mechanism and hypothesis, the digital transformation of enterprises is conducive to the formation of the eidos of fair development of enterprises. At present, the construction of various online interactive platforms has created the necessary technical conditions for the real-time transmission of information to the public. When enterprises conduct online business, they will leave corresponding traces on the Internet, which to a certain extent, also combats the illegal behavior of monopoly enterprises because they often use monopoly advantages to coerce other enterprises to cooperate with them or to conduct false transactions with related party enterprises, which greatly improves the concealment of their fraud, and digital technology greatly enhances the exposure of such behavior. On the other hand, from the perspective of social supervision, the combination of big data and blockchain technology provides the soil for the existence of credit digitization. Information asymmetry is rooted in the non-moral tendency of both parties to trade at the expense of others and self-interest. By recording the dishonesty of the credit grantor through big data and authenticating it through blockchain technology, many unqualified candidates can be excluded at the beginning of the loan, thus greatly reducing the credit risk caused by information asymmetry [65]. Enhanced protection of consumer rights and data security.

In the governance path to reduce the agency problem, the management cost rate *Mfee* is used as the intermediary variable. Columns (1) and (2) in Table 12 report the regression results of the mediating effect without adding control variables. The results show that *Lndigital* is −0.0132 for *Mfee*, which is significant at the 5% level, so there is a significant negative correlation between digital transformation and corporate agency problems. The regression coefficients of *Lndigital* and *Mfee* to ESG were 0.0163 and −0.0594, respectively, which were significant at the 1% level. Therefore, the mediating effect is established. Columns (3) and (4) report the regression results of the mediating effect of adding control variables, and the results are consistent with the above.

Table 12. The intermediary role of the agency problem (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$).

	(1)	(2)	(3)	(4)
	Mfee	***ESG***	***Mfee***	***ESG***
Lndigital	−0.0132 **	0.0163 ***	−0.0124 **	0.0133 ***
	(0.0058)	(0.0024)	(0.0052)	(0.0023)
Mfee		−0.0594 ***		−0.0155 ***
		(0.0043)		(0.0044)
lnsize			−0.1390 ***	0.0511 ***
			(0.0164)	(0.0072)
lev			−0.9930 ***	0.0702 ***
			(0.0400)	(0.0182)
growth			0.0253 ***	−0.0053 *
			(0.0063)	(0.0028)
roa			−2.7730 ***	0.1710 ***

Table 12. *Cont.*

	(1)	(2)	(3)	(4)
	Mfee	***ESG***	***Mfee***	***ESG***
			(0.1180)	(0.0536)
cashflow			−0.6000 ***	0.169 ***
			(0.0998)	(0.0442)
mb			−0.3000 ***	0.0754 ***
			(0.0158)	(0.0071)
fsh1			−0.1890 ***	0.0578 ***
			(0.0411)	(0.0182)
dlzb			−0.2240 **	0.1720 ***
			(0.1090)	(0.0481)
big4			−0.0564 ***	0.2170 ***
			(0.0195)	(0.0086)
lnage			−0.0263	0.0996 ***
			(0.0184)	(0.0082)
_cons	−2.6810 ***	2.8260 ***	−2.0860 ***	2.5600 ***
	(0.0545)	(0.0259)	(0.0894)	(0.0406)
Industry	control	control	control	control
Year	control	control	control	control
N	9766	9766	9797	9797
R^2	0.293	0.151	0.428	0.254
adj. R^2	0.290	0.147	0.425	0.250

In the governance path of reducing information asymmetry, accrual earnings management is used as an intermediary indicator. Columns (1) and (2) in Table 13 report the regression results of the mediating effect without adding control variables. The results show that *Lndigital* is −0.0045 for *Absdacc*, which is significant at the 1% level, so there is a significant negative correlation between digital transformation and enterprise information asymmetry. The regression coefficients of *Lndigital* and *Absdacc* to ESG were 0.0550 and −0.2760, respectively, which were significant at the 1% level. Therefore, the mediating effect is established. Columns (3) and (4) report the regression results of the mediating effect of adding control variables, and the results are consistent with the above.

Table 13. The mediating role of information asymmetry (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$).

	(1)	(2)	(3)	(4)
	Absdacc	***ESG***	***Absdacc***	***ESG***
Lndigital	−0.0045 ***	0.0550 ***	−0.0035 **	0.0352 ***
	(0.0017)	(0.0070)	(0.0017)	(0.0064)
Absdacc		−0.2760 ***		−0.1450 ***
		(0.0417)		(0.0395)
lnsize			−0.0008	0.0724 ***
			(0.0008)	(0.0031)
lev			0.0121 **	−0.0709 ***
			(0.0055)	(0.0194)

Table 13. *Cont.*

	(1)	(2)	(3)	(4)
	Absdacc	***ESG***	***Absdacc***	***ESG***
growth			0.0024 **	−0.0008
			(0.0011)	(0.0029)
roa			−0.0573 *	−0.0596
			(0.0313)	(0.0513)
cashflow			−0.1530 ***	0.0869 *
			(0.0222)	(0.0446)
lnmba			−0.0205 ***	0.0052
			(0.0022)	(0.0081)
fsh1			0.0032	0.0301 *
			(0.0048)	(0.0180)
dlzb			0.0199	0.0297
			(0.0130)	(0.0476)
big4			−0.0035	0.1520 ***
			(0.0022)	(0.0096)
lnage			0.0020	0.0875 ***
			(0.0022)	(0.0088)
_cons	0.0850 ***	2.8080 ***	0.0760 ***	1.001 ***
	(0.0057)	(0.0252)	(0.0191)	(0.0763)
Industry	control	control	control	control
Year	control	control	control	control
N	9361	9361	9361	9361
R^2	0.060	0.155	0.098	0.301
adj. R^2	0.055	0.150	0.092	0.296

5.5. Heterogeneity Analysis of Industry Monopoly

Although digital transformation has a positive impact on ESG performance, that is, technology is good, but under what circumstances; it is unknown whether this benign result will be reversed. Therefore, only by identifying the situation that affects the non-goodness of science and technology can we better control the problem of the non-goodness of science and technology. According to the above theoretical analysis, the application of digital technology may lead to data security, privacy leakage, algorithm misconduct, and new problems brought about by digital monopoly. Therefore, this paper explains this situation by pointing out the problem of poor science and technology in digital technology in the case of industry monopoly.

This paper believes that the implementation of digital transformation in the case of industry monopoly will have a negative impact on the ESG performance of enterprises. And the stronger the monopoly, the stronger the negative effect. Because in the case of monopoly, digital transformation will increase information barriers, resulting in increasingly serious problems such as data monopoly and algorithmic responsibility, such as events of the Didi platform, which uses data monopoly advantages to illegally collect 1196.39 million user album screenshots, an excessive collection of driver education information 14.29 million, in clear form, to store driver ID number information 57.8026 million; in the case of not clearly informing passengers, we analyze 539.76 billion travel intention information, 1538 million resident city information, and 304 million off-site business/tourism information, with the

intention to further expand their business territory, which seriously violates consumer rights and market equity, blindly pursues the maximization of our own interests, ignores social benefits, and does not pay attention to information security and algorithmic responsibility.

In view of this kind of problem, this paper argues that the following measures should be taken: First, both data security and data value mining, that is, the unity of protection and development, break through the zero-sum game; second, technology is good, handing digital technology to enterprises that can make good use of it, and severely punishing digital monopoly behavior.

Columns (1) and (2) in Table 14 report the regression results of the high industry monopoly group and the low industry monopoly group without adding control variables. In regression (1), the regression coefficient of *Lndigital* is −0.0519, which is significant at the 1% level, indicating that digital transformation does not utilize the ESG performance of enterprises under high industry monopolies. The regression coefficient for *Lndigital* in Regression (2) is 0.0140, significant at the 1% level, indicating that digital transformation has leveraged the ESG performance of firms under low industry monopolies. Columns (3) and (4) report the regression results of the high industry monopoly group and the low industry monopoly group in the case of adding control variables, and the results are basically the same as above.

Table 14. Heterogeneity analysis of industry monopoly (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$).

	(1)	(2)	(3)	(4)
	High Industry Monopoly	**Low Industry Monopoly**	**High Industry Monopoly**	**Low Industry Monopoly**
	ESG	***ESG***	***ESG***	***ESG***
Lndigital	−0.0519 ***	0.0140 ***	−0.0233 **	0.0120 ***
	(0.0085)	(0.0027)	(0.0096)	(0.0025)
lnsize			0.0786 ***	0.0683 ***
			(0.0103)	(0.0033)
lev			−0.0140	−0.0673 ***
			(0.0617)	(0.0209)
growth			−0.0025	−0.0037
			(0.0066)	(0.0030)
roa			−0.1120	−0.0898
			(0.1880)	(0.0555)
cashflow			0.1640	0.1110 **
			(0.1800)	(0.0474)
mb			−0.0227	0.0158 *
			(0.0316)	(0.00887)
fsh1			0.0136	0.0623 ***
			(0.0678)	(0.0206)
dlzb			0.2500	0.0222
			(0.1820)	(0.0512)
big4			0.1400 ***	0.1500 ***
			(0.0331)	(0.0105)
lnage			0.0176	0.0993 ***
			(0.0263)	(0.0095)
_cons	2.9320 ***	2.7550 ***	1.0390 ***	1.0250 ***
	(0.0355)	(0.0301)	(0.2280)	(0.0844)
Industry	control	control	control	control
Year	control	control	control	control
N	787	8359	771	8091
R^2	0.233	0.148	0.447	0.292
adj. R^2	0.206	0.142	0.407	0.287

5.6. Further Analysis: The Spillover Effect of Science and Technology

In the third part of the previous article, this paper has theoretically demonstrated the spillover effect of digital technology on the goodness of science and technology. Enterprises integrate the application of this concept into products and services so as to pass on good ESG ideas to other enterprises through competition in the same industry or region and the role of institutional investors' joint investment so as to support market goodness. Among them is the measurement of the common institutional ownership index of listed companies; this paper draws on the research of Du Yong [35] et al. (2021) and measures it in the form of dummy variables. If a common institutional investor held shares in the listed company that year, Coz is 1. Otherwise, it is 0. Among them, common institutional investors refer to institutional investors who hold no less than 5% shares in two or more companies in the same industry.

This paper verifies the spillover effect of science and technology to good through three transmission methods.

The first is the industry peer effect of the same industry network. The emergence of online platforms enables enterprises in the same industry to communicate more frequently, especially when a new development model appears in the industry. Other enterprises can follow in a shorter period of time, thereby improving the overall development level of the industry. Columns (1) and (2) show the regression results of the non-addition and addition of control variables in the same industry. The results show that the peer effect of the industry has a significant positive effect on improving the ESG performance of enterprises.

Secondly, the regional peer effect of the same regional network. The emergence of regional industrial Internet has deepened the collaborative operation ability of different industrial enterprises in the region, closely linked different industries, and realized the real-time transmission of supply and demand relationship between the upstream and downstream industries. Enterprises at the core of the industrial system can quickly make other enterprises obtain corresponding benefits after breaking through technical barriers, thus improving the overall development level of the region. Columns (3) and (4) show the regression results of the non-addition and addition of control variables in the same region. The results show that the regional peer effect has a significant positive effect on improving the ESG performance of enterprises.

The last is the peer effect of the common institutional investor network. Because there are common investors among enterprises, such enterprises have higher consistency of interests, so they can develop together under the coordination of common investors. Due to the rapid development of digital technology, the information barriers between such enterprises are further broken. Using digital technology, institutional investors can implement coordination means more accurately and enable different enterprises to develop by sharing part of the information. The results are shown in Table 15. Columns (5) and (6) show the regression results of adding and not adding control variables in the case of a common institutional investor network. The results show that the peer effect of a common institutional investor network has a significant positive effect on improving the ESG performance of enterprises.

Table 15. Spillover effects of science and technology (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$).

	(1)	(2)	(3)	(4)	(5)	(6)
	ESG	***ESG***	***ESG***	***ESG***	***ESG***	***ESG***
ESG_ind	0.3860 ***	0.0827 **				
	(0.0439)	(0.0421)				
ESG_province			0.5480 ***	0.4790 ***		

Table 15. *Cont.*

	(1)	(2)	(3)	(4)	(5)	(6)
	ESG	***ESG***	***ESG***	***ESG***	***ESG***	***ESG***
			(0.0402)	(0.0323)		
Coa					0.170 ***	0.0865 ***
					(0.0083)	(0.0080)
lnsize		0.0822 ***		0.0751 ***		0.0674 ***
		(0.0029)		(0.0029)		(0.0030)
lev		−0.0950 ***		−0.0684 ***		−0.0606 ***
		(0.0187)		(0.0184)		(0.0184)
growth		−0.0025		−0.0032		−0.0030
		(0.0027)		(0.0026)		(0.00269)
roa		−0.1603 ***		−0.0625		−0.0475
		(0.0490)		(0.0485)		(0.0485)
cashflow		0.1660 ***		0.1500 ***		0.1130 ***
		(0.0435)		(0.0430)		(0.0431)
mb		−0.0028		0.0039		0.0127
		(0.0079)		(0.0078)		(0.0078)
fsh1		0.0252		0.0196		0.0332 *
		(0.0179)		(0.0177)		(0.0177)
dlzb		0.0672		0.0503		0.0390
		(0.0467)		(0.0463)		(0.0459)
big4		0.1410 ***		0.1390 ***		0.1400 ***
		(0.0096)		(0.0094)		(0.0095)
lnage		0.1190 ***		0.0917 ***		0.0854 ***
		(0.0085)		(0.0083)		(0.0086)
_cons	1.8390 ***	0.5510 ***	1.2510 ***	−0.4070 ***	2.8060 ***	1.1250 ***
	(0.1340)	(0.1370)	(0.1170)	(0.1120)	(0.0239)	(0.0746)
Industry	control	control	control	control	control	control
Year	control	control	control	control	control	control
N	9767	9767	9767	9767	9767	9767
R^2	0.115	0.290	0.164	0.308	0.189	0.310
adj. R^2	0.111	0.285	0.160	0.304	0.185	0.305

6. Conclusions and Implications

Under the wave of digital transformation, international and domestic attention to ESG performance and its evaluation system has grown rapidly. Under this tone, this paper empirically verifies that digital transformation is positively related to ESG performance. The study found that: (1) Enterprise digital transformation can significantly improve the ESG performance of enterprises; (2) Monopoly will distort the 'digital goodness' effect and reduce the ESG performance of enterprises; (3) There are four specific paths for enterprise digital transformation to affect enterprise ESG performance: reducing the myopia of enterprise managers, improving enterprise innovation ability, enhancing enterprise information transparency, and enhancing enterprise governance ability. (4) Further analysis shows that the role of digital transformation in improving the ESG performance of enterprises will be

transmitted outward through three ways: the same industry, the same region and common institutional investors.

Based on the above empirical analysis and conclusions, this paper puts forward the following policy recommendations:

First, support enterprises to further promote digital transformation, and increase investment in digital enterprises, thus fostering a digital transformation and development environment. Although the individual development level of digital transformation of Chinese enterprises is still lagging behind the international level, if the policy support for digital transformation investment is continuously strengthened, the overall scale of China's digital economy can lead the world in magnitude, and data informatization can be used as a kind of 'resource', and the interest drive brought by this 'resource' can positively affect the ESG performance of enterprises. Whether from their own or external evaluation, good ESG performance of enterprises can bring sustainable benefits to enterprises themselves and can improve the performance of enterprises from the aspects of financing conditions, management costs and supervision efficiency. It makes the enterprise's investment in digitalization more objectively reflected in a greener and more efficient rating performance and obtains sustainable advantages in the environment of enterprise investment competition. The environment of the overall development of enterprises lays a foundation for China to realize a new round of industrial revolution.

Secondly, we should attach importance to the practice of enterprise ESG. Although ESG performance is evaluated by external institutions, there is no unified and standard authoritative evaluation system at present. However, in order to maintain good economic benefits for enterprises, it is not only necessary to increase investment in digitalization. More importantly, we should pay attention to the in-depth implementation of the ESG concept in the environment, society and corporate governance in the process of enterprise operation, cultivate the concept of green development, actively undertake corporate social responsibility, and optimize corporate governance ability, so that ESG performance can bring positive impact from the inside, and also objectively reflect the operating results of enterprises from the internal reality.

Third, strengthen the social and government supervision of digital and ESG rating agencies. The supervision mechanism is not perfect in the current environment, and the imperfect supervision mechanism and legal protection mechanism are difficult to guarantee that the digital transformation of enterprises will promote the continuous and positive development of Chinese enterprises as expected. Therefore, the relevant regulatory authorities should improve the relevant laws and regulations in a timely manner and build an appropriate supervision mechanism so that digital, an emerging factor of production, can play its real role. At the same time, set appropriate intervals to guide the market, avoid excessive or too little intervention in the market, make it unable to play its role in resource allocation, use the market to transmit effective information, improve the depth of data mining, and reduce the waste and misuse of data resources caused by information asymmetry. Through the continuous improvement of the supervision system, build a win-win future of benign interaction among enterprises, society and the environment.

On the theoretical level, this paper enriches the research on the influencing factors of enterprise ESG performance and demonstrates that digital transformation is an important factor affecting enterprise ESG performance. The influence mechanism is explored, and the black box of the effect of digital transformation on ESG performance is opened. This paper further explores the network effect of digital transformation on the ESG performance of enterprises and analyzes the effect of digital transformation on the ESG performance of other enterprises in the network. In the field of management, this paper provides theoretical guidance for enterprises to use digital transformation to improve their ESG performance.

On the basis of this study, we will provide suggestions for Future Research:

Firstly, this paper is a typical large sample research paradigm, which reveals the impact of the overall digital transformation of enterprises on their ESG performance in the market, which can provide a more reliable theoretical basis for policy formulation, but

it can not provide detailed guidance for enterprises to implement digital transformation to improve ESG level, so it is urgent to supplement relevant case studies. Secondly, the sample sources of this paper are all Chinese enterprises, so it is impossible to provide a theoretical reference closer to the national conditions of enterprises in other countries in the world, so it is urgent to expand the sample range for research; finally, this paper can only provide evidence for 'science and technology to be good', which cannot be fully proved. Therefore, more evidence of social progress caused by scientific and technological progress is needed to provide a more realistic basis for this theory.

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