sustainability

MDPI

Article

Blockchain Technology and Corporate Performance: Empirical Evidence from Listed Companies in China

Jie Zhang and Chen Ruan *

School of Business, Hohai University, Nanjing 211100, China; zhangjie_jie@126.com
* Correspondence: ruanchen2000@126.com; Tel.: +86-157-6875-9755

Abstract: Blockchain technology is widely recognized and adopted by many organizations, as it serves as a fundamental technological infrastructure for the digital economy. This has led to a rapid acceleration of industrial transformation and digital innovation. This study employs empirical data from a substantial sample to investigate the potential applications, strategies, and advantages of blockchain technology. This paper examines A-share listed companies in China from 2015 to 2021, offering valuable empirical insights that demonstrate how the implementation of blockchain technology can markedly improve corporate performance in a major global economy. The research in this paper examines the differential effects of blockchain technology by innovatively integrating financial and environmental performance metrics into an empirical model, revealing that implementing blockchain technology significantly enhances environmental performance. Furthermore, it has been observed that blockchain technology adoption can contribute to corporate performance by improving information transparency. It is worth noting that blockchain technology's influence on enterprises' performance exhibits discernible variations based on the ownership structure, environmental sensitivity, and technical features of said enterprises. This paper can be used as a guide for enterprises looking to implement blockchain technology and for governments seeking to develop digitalization legislation.

Keywords: blockchain technology; financial performance; environmental performance; information transparency

check for updates

Citation: Zhang, J.; Ruan, C. Blockchain Technology and Corporate Performance: Empirical Evidence from Listed Companies in China. *Sustainability* **2024**, *16*, 9177. https://doi.org/10.3390/su16219177

Academic Editors: Gazi Murat Duman, Kamal P. Upadhyaya and Ahmet Ozkul

Received: 23 September 2024
Revised: 15 October 2024
Accepted: 18 October 2024
Published: 23 October 2024

Copyright: © 2024 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

1. Introduction

The rapid advancement of information technology has resulted in the significant influence of the Internet on society and daily life. However, it is essential to note that the digital transformation process is still ongoing. Despite the transformative impact of the Internet on the facilitation of data interconnection, ensuring the reliability of such data still needs to be explored. Blockchain technology has arisen in response to the backdrop described above. Blockchain is a decentralized system that combines several technologies, such as distributed networks, cryptography, and smart contracts. It possesses several notable characteristics, such as decentralized management, high reliability, anonymity, transparency, traceability, robustness, and the continuous availability of information [1–3]. When integrated and applied with relevant information technology, blockchain begins to emerge as a crucial digital infrastructure that enhances the quality and efficiency of the real economy and drives innovative development in the digital economy. It is crucial in building a data-focused digital economy and is becoming increasingly important in the current era of scientific and technological advancements and industrial changes.

Presently, prominent nations and regions worldwide are hastening the strategic arrangement of the next-generation Internet (Web3.0) founded on blockchain technology. They also persistently investigate novel scenarios and business models, creating fresh prospects for advancing blockchain technology, application, and industry. At a technical level, Public Blockchain and Consortium Blockchain continuously advance towards

increased scalability, improved performance, and enhanced security. Public Blockchain has emerged as a crucial foundation for global digital banking. The United States and Germany collectively host over 70% of the total number of Ethereum nodes. There are other prominent public chains, such as Polygon from India and Solana from Switzerland. Consortium Blockchain has also been developed at the regional level, establishing larger-scale blockchain infrastructures. The European Union's European Blockchain Service Infrastructure (EBSI), China's Block-chain-based Service Network (BSN), and ASTRON (Xinghuo BIF Global) are all expediting the development of blockchain infrastructures to cater to various regions.

Blockchain technology is a disruptive innovation capable of transforming traditional business structures [4,5], enabling organizations to progress substantially. It is extensively incorporated into multiple sectors of the real economy, into livelihood services, and into other fields at the application level. First, blockchain technology facilitates more secure online business transactions than conventional database systems. It employs cryptographic hashes assigned to each ledger to create a decentralized database system, diminishing the frequency of information security problems. For example, Morgan and Citibank have submitted patents for blockchain-based interbank payment systems that enable real-time processing of cross-border transactions, facilitating seamless information exchange between organizations while reducing the risk of fraud and data manipulation. Also, utilizing blockchain can enhance supply chains' adaptability and robustness, augmenting transparency and sustainability [6]. Leveraging this advantage, retail giant Walmart has been advancing food safety through blockchain technology to enhance transparency in the food supply chain, aiming to trace product origins. The pertinent information, including the food's origin and transportation parameters such as temperature and humidity with a timestamp, is retained by suppliers. Maersk, the world's preeminent shipping corporation, has collaborated with IBM to develop TradeLens, a blockchain-based global supply chain transportation platform that integrates all parties, facilitates information sharing, enhances transparency, and promotes innovation. Blockchain technology is steadily infiltrating thousands of industries, giving rise to numerous innovative applications and showcasing the gradual emergence of scale effects.

Currently, numerous scholars concentrate on applying blockchain technology in internal business process management and external supply chain management [7], while examining the opportunities and problems that its future extensive adoption may present [8–10]. Several studies integrate or juxtapose blockchain technology with emerging technologies like the Internet of Things and Cloud Services to evaluate the effects of these technological combinations on company management [11,12]. However, there are relatively few empirical studies on the blockchain, mainly because the blockchain is still at an exploratory stage. There are relatively few enterprises implementing blockchains. Additionally, the study of corporate performance has consistently been a significant research focus within the management discipline. Typically, previous research has assessed company performance based solely on financial indicators, such as return on assets (ROA), return on equity (ROE), Tobin's Q, or a combination of these indicators [13–16]. Within sustainable development, there is an increasing acknowledgment of the importance of non-economic factors in the advancement of businesses. Therefore, enterprise performance assessment should include more than just financial aspects, contingent upon accounting-based metrics, and should also emphasize the non-economic performance that upholds the enterprise, such as corporate social performance [17,18], ESG performance [19,20], and corporate sustainability [21,22].

Based on the study above, there is merit in further enhancing research on the deployment of blockchain technology and its influence on corporate performance. On the one hand, existing research mostly centers around the analysis of the technical aspects and the description of blockchain technology. Insufficient focus has been directed towards the mechanisms and impacts of blockchain technology in corporate governance, and more pertinent empirical research needs to be conducted for testing purposes. On the other hand, the impact of digital technology extends beyond economic value, encompassing environ-

mental benefits as well. Therefore, it is crucial to thoroughly investigate the correlation between blockchain technology and company performance across various performance metrics to determine potential mechanisms. This understanding is crucial for companies to achieve both economic and environmental benefits.

This study centers on Chinese A-share companies listed in Shanghai and Shenzhen between 2015 and 2021. It investigates the effects of implementing blockchain technology on these companies' financial and environmental performance. This study uses actual data and employs a dummy variable to determine whether or not the companies are affected by blockchain technology implementation in a given year. Additionally, this study explores the potential mediating role of information transparency. The present study encapsulates the critical advancements made in the field.

- This study utilizes empirical data from Chinese listed corporations to examine the potential applications, tactics, and benefits of blockchain technology. One notable benefit of Chinese data pertains to the positive measures undertaken by the Chinese government to support the strong growth of blockchain technology. Multiple companies have been gradually implementing blockchain technology. An ample amount of data exists for conducting empirical experiments, which aids in investigating the many variables and challenges associated with utilizing blockchain technology in virtual environments.
- This study comprehensively analyzes the effects of implementing blockchain technology on enterprise performance. It incorporates both financial and environmental performance measures into an empirical model and investigates the varying impacts of blockchain technology on these measures. This research enhances the current understanding of the relationship between blockchain technology and enterprise performance. It also offers potential practical strategies for organizations to enhance their financial and environmental performance by implementing blockchain technology.

This paper is structured as follows: Section 2 presents a literature review, Section 3 provides the theoretical analysis and hypothesis, Section 4 includes the model design and data, Section 5 describes the empirical results, and Section 6 discusses conclusions and implications.

2. Literature Review

The concept of blockchain was initially presented in 2008, prompting extensive scholarly research on the subject afterwards. Blockchain technology is a distributed ledger database designed to record and store digital data in blocks across multiple locations in the network connected via cryptography, thus establishing verifiable and permanent transaction records among parties [10,23]. The blockchain attains widespread consensus through workload proof or equity proof, allowing all members in the peer-to-peer network to access identical data [24]. The data are not easily alterable, and any falsification will result in subsequent modifications to all succeeding entries [25]. The unique consensus mechanism and compatible encryption algorithms of blockchain have progressively attracted attention in various fields.

Scholars are actively investigating ways to broaden the application breadth of blockchain based on findings regarding the underlying technology, aiming to address the prevailing and enduring issues in many industry sectors, as well as the challenges and hardships faced by the industry. Scholars have studied the use of blockchain in areas such as accounting and auditing [26,27], construction engineering [28], supply chain management [29,30], finance [31,32], tourism [33], and medicine [34], among others, demonstrating its potential for significant advancements in these fields. Currently, numerous industries are actively promoting the development of blockchain technology and its deep integration with the real economy. Given the characteristics of blockchain technology, including decentralized management, high reliability, transparency, traceability, and the continuous availability of information, its main applications in enterprises encompass supply chain tracking [35], intelligent transportation systems [36], product traceability and safety assurance [37],

digitization [38], information sharing [39], enhancing supply chain flexibility [40], optimizing bookkeeping methods in accounting [41], improving financial forecasting [42], and sustainable performance [43,44]. The utilization of blockchains in business processes has far-reaching consequences. As a result, numerous companies have tried to develop blockchain technology as a strategic instrument to enhance their earnings.

The benefits of blockchain can radically change business processes in organizations. However, the technology is still developing, and research studies have raised concerns around technological challenges during implementation, ethical issues, and security threats [45–47]. The realization of blockchain's consensus mechanism diminishes transaction confirmation speed, necessitates each node to retain additional redundant data, and incurs greater computing resource consumption due to the execution of generic code and the maintenance of a generic state [48]. In addition, being a quintessential blockchain application, smart contracts must anticipate all possibilities in advance and be encoded accordingly. The immutability of contract terms results in a lack of flexibility, complicating adaptation to the dynamic market and supply chain environment, and may also conflict with prevailing legal frameworks [49]. Moreover, blockchain technology cannot guarantee that the stored information is true and reliable; if the information input from the source is wrong, the information flow in the process will also be wrong [25].

Based on the review above, existing research mostly centers around the analysis of the technical aspects and the description of blockchain technology, intending to address fundamental inquiries such as the definition of blockchain technology and its practical applications. There is a need for more empirical research on the operational procedures of blockchain technology and its resultant implications. Financial performance is a crucial indicator of economic efficiency and profitability, and environmental performance denotes the efficacy of enterprises in terms of environmental conservation and social accountability. Since blockchain technology is presently in its nascent phase and has a higher level of uncertainty, a more accurate evaluation of its worth and efficacy can be achieved by evaluating how blockchain technology actually impacts business performance and through what channels this impact occurs.

3. Theoretical Analysis

3.1. Blockchain Technology and Corporate Financial Performance

The transaction cost theory offers a theoretical framework to examine the potential enhancements in business financial performance resulting from the implementation of blockchain technology. Corporations are required to allocate resources towards various costs associated with searching, negotiating, executing, regulating, and so on. Nevertheless, these costs frequently diminish transaction efficiency and accuracy, imposing constraints on the progress of economic ventures. Blockchain technology can automate internal operations and external supply chains, augment transparency, and improve transaction trust and dependability, thus decreasing transaction costs and providing economic advantages for enterprises.

Specifically, the decentralization and anonymity of blockchain technology will boost the standardization and transparency of business management procedures, decrease internal control costs, and optimize the allocation of human, material, and financial resources. Thus, these enhancements augment production and operational efficiency [3], ultimately resulting in effective organizational functioning and sustained economic benefits.

Moreover, blockchain's attributes regarding anti-counterfeiting, traceability, and information integrity enhance communication and information exchange among upstream and downstream supply chain entities, thereby diminishing information acquisition and external coordination expenses while preserving supply chain agility. Consequently, implementing blockchain technology will increase supply chain efficiency, improve synergistic capabilities, and ultimately bolster the financial performance of enterprises [50,51]. This paper suggests the following hypothesis based on the analyses provided above:

Hypothesis 1. *The adoption of blockchain technology has a positive effect on corporate financial performance.*

3.2. Blockchain Technology and Corporate Environmental Performance

From the standpoint of technological innovation, the use of blockchain, as an emerging digital technology, has the potential to enhance organizations' digital competencies. Blockchain facilitates enterprises in comprehensively understanding and managing their production and operational processes by utilizing information and data, enabling rational allocation of factors and resources, maximizing the positive spillover effects of digital technology, and establishing a significant advantage in the application of cleaner production technologies.

Secondly, blockchain supplants the conventional authoritative governance and emotional trust framework. Blockchain facilitates the advancement of environmental regulation instruments within organizations through its technical framework. It impacts numerous illicit operations, including environmental fraud and the manipulation of monitoring data. Consequently, it fosters the research and development of pollution control technologies, enhances the caliber of green technology innovation and energy utilization efficiency, bolsters the environmental protection capabilities and pollution control standards of enterprises, and serves as a crucial method for enterprises to attain energy conservation, emission reduction, and green transformation [52].

The advent of blockchain technology enhances the technological and external landscape for businesses to enable digital transformation. In response to escalating environmental requirements, companies are implementing blockchain technology to facilitate precise tracking of production and emission data. The unchangeable and decentralized characteristics of blockchain technology necessitate organizations to enhance their technical infrastructure, thus diminishing pollution emissions and the expenses associated with pollution management, which is anticipated to influence environmental performance positively. Based on the analyses presented, this paper proposes the following hypothesis:

Hypothesis 2. *The adoption of blockchain technology has a positive effect on corporate environmental performance.*

3.3. The Differential Impact of Blockchain Technology on Corporate Financial and Environmental Performance

The potential enhancement of economic efficiency in enterprises through blockchain technology is contingent upon the comparative magnitude of its influence on financial performance in relation to the associated implementation expenses and costs. The interplay between these factors determines the extent to which blockchain technology can augment the financial performance of enterprises, thereby imposing certain limitations. Currently, enterprises in China are in the initial phases of their digital transformation, necessitating significant financial backing. The elevated consumption cost may restrict the positive impact of emerging digital technologies, such as blockchain technology, on the financial performance of enterprises during the pre-digital transformation phase [53]. Implementing blockchain technology may have a limited impact on the environmental performance of firms, as shown in their financial statistics. However, the expenses associated with achieving positive environmental outcomes through blockchain technology are primarily represented in the financial performance of these enterprises. Therefore, Hypothesis 3 is proposed:

Hypothesis 3. *Compared to financial performance, the application of blockchain technology is more likely to contribute to the improvement of corporate environmental performance.*

4. Research Models and Variable Description

4.1. Research Models

The Hausman test results decisively disproved the original hypothesis of random effects, so this study uses a fixed-effects model for regression, with two-way fixing for individual and year. At the same time, standard errors under cluster robustness are used to reduce bias. Based on the theoretical research above, the following benchmark models have been created to examine the correlation between corporate performance and blockchain technology:

$$FP_{i,t} = \alpha_0 + \alpha_1 Blockchain_{i,t} + \alpha_2 Controls + \mu_i + \theta_t + \varepsilon_{i,t} \quad (1)$$

$$EP_{i,t} = \beta_0 + \beta_1 Blockchain_{i,t} + \beta_2 Controls + \mu_i + \theta_t + \delta_{i,t} \quad (2)$$

where $FP_{i,t}$ and $EP_{i,t}$ represent the financial and environmental performance of firm i in year t, respectively. $Blockchain_{i,t}$ describes whether firm i is affected by the implementation of blockchain technology in year t. Controls represents the set of control variables. μ_i and θ_t denote the individual and time fixed effects. $\varepsilon_{i,t}$ and $\delta_{i,t}$ are random error terms. α_0 and β_0 are constant terms. α_1 and β_1 are important coefficients indicating that blockchain adoption facilitates enterprises' financial and environmental performance if the coefficients are significantly positive.

4.2. Variable Definition

4.2.1. Dependent Variable

The corporate performance studied in this article includes both financial performance and environmental performance dimensions. The existing literature shows that financial performance can be measured using indicators such as ROA, ROE, Tobin's Q, and so on. In essence, Tobin's Q is the assessment of future profitability, long-term development trends, and potential for investment value increase by groups such as stakeholders and potential investors of the firm [54–56]. Blockchain technology provides firms with a sustained competitive advantage that improves their potential future earnings [51]. Therefore, this study uses Tobin's Q to measure corporate financial performance.

The measurement methods of environmental performance (EP) proposed in the existing literature can be broadly summarized as the evaluation system, pollution emission, and ecological benefit methods. Since there is a lack of an objective quantitative evaluation system and pollution emission data are unavailable, this paper draws on the connotation of the ecological benefit method to measure environmental performance. (The ecological benefit method is an indicator framework introduced by the World Business Council for Sustainable Development. It primarily assesses corporate environmental performance by quantifying the reduction in environmental impact resulting from the value of the company's products or services.) The measurement formula is

$$EP = \ln Growth / \ln ET \quad (3)$$

where the operating revenue (Growth) represents the value of products and services, and the environmental protection tax (ET) represents the environmental impact of enterprises. (This study employs a specific environmental protection tax as a metric for assessing the environmental tax. This tax was officially introduced in 2018 and was previously referred to as the pollutant discharge fee. Given that both environmental taxes and pollutant discharge fees are levied on the same entity, the environmental impact of firms is assessed by utilizing pollutant discharge fees from 2015 to 2017, while environmental tax data is employed for 2018 onwards.)

4.2.2. Independent Variable

This study examines whether the adoption of blockchain technology can positively impact corporate performance. The core variable of interest is blockchain technology

adoption, defined as the dummy variable. The first two years, the preceding year, the current year, and the year following the implementation of blockchain based on the time of measurement are the years related to the adoption, where the value is 1 and the value of the other years is 0 [57].

4.2.3. Control Variables

This paper focuses on how corporate information transparency influences the relationship between blockchain technology and corporate performance. Hence, variables that could impact corporate performance should be included in the models. In accordance with the relevant literature [58–60], the empirical analysis in this paper controls for variables including the number of employees (Staff), leverage ratio (Lev), growth rate of operating income (Growth), year of firm establishment (FirmAge), balanced concentrated ownership structure (Balance), board size (Board), and proportion of independent directors (Indep).

4.2.4. Mechanism Variable

In this paper, we measure corporate information transparency from five perspectives: earnings quality (DD), disclosure score (Dscore), number of analysts (Analyst), forecast accuracy (Accuracy), and Big4 audit (Big4). Then, we construct the variable Trans as a composite indicator of information transparency [61], which is the average value of the sample percentile rank of the above variables. The larger the Trans value, the higher the corporate information transparency. If one or more of the transparency variables of a listed company is missing, then Trans is the mean of the percentile ranks of the others.

Appendix A presents a summary of the important variables in this paper.

4.3. Data

4.3.1. Data Source

The data utilized to measure corporate environmental performance were gathered from the annual financial statements of listed companies. The corporate financial performance data, information transparency indicators, blockchain technology data, and related control variables used in the models were gathered from the China Stock Market & Accounting Research (CSMAR) database. All data used in this research are secondary and do not include information that can identify individuals. Therefore, this study is exempted from ethical approval. All continuous variables are subjected to bilateral winsorization at 1% to mitigate the impact of outliers. Data processing and analysis were performed using the software Stata 16.

4.3.2. Data Description

In 2016, the World Economic Forum listed "blockchain" as a disruptive technology that would lead the fourth industrial revolution. From then on, blockchain-related technologies showed a trend of explosive growth, and the blockchain technology industry entered a period of rapid development. Thus, choosing a panel data set of Chinese A-share companies listed in Shanghai and Shenzhen from 2015 to 2021 is reasonable. The data are processed in a certain manner to prevent any potential bias.

- Listed firms in financial sectors are excluded;
- Firms that have not been in continuous operation for more than four years are excluded;
- Firms with missing data and a non-normal trading status of ST and *ST are excluded.

Finally, there are 599 eligible listed firms with 2784 observations.

4.3.3. Descriptive Statistics

The descriptive statistics results for the primary variables are presented in Table 1. In this study, the dependent variable FP has a standard deviation of 1.128, suggesting some divergence in the profitability and value-added potential of different firms. Another dependent variable, EP, has a standard deviation of 2.867, showing that the environmental

performance of different enterprises varies significantly. The core explanatory variable blockchain has a mean value of 0.057 and a standard deviation of 0.233. These results indicate that the popularity of blockchain technology in China still needs to grow, and only a few listed companies have implemented blockchain technology. The mechanism variable Trans has a minimum value of 0.005 and a maximum value of 0.773, showing that a certain degree of information opacity still exists in China's listed companies and that this needs to be improved continuously. Furthermore, the standard deviations of all the control variables except Indep are around 1.000, with small fluctuations. The little disparity between the mean and median values of variables suggests a more uniform distribution among the sample enterprises.

Table 1. Descriptive statistics.

Variables	Obs	Mean	Std.Dev.	Min	Median	Max
FP	2784	1.800	1.128	0.811	1.423	6.930
EP	2784	9.846	2.867	4.264	9.547	16.718
Blockchain	2784	0.057	0.233	0.000	0.000	1.000
Trans	2784	0.335	0.184	0.005	0.338	0.773
Staff	2784	8.031	1.116	5.765	7.961	10.628
Lev	2784	0.427	0.186	0.071	0.420	0.865
Growth	2784	0.148	0.304	−0.442	0.096	1.657
FirmAge	2784	3.035	0.254	2.303	3.045	3.555
Balance	2784	0.729	0.613	0.024	0.550	2.846
Board	2784	2.133	0.197	1.609	2.197	2.708
Indep	2784	37.620	5.320	30.770	36.360	55.560

Notes: The definition and measurement of the mechanism variable Trans and the control variables including Staff, Lev, Growth, FirmAge, Balance, Board, and Indep are elaborated in Appendix A.

5. Empirical Analysis

5.1. Benchmark Analysis

The empirical results from the benchmark model are shown in Table 2. Model (1) and (3) present the regression results without control variables. Models (2) and (4) suggest that the coefficients of the independent variable Blockchain are both statistically significant at the 1% level when considering the firms' leading indicators, indicating that enterprises can improve financial and environmental performance after adopting blockchain technology. Thus, Hypothesis 1 and 2 are validated.

The regression coefficients are not standardized and cannot be directly used to compare the difference in the effect of blockchain technology adoption on corporate financial and environmental performance. After eliminating the differences in dimension and order of magnitude, the standardized regression coefficients show that the positive effect of blockchain technology adoption on financial performance ($\alpha_1 = 0.061$, $p < 0.01$) is smaller than the positive effect on environmental performance ($\beta_1 = 0.141$, $p < 0.01$), which indicates that compared with financial performance, the implementation of blockchain technology is more capable of enhancing corporate environmental performance; therefore, Hypothesis 3 is confirmed. At present, the majority of enterprises in China are still in the primary stage of digital transformation. The level of integration between blockchain and other digital technologies with traditional business practices needs to be improved, with this shortfall leading to a specific limitation on the enhancement of corporate financial performance. While blockchain technology's pathway for impacting enterprises' environmental performance is relatively shorter, its impact on environmental performance is more direct.

Table 2. The effect of blockchain technology on corporate performance.

	FP		EP	
	Model (1)	**Model (2)**	**Model (3)**	**Model (4)**
Blockchain		0.294 ***		1.738 ***
		(3.71)		(4.04)
Staff	−0.152 **	−0.146 *	0.409 ***	0.448 ***
	(−2.05)	(−1.96)	(3.12)	(3.46)
Lev	−0.561 **	−0.570 **	−1.325 ***	−1.381 ***
	(−2.27)	(−2.30)	(−3.12)	(−3.30)
Growth	0.191 ***	0.190 ***	0.327 ***	0.324 ***
	(3.32)	(3.31)	(3.10)	(3.07)
FirmAge	0.537	0.564	1.564	1.723
	(0.63)	(0.66)	(0.91)	(1.03)
Balance	0.071	0.072	0.098	0.103
	(0.71)	(0.72)	(0.79)	(0.83)
Board	−0.390 *	−0.414 *	−0.708	−0.852 *
	(−1.77)	(−1.89)	(−1.45)	(−1.83)
Indep	−0.008	−0.008	−0.008	−0.006
	(−1.35)	(−1.31)	(−0.57)	(−0.47)
Year FE	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
Obs	2784	2784	2784	2784
R^2	0.744	0.745	0.804	0.809

Notes: ***, **, and * denote 1%, 5%, and 10% significance levels, respectively; t-statistics are in parentheses.

5.2. Mechanism Analysis

Information asymmetry theory suggests that discrepancies in obtaining and understanding information exist across individuals or entities in market economic activities. The party possessing greater information resources tends to hold a favorable position in the transactional process due to its relative advantage. This advantage is derived from the ability to provide and disseminate reliable information to the party lacking sufficient information. Consequently, the party with incomplete information incurs potential losses in the market. Utilizing blockchain technology allows enterprises to establish extensive mechanisms for storing and sharing vast amounts of information, both internally and externally. Blockchain adoption has the potential to address the issue of information asymmetry, leading to increased information transparency. Consequently, it can facilitate the gradual alignment of resource utilization and allocation with optimal efficiency, thereby empowering enterprises to enhance their performance [62]. We therefore believe that information transparency can be a channel through which blockchain technology affects corporate performance behavior.

We aim to test if the adoption of blockchain technology could influence corporate performance via the intermediate step of information transparency. Mechanically, the indicator variable Trans is used to measure corporate information transparency in a linear regression set-up. We derive "first stage" estimates of the statistical effect of blockchain technology adoption on information transparency and "final stage" estimates of the effect of information transparency on corporate performance. The following models are constructed based on the benchmark models to estimate both steps of this chain.

$$\text{Trans}_{i,t} = \gamma_0 + \gamma_1 \text{Blockchain}_{i,t} + \gamma_2 \text{Controls} + \mu_i + \theta_t + \sigma_{i,t} \quad (4)$$

$$\text{FP}_{i,t} = \alpha_0' + \alpha_1' \text{Trans}_{i,t} + \alpha_2' \text{Controls} + \mu_i + \theta_t + \varepsilon_{i,t} \quad (5)$$

$$\text{EP}_{i,t} = \beta_0' + \beta_1' \text{Trans}_{i,t} + \beta_2' \text{Controls} + \mu i + \theta t + \delta i,t \quad (6)$$

Table 3 presents the results of the key coefficients γ_1, α_1', and β_1'. The Blockchain coefficient in Model (5) is statistically significant, suggesting that the adoption of blockchain technology contributes to firms' information transparency. Moreover, the coefficients of the

mechanism variable Trans are significantly positive at the 1% level, indicating that information transparency is an important channel through which blockchain technology affects corporate financial and environmental performance. In summation, the adoption of blockchain technology can improve corporate performance by enhancing information transparency.

Table 3. The effects of various channels on information transparency: two-step analysis.

	Trans	**FP**	**EP**
	Model (5)	**Model (6)**	**Model (7)**
Blockchain	0.055 ***		
	(3.19)		
Trans		1.026 ***	1.139 ***
		(7.39)	(3.56)
Staff	0.065 ***	−0.217 ***	0.337 **
	(6.46)	(−2.93)	(2.54)
Lev	−0.094 ***	−0.467 *	−1.221 ***
	(−2.78)	(−1.90)	(−2.88)
Growth	0.057 ***	0.133 **	0.263 **
	(6.58)	(2.32)	(2.47)
FirmAge	0.106	0.434	1.449
	(0.83)	(0.52)	(0.84)
Balance	0.021 **	0.050	0.075
	(1.97)	(0.50)	(0.60)
Board	−0.016	−0.378 *	−0.695
	(−0.49)	(−1.74)	(−1.42)
Indep	−0.001	−0.008	−0.007
	(−0.57)	(−1.28)	(−0.52)
Year FE	Y	Y	Y
Firm FE	Y	Y	Y
Obs	2784	2784	2784
R^2	0.747	0.751	0.805

Notes: ***, **, and * denote 1%, 5%, and 10% significance levels, respectively; t-statistics are in parentheses.

5.3. Heterogeneity Analysis

5.3.1. Enterprise Nature

China demonstrates significant differences between state-owned enterprises (SOEs) and non-SOEs regarding corporate objectives, management strategies, and financial institutions. Therefore, this study performs a group regression analysis by classifying the sample firms according to the characteristics of their property rights. This approach analyzes how property rights affect the correlation between blockchain technology and corporate performance.

Panel A of Table 4 shows the empirical results, suggesting that the adoption of blockchain technology by both SOEs and non-SOEs' favorably influences their financial and environmental performance. This impact is statistically significant at the 1% level, aligning with the outcomes of the benchmark regression analysis. After adjusting for standardization, it is discovered that the impact of implementing blockchain technology on the financial performance ($\theta = 0.059$, $p < 0.01$) and environmental performance ($\theta = 0.152$, $p < 0.01$) of non-SOEs is more significant than the impact on SOEs' financial performance ($\theta = 0.032$, $p < 0.01$) and environmental performance ($\theta = 0.143$, $p < 0.01$).

SOEs are responsible for promoting the economic and social progress of the nation. Their primary focus is not on maximizing short-term profits. Consequently, their motivation to improve market competitiveness and expand their presence in the market is not immediate. As a result, they tend to adopt a more cautious approach when formulating their digital transformation strategy, leading to slower progress in their digital transformation efforts. Non-SOEs are faced with limited support regarding financing constraints and tax incentives compared to SOEs. Additionally, they must contend with market competition if they fail to progress. However, the implementation of blockchain technology allows external institutional investors to have more access to internal information. This creates an

effective feedback loop in the capital market, encouraging non-SOEs to embrace blockchain technology to enhance core competitiveness, build a positive corporate image, and secure a significant market share, ultimately enhancing corporate performance significantly.

Table 4. Heterogeneity analysis results.

Panel A: Heterogeneity Based on Enterprise Ownership				
	FP		**EP**	
	SOE	**Non-SOE**	**SOE**	**Non-SOE**
	Model (8)	**Model (9)**	**Model (10)**	**Model (11)**
Blockchain	0.157 **	0.288 **	1.760 ***	1.871 ***
	(2.07)	(2.19)	(3.09)	(2.92)
Controls	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
Obs	1082	1689	1082	1689
R^2	0.759	0.756	0.810	0.787
Panel B: Heterogeneity Based on Industry Environmental Sensitivity				
	FP		**EP**	
	High Sensitivity	**Low Sensitivity**	**High Sensitivity**	**Low Sensitivity**
	Model (12)	**Model (13)**	**Model (14)**	**Model (15)**
Blockchain	0.246 ***	0.304 **	1.776 ***	1.743 ***
	(3.19)	(2.23)	(2.68)	(3.11)
Controls	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
Obs	1396	1379	1396	1379
R^2	0.726	0.754	0.767	0.796
Panel C: Heterogeneity Based on Technical Features of the Firm				
	FP		**EP**	
	High-Tech	**Non-High-Tech**	**High-Tech**	**Non-High-Tech**
	Model (16)	**Model (17)**	**Model (18)**	**Model (19)**
Blockchain	0.525 ***	0.057	1.684 ***	1.896 ***
	(3.58)	(0.89)	(2.83)	(2.98)
Controls	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
Obs	1661	1113	1661	1113
R^2	0.721	0.796	0.812	0.805

Notes: *** and ** denote 1% and 5% significance levels, respectively; t-statistics are in parentheses.

5.3.2. Environmental Sensitivity of the Enterprise

The effect of using blockchain technology on company performance may vary based on each company's pollution level. This article categorizes the sample firms into two categories, high environmentally sensitive industry and low environmentally sensitive industry firms, based on their affiliation with heavily polluting industries. (The heavily polluting industries are defined as B06, B07, B08, B09, C17, C19, C22, C25, C26, C28, C29, C30, C31, C32, and D44, according to the revised Guidelines for Industry Classification of Listed Companies by the China Securities Regulatory Commission in 2012 and the Management List of Industry Classification for Environmental Verification of Listed Companies issued by Ministry of Ecology and Environment). The objective is to examine the disparities between these groups thoroughly.

The empirical findings shown in Panel B indicate that companies in heavily polluting industries significantly improve their performance after implementing blockchain technology compared to non-heavily polluting industries. Environmental pollution has emerged as a prominent societal concern in recent years. Enterprises operating in heavily polluting industries are the main sources of pollution emissions. As a result, they are experiencing mounting pressure to fulfill their environmental obligations. Implementing blockchain technology can enhance the transparency of corporate data. This increased visibility, combined with market scrutiny and oversight from the public and other stakeholders, provides greater motivation for enterprises in heavily polluting industries to enhance their environmental performance. Consequently, this leads to overall improvements in environmental outcomes. Furthermore, enhancing information transparency partially undermines financial institutions' preconceived notions about heavily polluting enterprises. This can effectively mitigate the significant credit limitations that heavily polluting enterprises previously encountered and positively affect their financial performance.

5.3.3. Technical Features of the Enterprise

Variations exist in the timeframe for acceptance and the extent of deployment of blockchain technology across firms belonging to specific industry sectors. To conduct a more comprehensive analysis of the impact of blockchain technology on business performance, this research employs a group regression approach. The sample firms are categorized into high-tech and non-high-tech industries. (The high-tech industries are defined as C25, C26, C27, C28, C29, C31, C32, C34, C35, C36, C37, C38, C39, C40, C41, I63, I64, I65, and M73, according to the revised Guidelines for Industry Classification of Listed Companies by the China Securities Regulatory Commission in 2012.) This division allows for a deeper exploration of the heterogeneity of industry attributes.

The empirical results shown in Panel C demonstrate that the utilization of blockchain technology substantially and positively influences the overall performance of high-tech companies, encompassing both financial and non-financial aspects. Within the context of the non-high-tech industries sample group, blockchain technology primarily facilitates the enhancement of an enterprise's environmental performance. However, its influence on financial performance is shown to be relatively insignificant. In contrast, in cases where the firm operates within the high-tech industry, blockchain technology can improve both its financial and environmental performance significantly. From one perspective, high-tech enterprises prioritize scientific and technological innovation in their production and operations. Consequently, the utilization and advancement of blockchain and other digital technologies, considered cutting-edge in the contemporary era, become focal points of interest and investment for these enterprises. Conversely, the digital transformation process necessitates a robust basis of innovation to provide support. High-tech enterprises possess the capability to fulfill the necessary technical prerequisites for digital transformation and can adeptly integrate it within their organizational structure, decision-making system, and production processes.

Overall, the subjective inclination and objective circumstances of high-tech enterprises are vital in facilitating blockchain adoption and improving corporate performance during the digital transformation process. On the contrary, non-high-tech firms do not prioritize innovation as their development aim. Moreover, their decision-making orientation lacks the necessary acuity to comprehend and embrace digital transformation fully, and they therefore lack the fundamental prerequisites for a comprehensive digital transformation. Non-high-tech firms encompass various conventional industries, such as forestry, coal, and transportation. These industries exhibit a lower level of adoption and utilization of emerging digital technologies, such as blockchain, compared to high-tech enterprises. The capital market cannot extensively acknowledge and appreciate the limited innovation and transformation behaviors due to inadequate information-gathering capabilities and information disclosure channels. Consequently, this hinders the potential for significant improvements in company performance.

5.4. Robustness Tests

5.4.1. Using Alternative Dependent Variables

To enhance the robustness of the empirical results, this study adopts different indicators and methods to measure corporate performance. Firstly, the indicator ROA is used to replace the original Tobin's Q as a proxy variable for corporate financial performance. The results are presented in Model (20) of Table 5, where the independent variable Blockchain still significantly and positively affects corporate financial performance, with a regression coefficient of 0.013 ($p < 0.05$), which is consistent with the benchmark regression results in the previous section. Secondly, the SSI ESG Index is a new proxy variable for corporate environmental performance. The SSI ESG Index has nine grades from "AAA-C", according to which the environmental performance is assigned a value of 9-1. A higher score indicates better corporate environmental performance. The regression results are presented in Model (21); at this time, the coefficient of Blockchain is still positive at the 1% significance level, suggesting that implementing blockchain technology could enhance corporate environmental performance, which is consistent with the benchmark regression results.

Table 5. Robustness checks.

	Replace the Dependent Variables		**Replace the Regression Model**		**Propensity Score Matching**	
	FP	**EP**	**FP**	**EP**	**FP**	**EP**
	Model (20)	**Model (21)**	**Model (22)**	**Model (23)**	**Model (24)**	**Model (25)**
Blockchain	0.013 **	0.336 ***	0.294 ***	1.738 ***	0.289 ***	1.788 ***
	(2.12)	(2.81)	(3.21)	(8.61)	(3.54)	(4.01)
Controls	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
Obs	2784	2784	2784	2784	2615	2615
R^2	0.241	0.030	—	—	0.753	0.811

Notes: *** and ** denote 1% and 5% significance levels, respectively; t-statistics are in parentheses.

5.4.2. Replacing the Regression Model

The descriptive statistics of the original data show that the values of FP are located between [0, 7], while the values of EP are located between [4, 17]. Considering that the data of the dependent variables are all truncated within a specific range, this paper uses the panel Tobit model for further validation after controlling for year and individual fixed effects, and the results are shown in Models (22) and (23). The independent variable Blockchain significantly and positively affects corporate performance, and the impact on environmental performance is still more significant than the impact on financial performance, consistent with the benchmark regression results.

5.4.3. After Propensity Score Matching

The initial conditions of the listed companies whether or not they implement blockchain are not the same, leading to the problem of sample selection bias. In order to avoid the problem of endogeneity, this study adopts the propensity score matching method (PSM) to expand sample capacity and enhance the effectiveness of the sample analysis. The control variables are used as covariates to calculate the propensity scores, and the one-to-one caliper nearest neighbor matching method is used to select the samples with similar propensity matching values that have not applied blockchain technology. Models (24) and (25) provide the results of a regression of the matched samples, and the coefficient of Blockchain is also significantly positive, suggesting that enterprises can improve their financial performance and environmental performance after applying blockchain technology, which is consistent with the conclusions above.

6. Conclusions

The growing importance of the digital economy has led to the steady integration of digital transformation in traditional sectors. Since its emergence in China in 2016, blockchain technology has made significant progress and has been successfully applied in various domains such as finance, depository systems, and e-government. The integration of enterprise and digitalization is a key factor in China's innovation-driven development strategy.

This paper analyzes the effects of adopting blockchain technology on the performance of A-share listed companies in China using panel data from 2015 to 2021. The benchmark research findings indicate that blockchain technology positively affects corporate performance, with a powerful influence on environmental performance. In addition, the mechanism analysis suggests that information transparency plays an intermediary role in the positive relationship between blockchain technology and corporate performance. Furthermore, the results of the heterogeneity analysis suggest that the adoption of blockchain technology could lead to greater advantages and improved performance, especially for non-state-owned, heavily polluting, and high-tech firms.

6.1. Theoretical Contributions

This paper suggests the following theoretical implications based on the conclusions. First, past studies have primarily considered the business process modelling and technology design process of a blockchain-based solution. This study contributes to the blockchain literature by examining the correlation between blockchain adoption and business performance based on transaction cost theory and a technological innovation view, enriching the empirical research on the implementation effect of blockchain. Second, this study integrated the other contributions and proposed a standard model to explore the mechanisms of influence of blockchain technology on enterprise performance. Specifically, implementing blockchain effectively solves the problem of information asymmetry, leading to increased information transparency. This article deeply analyzed the channel mechanisms by which information transparency mediates the relationship between blockchain technology and firm performance.

6.2. Managerial Implications

6.2.1. Government Macro-Control Level

Since blockchain technology implementation may entail substantial initial expenditures and infrastructure investments, governments should systematically enhance digital infrastructure, promote regional digitization and informatization, and consistently augment financial assistance for enterprises, particularly small and medium-sized enterprises, to adopt blockchain technology. Moreover, this study indicates that the limited adoption of blockchain technology by listed companies necessitates a greater emphasis on policy advocacy and educational initiatives to facilitate its integration, to enable firms to fully leverage their operational benefits, and to receive guidance on mitigating the unforeseen risks linked to this emerging technology. Specifically, there should be enhanced support for state-owned organizations to facilitate the harmonized advancement of digital transformation within the business sector. Additionally, research has shown that the beneficial impact of blockchain technology adoption is more pronounced in environmentally sensitive and high-tech firms. Consequently, the government might refine digitization policies to concentrate on low environmentally sensitive and non-high-tech enterprises to promote the adoption of blockchain technology.

6.2.2. Micro-Enterprise Level

To remain competitive in the face of digitization and evolving infrastructure, it is crucial for listed companies to fully embrace digital transformation opportunities. A crucial method for accomplishing this is the proactive implementation of blockchain technology, a substantial driver of innovation. Second, it is essential to incorporate the deployment of blockchain technology into the comprehensive strategic framework of enterprises to

guarantee sustained success. Our research illustrates that adopting blockchain technology allows non-state-owned, heavily polluting, and high-tech enterprises to attain concurrent enhancements in performance. It advises firms to concentrate on resource accumulation and enhancing resource use efficiency during operations. Additionally, it recommends that organizations establish a digital transformation strategy that is flexible and customized to their existing growth phase and operational conditions. Third, achieving a harmonious equilibrium between enhancing financial and environmental performance is imperative. In the phase of advanced economic development, enterprises must accelerate their research into and development of green technologies while actively seeking innovation to achieve a sustainable competitive advantage.

6.3. Limitations and Future Research

Given that the adoption of blockchain technology is now in its nascent phase, it is important to note that the sample size and duration of the study discussed in this work are limited. Consequently, there is a need for future research to enhance the richness of panel data in order to provide more comprehensive insights.

Author Contributions: Funding acquisition, Resources, Writing—review and editing, J.Z.; Data curation, Software, Writing—original draft, C.R. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the National Social Science Fund of China, grant number 20BGL196.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data that have been used are confidential.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Table A1. Variable definitions.

Role	Variable	Definition	Measurement
Dependent variables	FP	Corporate financial performance	The ratio of total market value of equity to total book value
	EP	Corporate environmental performance	The logarithm of operating revenue/the logarithm of environmental protection tax
Independent variable	Blockchain	Blockchain technology	This dummy variable equals 1 in the years related to the implementation; otherwise, it is 0
Control variables	Staff	Number of employees	The logarithm of the number of employees
	Lev	Leverage ratio	The ratio of total liabilities to total assets
	Growth	Growth rate of operating income	Operating income in the current year/operating income in the previous year—1
	FirmAge	Year of firm establishment	The logarithm of firm's age since establishing
	Balance	Balanced concentrated ownership structure	The shareholding ratio of the 2nd–5th shareholder/the shareholding ratio of the 1st shareholder
	Board	Board size	The logarithm of the number of board members
	Indep	Percentage of independent directors	Number of independent board members/total number of board of directors

Table A1. *Cont.*

Role	Variable	Definition	Measurement
Mechanism variable	Trans	Earnings quality (DD)	The discretionary accrual according to the DD Model proposed by Dechow and Dichev
		Disclosure score (Dscore)	Dscore was assigned values of 4, 3, 2, and 1 according to the four grades of enterprise information disclosure quality disclosed on the official website of the Shenzhen Stock Exchange
		Number of analysts (Analyst)	The number of analysts forecasting current year earnings
		Forecast accuracy (Accuracy)	The extent to which analysts were able to forecast earnings for a given magnitude of earnings surprise and bias
		Big4 audit (Big4)	Include a firm year-specific indicator variable if a firm's auditor is affiliated with a Big4 audit

References

1. Babich, V.; Hilary, G. OM Forum—Distributed ledgers and operations: What operations management researchers should know about blockchain technology. *Manuf. Serv. Oper. Manag.* **2020**, *22*, 223–240. [CrossRef]
2. Wamba, S.F.; Queiroz, M.M.; Trinchera, L. Dynamics between blockchain adoption determinants and supply chain performance: An empirical investigation. *Int. J. Prod. Econ.* **2020**, *229*, 107791. [CrossRef]
3. Wang, H.; Yang, G.; Ouyang, X.; Qin, J. Does central environmental inspection improves enterprise total factor productivity? The mediating effect of management efficiency and technological innovation. *Environ. Sci. Pollut. Res.* **2021**, *28*, 21950–21963. [CrossRef] [PubMed]
4. Marikyan, D.; Papagiannidis, S.; Rana, O.F.; Ranjan, R. Blockchain: A business model innovation analysis. *Digit. Bus.* **2022**, *2*, 100033. [CrossRef]
5. Frizzo-Barker, J.; Chow-White, P.A.; Adams, P.R.; Mentanko, J.; Ha, D.; Green, S. Blockchain as a disruptive technology for business: A systematic review. *Int. J. Inf. Manag.* **2020**, *51*, 102029. [CrossRef]
6. Bai, C.; Sarkis, J. A supply chain transparency and sustainability technology appraisal model for blockchain technology. *Int. J. Prod. Res.* **2020**, *58*, 2142–2162. [CrossRef]
7. Wu, H.; Li, Z.; King, B.; Ben Miled, Z.; Wassick, J.; Tazelaar, J. A distributed ledger for supply chain physical distribution visibility. *Information* **2017**, *8*, 137. [CrossRef]
8. Saberi, S.; Kouhizadeh, M.; Sarkis, J.; Shen, L. Blockchain technology and its relationships to sustainable supply chain management. *Int. J. Prod. Res.* **2019**, *57*, 2117–2135. [CrossRef]
9. Venkatesh, V.G.; Kang, K.; Wang, B.; Zhong, R.Y.; Zhang, A. System architecture for blockchain based transparency of supply chain social sustainability. *Robot. Comput.-Integr. Manuf.* **2020**, *63*, 101896. [CrossRef]
10. Treiblmaier, H. The impact of the blockchain on the supply chain: A theory-based research framework and a call for action. *Supply Chain Manag. Int. J.* **2018**, *23*, 545–559. [CrossRef]
11. Zhang, Y.; Wen, J. The IoT electric business model: Using blockchain technology for the internet of things. *Peer-to-Peer Netw. Appl.* **2017**, *10*, 983–994. [CrossRef]
12. Rimba, P.; Tran, A.B.; Weber, I.; Staples, M.; Ponomarev, A.; Xu, X. Quantifying the cost of distrust: Comparing blockchain and cloud services for business process execution. *Inf. Syst. Front.* **2020**, *22*, 489–507. [CrossRef]
13. Damert, M.; Paul, A.; Baumgartner, R.J. Exploring the determinants and long-term performance outcomes of corporate carbon strategies. *J. Clean. Prod.* **2017**, *160*, 123–138. [CrossRef]
14. Khan, A.; Afeef, M.; Ilyas, M.; Jan, S. Does CSR committee drive the association between corporate social responsibility and firm performance? International evidence. *Manag. Financ.* **2023**, *50*, 50–74. [CrossRef]
15. Naseem, T.; Shahzad, F.; Asim, G.A.; Rehman, I.U.; Nawaz, F. Corporate social responsibility engagement and firm performance in Asia Pacific: The role of enterprise risk management. *Corp. Soc. Responsib. Environ. Manag.* **2020**, *27*, 501–513. [CrossRef]
16. Radu, C.; Smaili, N. Corporate performance patterns of Canadian listed firms: Balancing financial and corporate social responsibility outcomes. *Bus. Strategy Environ.* **2021**, *30*, 3344–3359. [CrossRef]
17. Kwong, C.; Bhattarai, C.R.; Bhandari, M.P.; Cheung, C.W.M. Does social performance contribute to economic performance of social enterprises? The role of social enterprise reputation building. *Int. J. Entrep. Behav. Res.* **2023**, *29*, 1906–1926. [CrossRef]
18. Robles-Elorza, D.; San-Jose, L.; Urionabarrenetxea, S. Deep-diving into the relationship between Corporate Social Performance and Corporate Financial Performance—A comprehensive investigation of previous research. *Eur. Res. Manag. Bus. Econ.* **2023**, *29*, 100209. [CrossRef]
19. DasGupta, R. Financial performance shortfall, ESG controversies, and ESG performance: Evidence from firms around the world. *Financ. Res. Lett.* **2022**, *46*, 102487. [CrossRef]
20. Wang, S.; Esperança, J.P. Can digital transformation improve market and ESG performance? Evidence from Chinese SMEs. *J. Clean. Prod.* **2023**, *419*, 137980. [CrossRef]

21. Jadoon, I.A.; Ali, A.; Ayub, U.; Tahir, M.; Mumtaz, R. The impact of sustainability reporting quality on the value relevance of corporate sustainability performance. *Sustain. Dev.* **2021**, *29*, 155–175. [CrossRef]
22. Yasin, R.; Huseynova, A.; Atif, M. Green human resource management, a gateway to employer branding: Mediating role of corporate environmental sustainability and corporate social sustainability. *Corp. Soc. Responsib. Environ. Manag.* **2023**, *30*, 369–383. [CrossRef]
23. Albayati, H.; Kim, S.K.; Rho, J.J. Accepting financial transactions using blockchain technology and cryptocurrency: A customer perspective approach. *Technol. Soc.* **2020**, *62*, 101320. [CrossRef]
24. O'Dair, M.; Beaven, Z. The networked record industry: How blockchain technology could transform the record industry. *Strateg. Change* **2017**, *26*, 471–480. [CrossRef]
25. Biswas, B.; Gupta, R. Analysis of barriers to implement blockchain in industry and service sectors. *Comput. Ind. Eng.* **2019**, *136*, 225–241. [CrossRef]
26. ALSaqa, Z.H.; Hussein, A.I.; Mahmood, S.M. The impact of blockchain on accounting information systems. *J. Inf. Technol. Manag.* **2019**, *11*, 62–80. [CrossRef]
27. Bonsón, E.; Bednárová, M. Blockchain and its implications for accounting and auditing. *Meditari Account. Res.* **2019**, *27*, 725–740. [CrossRef]
28. Mahmudnia, D.; Arashpour, M.; Yang, R. Blockchain in construction management: Applications, advantages and limitations. *Autom. Constr.* **2022**, *140*, 104379. [CrossRef]
29. Kshetri, N. 1 Blockchain's roles in meeting key supply chain management objectives. *Int. J. Inf. Manag.* **2018**, *39*, 80–89. [CrossRef]
30. Khan, S.A.R.; Godil, D.I.; Jabbour, C.J.C.; Shujaat, S.; Razzaq, A.; Yu, Z. Green data analytics, blockchain technology for sustainable development, and sustainable supply chain practices: Evidence from small and medium enterprises. *Ann. Oper. Res.* **2021**, 1–25. [CrossRef]
31. Kowalski, M.; Lee, Z.W.Y.; Chan, T.K.H. Blockchain technology and trust relationships in trade finance. *Technol. Forecast. Soc. Change* **2021**, *166*, 120641. [CrossRef]
32. Osmani, M.; El-Haddadeh, R.; Hindi, N.; Janssen, M.; Weerakkody, V. Blockchain for next generation services in banking and finance: Cost, benefit, risk and opportunity analysis. *J. Enterp. Inf. Manag.* **2020**, *34*, 884–899. [CrossRef]
33. Rashideh, W. Blockchain technology framework: Current and future perspectives for the tourism industry. *Tour. Manag.* **2020**, *80*, 104125. [CrossRef]
34. Radanović, I.; Likić, R. Opportunities for use of blockchain technology in medicine. *Appl. Health Econ. Health Policy* **2018**, *16*, 583–590. [CrossRef]
35. Cole, R.; Stevenson, M.; Aitken, J. Blockchain technology: Implications for operations and supply chain management. *Supply Chain Manag. Int. J.* **2019**, *24*, 469–483. [CrossRef]
36. Hasan, H.; AlHadhrami, E.; AlDhaheri, A.; Salah, K.; Jayaraman, R. Smart contract-based approach for efficient shipment management. *Comput. Ind. Eng.* **2019**, *136*, 149–159. [CrossRef]
37. Hamilton, M. Blockchain distributed ledger technology: An introduction and focus on smart contracts. *J. Corp. Account. Financ.* **2020**, *31*, 7–12. [CrossRef]
38. Choi, T.M. Blockchain-technology-supported platforms for diamond authentication and certification in luxury supply chains. *Transp. Res. Part E Logist. Transp. Rev.* **2019**, *128*, 17–29. [CrossRef]
39. Yang, C.S. Maritime shipping digitalization: Blockchain-based technology applications, future improvements, and intention to use. *Transp. Res. Part E Logist. Transp. Rev.* **2019**, *131*, 108–117. [CrossRef]
40. Chang, S.E.; Chen, Y.C.; Lu, M.F. Supply chain re-engineering using blockchain technology: A case of smart contract based tracking process. *Technol. Forecast. Soc. Change* **2019**, *144*, 1–11. [CrossRef]
41. Kurpjuweit, S.; Schmidt, C.G.; Klöckner, M.; Wagner, S.M. Blockchain in additive manufacturing and its impact on supply chains. *J. Bus. Logist.* **2021**, *42*, 46–70. [CrossRef]
42. Carlin, T. Blockchain and the journey beyond double entry. *Aust. Account. Rev.* **2019**, *29*, 305–311. [CrossRef]
43. Tan, B.S.; Low, K.Y. Blockchain as the database engine in the accounting system. *Aust. Account. Rev.* **2019**, *29*, 312–318. [CrossRef]
44. Kamble, S.S.; Gunasekaran, A.; Gawankar, S.A. Achieving sustainable performance in a data-driven agriculture supply chain: A review for research and applications. *Int. J. Prod. Econ.* **2020**, *219*, 179–194. [CrossRef]
45. Fotaki, M.; Voudouris, I.; Lioukas, S.; Zyglidopoulos, S. More accountable, more ethical, yet less trusted: Misplaced corporate governance in the era of big data. *Br. J. Manag.* **2021**, *32*, 947–968. [CrossRef]
46. Kumar, V.; Ramachandran, D.; Kumar, B. Influence of new-age technologies on marketing: A research agenda. *J. Bus. Res.* **2021**, *125*, 864–877. [CrossRef]
47. Yli-Huumo, J.; Ko, D.; Choi, S.; Park, S.; Smolander, K. Where is current research on blockchain technology?—A systematic review. *PLoS ONE* **2016**, *11*, e0163477. [CrossRef]
48. Chiu, J.; Koeppl, T.V. Blockchain-based settlement for asset trading. *Rev. Financ. Stud.* **2019**, *32*, 1716–1753. [CrossRef]
49. Khan, S.N.; Loukil, F.; Ghedira-Guegan, C.; Benkhelifa, E.; Bani-Hani, A. Blockchain smart contracts: Applications, challenges, and future trends. *Peer-to-Peer Netw. Appl.* **2021**, *14*, 2901–2925. [CrossRef]
50. Wang, H.; Feng, J.; Zhang, H.; Li, X. The effect of digital transformation strategy on performance: The moderating role of cognitive conflict. *Int. J. Confl. Manag.* **2020**, *31*, 441–462. [CrossRef]

51. Sheel, A.; Nath, V. Effect of blockchain technology adoption on supply chain adaptability, agility, alignment and performance. *Manag. Res. Rev.* **2019**, *42*, 1353–1374. [CrossRef]
52. Acemoglu, D.; Aghion, P.; Bursztyn, L.; Hemous, D. The environment and directed technical change. *Am. Econ. Rev.* **2012**, *102*, 131–166. [CrossRef] [PubMed]
53. Lu, L.W.; Taylor, M.E. A study of the relationships among environmental performance, environmental disclosure, and financial performance. *Asian Rev. Account.* **2018**, *26*, 107–130. [CrossRef]
54. Tobin, J. A general equilibrium approach to monetary theory. *J. Money Credit Bank.* **1969**, *1*, 15–29. [CrossRef]
55. Chung, K.H.; Pruitt, S.W. A simple approximation of Tobin's q. *Financ. Manag.* **1994**, *23*, 70–74. [CrossRef]
56. Flammer, C.; Kacperczyk, A. Corporate social responsibility as a defense against knowledge spillovers: Evidence from the inevitable disclosure doctrine. *Strateg. Manag. J.* **2019**, *40*, 1243–1267. [CrossRef]
57. Pan, X.; Pan, X.; Song, M.; Ai, B.; Ming, Y. Blockchain technology and enterprise operational capabilities: An empirical test. *Int. J. Inf. Manag.* **2020**, *52*, 101946. [CrossRef]
58. Tseng, F.M.; Liang, C.W.; Nguyen, N.B. Blockchain technology adoption and business performance in large enterprises: A comparison of the United States and China. *Technol. Soc.* **2023**, *73*, 102230. [CrossRef]
59. Li, R.; Wan, Y. Analysis of the negative relationship between blockchain application and corporate performance. *Mob. Inf. Syst.* **2021**, *2021*, 9912241. [CrossRef]
60. Ren, X.; Zeng, G.; Sun, X. The peer effect of digital transformation and corporate environmental performance: Empirical evidence from listed companies in China. *Econ. Model.* **2023**, *128*, 106515. [CrossRef]
61. Lang, M.; Lins, K.V.; Maffett, M. Transparency, liquidity, and valuation: International evidence on when transparency matters most. *J. Account. Res.* **2012**, *50*, 729–774. [CrossRef]
62. Martinez, V.; Zhao, M.; Blujdea, C.; Han, X.; Neely, A.; Albores, P. Blockchain-driven customer order management. *Int. J. Oper. Prod. Manag.* **2019**, *39*, 993–1022. [CrossRef]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.