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Digital Transformation of Value Chains and CSR Performance

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Abstract: With the accelerated evolution of the digital transformation of economic activities, the digitalization of the different parts of the value chain, such as manufacturing, marketing, and management, has increased significantly, thereby changing the form of organizational production management while affecting how corporate social responsibility (CSR) is achieved. Therefore, in this study, we examined the relationship between the digital transformation of value chains and CSR performance and the moderating role of property ownership and market dependence. The results show that the digital transformation of value chains can improve CSR performance. When the three types of digital transformation are conducted at the same time, compared with digital manufacturing transformation and digital marketing transformation, digital management transformation has a greater impact on CSR performance. Non-state-owned enterprises and enterprises with higher market dependency show greater improvement in their CSR performance than state-owned enterprises and enterprises with lower market dependency as a result of the digital transformation of value chains. Furthermore, we found a certain degree of value mismatch between the digital transformation of the different value chain links of enterprises and the different dimensions of social responsibility. Specifically, the digital transformations of manufacturing, marketing, and management activities only exert a significant impact on shareholder responsibility, public responsibility, and shareholder and employee responsibility, respectively. This result indicates that the digital transformation of the entire value chain needs to be further optimized and integrated to achieve social responsibility values that match the value chain. This study not only helps enterprises identify the shortcomings in the digital transformation of the value chain but also provides development ideas for enterprises to realize the two-wheel drive of business value and social value through the digital transformation of the whole value chain.

Keywords: digital transformation of value chains; social responsibility performance; property ownership; market dependence

1. Introduction

The digital economy has become an important global resource element and the main direction of international competition. The outbreak and continuation of the COVID-19 epidemic further accelerates the process of digitalization, and the digital transformation has become a vital strategy for enterprises. Digital technologies are profoundly changing the organizational forms and business models of enterprises [1]; advancing the digitization of the production, procurement, marketing, and management processes in value chains [2]; driving the vertical and deep digital transformation of enterprises; and reconfiguring how enterprises create value [3–5]. Digital transformation refers to how companies integrate stakeholders, data, processes, and models to achieve value creation [6]. It enables companies to gain and maintain competitive advantage in an increasingly competitive digital environment [7] and achieve a rapid recovery from the COVID-19 epidemic [8]. The success of digital transformation stems from the profound insights into the awakening and value pursuit of corporate green innovation [9], social mission [10], and stakeholderism [1] in an era when business is to increase social value. Meanwhile, corporate social responsibility

(CSR) requires companies to pay attention to other stakeholders besides shareholders [11]. Thus, the digital transformation is closely related to CSR.

Value chain management organically integrates the value creation activities within the enterprise, while digital transformation profoundly changes the value creation activities of an enterprise. For example, digital manufacturing, as a basic activity in the enterprise value chain, drives enterprise production management toward intelligence [12], changes how production is organized [13], optimizes productional and operational efficiency [12,14], and promotes the matching of environmental innovation with market demand [15]. Digital marketing drives enterprise marketing management toward precision [16], reshapes the mechanism and space of value interaction between enterprises and customers, and enhances customer stickiness [17]. Digital management in the value chain drives enterprise resource management to become efficient [18]; gives the enterprise comprehensive and systematic support at the organizational, operational, and strategic levels [19]; and helps the enterprise to achieve its economic mission while undertaking its social mission for its stakeholders (e.g., employees, suppliers, customers, consumers, and the government) and promoting the evolution of shareholderism to stakeholderism. Therefore, from the perspective of stakeholders, the digital transformation of value chains may be an effective way to promote CSR performance.

In the business practice of enterprises, the degree of digital transformation in the different parts of the enterprise value chain varies in terms of cost, benefit, and ease of transformation. Moreover, enterprises generally face the development dilemma in which business systems, such as research and development (R&D), management, production, marketing, and services, are not integrated. Additionally, there exist many breakpoints in data circulation, and key information cannot be efficiently collaborated. These challenges restrict the value creation of digital technology. It is of great importance for enterprises to efficiently coordinate and integrate these value chain links in order to realize the two-wheel drive of business value and social value through the digital transformation. Although the existing literature has demonstrated the positive impact of digital transformation on CSR performance [1,20–23], digital transformation has not been anchored in specific value chain links, and the unique value for stakeholders created by combining digitalization with core value-creating activities has yet to be elucidated. Therefore, it is necessary to study the impact of the digital transformation of value chains on CSR to compensate for the shortage of existing studies.

Using a sample of Chinese A-share listed companies from 2010 to 2020, we empirically investigated the impact of the digital transformation of value chains on CSR performance. We conducted this study using China as the background for the following reasons. The Chinese government has been attaching great importance to the digital economy strategy, and according to the China Information and Communication Research Institute, China's digital economy reached USD 7.1 trillion in 2021, accounting for 39.8% of GDP, making it the second-largest digital economy in the world. Since the COVID-19 epidemic, digitalization has played an important role for China in promoting residents' consumption, ensuring social stability, helping enterprises resume work and production, and optimizing government governance, creating a situation in which all people share the dividends of digital economy development [8]. This has also prompted companies to actively implement digital transformation strategies while effectively fulfilling their social responsibilities to meet the demands of the country and stakeholders. Therefore, the Chinese market provides an ideal scenario to test the role of the digital transformation of value chains in CSR performance, which will also provide a useful reference for other developing countries.

This study offers the following important contributions. First, a value chain perspective unveils the "black box" of the impact of digital transformation on CSR. The existing studies have the viewpoint that the digital transformation of enterprises is the organic integration of digital technology and physical elements [5,14]. Related work only focuses on the positive effects of digital transformation on CSR performance [1,20–23] and does not embed digitalization into the value creation activity. What really works is the digitalization

of each business link and operation level and the effective integration of the whole value chain system in the digitalization process. In this study, we found that digital transformation embedded in value chain activities transforms the demands of stakeholders into value creation activities, so as to improve the ability of enterprises to undertake more CSR, which put forward the idea of synergic digital transformation of enterprises value chains. Second, this study enriches the related studies on digital transformation and CSR. Existing research has focused on the moderating role of corporate governance [23]; this study examines the moderating role of property rights and market dependence based on the willingness of companies to fulfill their social responsibility. In this way, it broadens the research on the impact of digital transformation on CSR performance under different institutional environments and corporate resource conditions. Third, this study helps to identify the problem of value mismatch between the digitalization of different value chain links and the social responsibility performance in different dimensions. This finding indicates that the digital transformation of the value chain links of enterprises needs to be further optimized and integrated to achieve social responsibility values that match the value chain.

The rest of this paper is organized as follows: Section 2 explains the theoretical analysis and research hypotheses. Section 3 describes the empirical design. Section 4 provides the analysis and discussion of the empirical results. Section 5 presents further research. Finally, Section 6 presents the conclusion and discussion.

2. Theoretical Analysis and Research Hypothesis

2.1. Digital Transformation of the Value Chain and CSR Performance

Corporate social responsibility (CSR) is outsiders' expectation of organizations, which is reflected in the economic, legal, ethical, and philanthropic responsibilities of enterprises [24]. Dodd [25] argues that enterprises have responsibilities to shareholders and other stakeholders, i.e., corporate social responsibility, from the perspective of the many stakeholders they involve. The stakeholders of enterprises mainly include shareholders, consumers, customers, suppliers, government, and the public, all of whom have the right to demand the interests of enterprises and to monitor the performance of CSR [26]. CSR performance is the external judgement on CSR behavior, which is an observable organizational outcome [27] influenced by the actual level of CSR and the transmit efficiency to the outside world.

Digital transformation has an important impact on the internal and external social responsibility performance. The impact of digital transformation on internal CSR mainly refers to shareholders' value and employee responsibility. In terms of shareholders' value, digital transformation can innovate business models [1,28], restructure corporate value chains [4], improve innovation [29], ease financial pressure [30,31], improve organizational operational efficiency [14] and financial performance [5], and help companies achieve higher reputation and industry status [19], as well as create lower labor costs [1]. In terms of employees' responsibility, digital transformation can improve workplace safety, increase working efficiency, and reduce working stress, but it also increases employees' anxiety of being replaced by machines, which may cause employees' resistance to digitalization [13].

The impact of digital transformation on external corporate social responsibility is mainly seen in the areas of customer, supplier, environmental, and public responsibility. Firstly, in terms of customer and supplier rights and responsibilities, digital transformation enables companies to efficiently access, store, and share real-time information about customers, suppliers, distributors, and other business participants [32,33]; better communicate and interact with customers and external partners [34]; more sensitively capture stakeholder expectations; and mobilize resources and provide customized production [35] to meet customer needs and improve customer satisfaction [36]. However, at the same time, digitization has given rise to a digital surveillance economy [37], in which users are induced and bribed to provide their personal data to marketers at minimal cost [38], which is used to target advertising and manipulate consumer behavior and poses a threat in terms of forced purchasing, net price increases, discriminatory sales, wrong data decision

making, etc. [39]. In addition, digitalization disrupts traditional value chains and forces traditional manufacturers to provide smart, connected products and services, which leads to the fragmentation and instability of network relationships [4]. Secondly, in terms of environmental responsibility, digital transformation enhances the productive capacity of companies to achieve sustainable development [40], promotes green practices [41] and higher levels of green innovation [42] by influencing eco-innovation and green diversification, and helps stakeholders understand the willingness and actions of companies in environmental governance to improve their environmental performance [43]. Finally, in terms of public responsibility, digital transformation helps governments to accurately provide public services, enhance social communication, assist in governance, improve urban governance performance [8], and build a more resilient public service system [44] to meet citizens' needs, while enhancing employment opportunities and improving the social environment [45], enabling consumers to enjoy lower prices and higher-quality goods and services through higher productivity and increased consumer surplus, thus stimulating consumption to increase production and raise economic growth [46].

Comprehensive studies have shown that digital transformation has both positive and negative effects on different stakeholders, and the conclusion is also not consistent, so it is necessary to research the impact of digital transformation on CSR, which is a comprehensive index of all stakeholders' interests. Moreover, different processes in value chains link to specific stakeholders, and corporate social responsibility would be different accordingly. However, the existing studies do not deeply analyze the digital transformation in different value chain segments, such as digital manufacturing transformation, digital marketing transformation, and digital management transformation, and their impact on CSR. Only by combining digital transformation with value creation activities can we know how digital transformation influences CSR. Therefore, it is important and meaningful to explore the impact of digital transformation in different value chains on CSR.

With the extensive application of digital technologies in the internal value chain, the production, marketing, and business models of enterprises are changing [1]; the operational efficiency and automation levels of organizations are increasing; and digital manufacturing [12], digital marketing [16], and digital management [18] are emerging. The digital transformation of different parts of the corporate value chain may facilitate or reduce CSR performance.

On the one hand, the digital transformation of value chains may enhance CSR performance for the following four reasons. Firstly, the digital transformation of value chains improves the ability to transmit the CSR signals, which is helpful for the stakeholders to perceive the enterprise's moral and responsible behavior. Enterprise digital transformation can produce more digital information about the whole business process, which is more informative and easier to transmit, and the digital transformation makes the communication channels more diversified, giving stakeholders a deeper understanding of all aspects of the production and operation of the enterprise. As a result, it is easier for the enterprises to earn the trust and support of stakeholders. Secondly, digital transformation allows firms to better identify more stakeholders and the potential expectations of all stakeholders. In digital transformation of the whole process of R&D, procurement, production, and sales services, companies are able to share, exchange, and monitor information with their partners [32,47], which will help them be aware of stakeholders' additional and potential needs [23]. Thirdly, digital transformation enables stakeholders to better participate in corporate decisions and promote their willingness to be better conveyed into corporate actions. Stakeholders' pressure is an important motivation for enterprises to fulfill their social responsibility [48]. The digital transformation of the whole value chain process creates timely interaction between enterprises and stakeholders, which can enable enterprise stakeholders to participate in the strategic decision-making process of enterprises [49], promote more democratized decision-making results internalized in the strategic goals of enterprises, and enhance the pressure on enterprises to fulfill their social responsibility to meet stakeholders' expectations. Fourthly, the digitization of the value chain helps to

improve enterprises' ability to fulfill their social responsibility. The digital transformation of the value chain provides technical support to meet stakeholders' demands timely [28] by integrating all aspects of enterprise value creation activities and breaking down the isolation of information. Resources and capabilities are fully integrated [32], and all value creation activities are highly collaborative. By digital transformation of value chains, enterprises can also provide more scenario-based and personalized products and services to meet the needs of different stakeholders [1].

On the other hand, the digital transformation of value chains may reduce CSR performance. The reasons are as follows. First of all, digital transformation may trigger employees' resistance [13]. The digital transformation of R&D, purchasing, production, and sales and the demand for digital talent in companies enhances the possibility of employees being replaced by AI. The stress forces employees to continuously learn new knowledge and skills, leading to lower employee satisfaction. Second, the abuse of digitalization infringes on stakeholders' interests. The massive amount of data generated during the digitization may make it possible for companies to extract private data, and challenges may arise such as data redundancy, contradiction, absence, security, and privacy [50], as well as problems in storage, disclosure, and moral use of private data. In addition, customers may dislike the commerce advertisements pushed by companies, which serve to cater to customers' needs based on big data analysis. Moreover, customers are gradually realizing that their consumption behavior is being manipulated and induced [51], which may significantly reduce satisfaction. Third, the relation between the digital transformation of the value chain and CSR strategies may be "competitive substitution" and "competition for resources". Companies hope to gain stakeholders' attention and trust by taking social responsibility and developing corporate competitiveness and a good reputation, which can also be achieved through digital transformation [2,36], forming a "substitution" relationship between the two strategies. Both digital transformation and CSR require certain resources [52,53], and when the expected goals and effects of both are the same and the resource is constrained, enterprises may only be willing to invest in one of them, so the digital transformation of value chains may reduce CSR investment, producing a "crowding-out effect". Based on the above analysis, the following competing hypotheses are proposed:

H1a. *The digital transformation of value chains would improve CSR performance.*

H1b. *The digital transformation of value chains would reduce CSR performance.*

Furthermore, digital transformation in different parts of the enterprise value chain can impact CSR performance in different ways. In the production chain, the digital manufacturing transformation can achieve the real-time coordination of the production chain through the sharing and effective utilization of large-scale data [54] and integrate production automation systems with enterprise information management [55] through the refinement of the whole product life cycle to achieve optimal allocation and refined and flexible production [13], which is conducive to improving the productivity and management efficiency of the enterprise, optimizing the human capital structure and reducing resource waste [12], which in turn improves shareholder and employee responsibility performance.

For digital marketing transformation, first, it can quickly capture customers' needs through big data regarding various economic and social behavior data of consumers, accurately innovate products and needs, and automatically provide customized products and services via intelligent systems [35]. Second, digital marketing transformation can achieve cross-space, cross-platform, and other scenarios of connectivity, expand the full range of online and offline sales channels, and create a digital experience environment that is open, transparent, and can be supervised to enhance customer experience and satisfaction [17]. Therefore, digital marketing is conducive to the realization of the interests and needs of the shareholders, suppliers, and customers.

In contrast to basic value activities such as production and marketing, management is the comprehensive performance of auxiliary activities in the enterprise value chain. For digital management transformation, first, it can break the path dependence in tradi-

tional industrialized management [18]; provide digital technology support for intelligent production, sales process reengineering, and internal organization management of enterprises [19], and drive enterprise production management toward intelligence, enterprise marketing management toward precision, and enterprise resource management toward efficiency [2]. Second, through the digital technology embedded in each business link, digital management transformation can capture data and information in the process of enterprise production management more systematically and precisely [18] and provide enterprises with comprehensive and systematic support at the organizational, operational, and strategic levels through demand creation, process reengineering, and value chain reconstruction [4], which will affect the interests of extensive stakeholders, including shareholders, suppliers, customer environment, and public responsibility. Therefore, compared with digital manufacturing transformation and digital marketing transformation, digital management transformation has a more comprehensive and systematic impact on CSR. Based on the above analysis, we propose hypothesis H2:

H2. *When the three types of digital transformation are conducted at the same time, compared with digital manufacturing transformation and digital marketing transformation, digital management transformation has a greater impact on CSR performance.*

2.2. Moderating Role of Property Ownership

Based on China's special institutional background, enterprises can be divided into two types of enterprises based on the nature of enterprise property ownership, namely, state-owned enterprises (SOEs) and non-state-owned enterprises (non-SOEs). There are obvious differences between them in terms of resource constraints and competitive market position [56]. SOEs have natural advantages in terms of government and social resources and face the problem of soft budget constraints, while non-SOEs must participate in full market-based competition due to the lack of government support and face intense survival pressure from the product market [57]. The above differences also lead to significant differences between the two types of enterprises in terms of digital transformation and the formulation and fulfillment of CSR strategic goals.

In China, non-state-owned enterprises generally face greater resource constraints than state-owned enterprises, which are highlighted by the fact that it is more difficult and expensive to acquire external finance. Based on resource constraints and signaling theory, they need higher CSR performance to demonstrate sound business posture, strong technological capabilities, and strong financial strength to the outside world, which can effectively alleviate information asymmetry [28], reduce operational risks [14], enhance the ability of enterprises to obtain external resources [58], and reduce the probability of their financial distress [59]. Thus, they are more willing to take into account the interests of extensive stakeholders besides the shareholders. However, only willingness does not bring high CSR performance—the ability counts more. Digital transformation in value chains improves an enterprise's ability to send more useful data about CSR and understand the potential needs of different shareholders. Most importantly, digital transformation in value chains can optimize existing business processes, make processes more effectively coordinated, and make timely and effective adjustments to a company's resources based on real-time information, thus avoiding unnecessary resource wastage [60], which can alleviate the resource constraints of non-state enterprises and enhance their ability to fulfill their social responsibilities.

Based on stakeholder theory, non-SOEs engage in more intensive market competition and have higher pressure from stakeholders. In order to gain the support of stakeholders and maintain their competitive advantage, non-SOEs must be sensitive to the needs of stakeholders and provide timely feedback to the demands of stakeholders. Digital transformation enhances the ability to adapt [61], learn [32], and innovate [29] in a dynamic environment and facilitates the ability of timely communication with stakeholders [62] and create additional value and satisfaction in the process by the digital technology. Therefore,

the digital transformation of value chains helps non-SOEs to better handle the market pressures from stakeholders and promote the fulfillment of CSR. On the basis of the above analysis, hypothesis H3 is proposed.

H3. *The digital transformation of value chains has a more significant effect on the social responsibility performance of non-SOEs than on that of SOEs.*

2.3. Moderating Role of Market Dependence

Resource dependence theory suggests that the survival and growth of firms depend on the resources obtained from the external environment and that stakeholder groups in the market are the most important source of resources for firms in the face of intense product competition. Studies have shown that markets can have a direct impact on firm legitimacy and resource acquisition [63]. Usually, the more a company depends on the market economy for its business development and profit sources, the stronger the need for market legitimacy recognition and resource acquisition. Therefore, the contribution of the digital transformation of value chains to CSR is also influenced by the degree of market dependence.

On the one hand, digital transformation can reduce information asymmetry [28], enhance information transparency [64], and open the black box of the corporate implementation of social responsibility management. With the help of big data analysis tools, enterprises can clearly show and explain the implementation process of R&D, procurement, production, and marketing to stakeholders in the external market. All performance and default behaviors will have visible and traceable digital tracks, which can enhance trust and attract more consumers, customers, and suppliers and help obtain more positive evaluations [65], which are conducive to corresponding resource acquisition to enhance the competitiveness of companies in the market [7]. In addition, the openness and wide connectivity of digital technology can break the organizational limitations of enterprises and broaden the boundaries and width of their access to information [66], which is conducive to the construction and expansion of their social networks [67] but also to obtain incremental customers and suppliers, which will bring more social resources and business opportunities to enterprises. Therefore, the digital transformation of corporate value chains can better meet the urgent needs of resource acquisition for enterprises with high market dependency, which have a stronger desire to use the digital transformation of the value chain to convey CSR fulfillment to the outside world, which will improve stakeholders' perception and evaluation of CSR and thereby enhance enterprises' social responsibility performance.

On the other hand, companies with higher market dependency are more sensitive to the demands of stakeholders in the market and have stronger motivation to use digital transformation to capture their potential needs and actively satisfy them. Digital scenarios constructed by digital decentering and information fission enhance the discourse of multiple participating subjects in society [65], and stakeholder-driven value propositions in the market economy are reflected in all aspects of digital scenarios [68]. Companies with higher market dependency will take the initiative to use digital tools to accurately profile stakeholders needs and tend to provide scenario-based, diversified, and personalized goods and services. At the same time, enterprises with higher market dependency will also dynamically match their value creation activities with the value demands of their stakeholders [69], optimize their business processes with the opportunity of digital transformation, enhance product and service innovation, and optimize their resource allocation. All of these changes brought by digital transformation enhance the stickiness and long-term cooperative relationships between enterprises, consumers, customers, and suppliers and help to improve and maintain market competitiveness. Therefore, the digital transformation of enterprise value chains is more helpful for enterprises with higher market dependency than for those with lower market dependency, as it strengthens their stickiness

and cooperative relationships with their stakeholders and thus enhances the efficiency of CSR performance. Given the above analysis, we propose hypothesis H4.

H4. *The digital transformation of value chains has a more significant effect on the social responsibility performance of companies with high market dependence than on that of companies with low market dependence.*

The theoretical model of this study is shown in Figure 1.
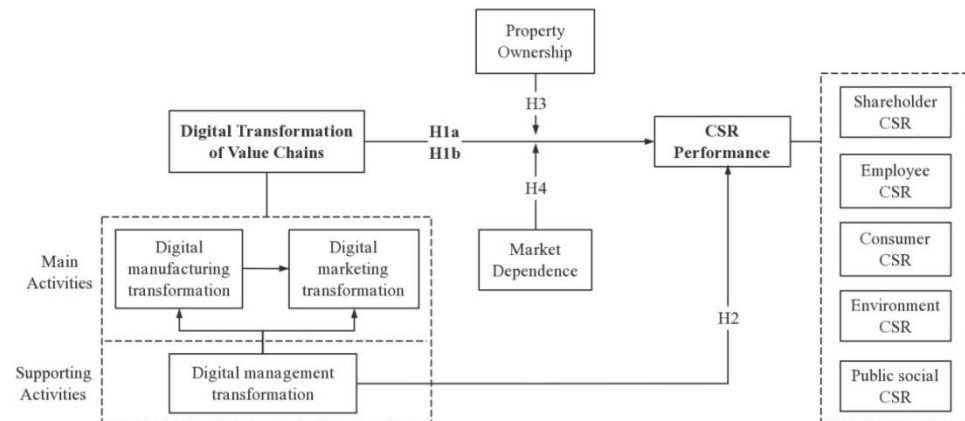
Figure 1. The theoretical model.

3. Empirical Design

3.1. Sample Selection and Data Sources

We used Chinese A-share listed companies from 2010 to 2020 as the initial sample with the following screening criteria: companies in the financial sector, those whose issued stocks receive special treatment or delisting risk warning, and samples with missing financial data are excluded. The financial data and enterprise characteristics used in this study were obtained from the China Stock Market & Accounting Research database. To mitigate the effect of extreme values on the results, we performed Winsorization for all continuous variables at the 1% and 99% quartiles.

3.2. Variable Definition and Measurements

3.2.1. Explained Variables: Social Responsibility

In this study, the total index of social responsibility evaluation of Hexun (https://www.hexun.com (accessed on 20 May 2021)) is selected to measure the social responsibility performance of enterprises. This total index of social responsibility evaluation is composed of the sum of five sub-scores of shareholder responsibility; environmental responsibility; employee responsibility; supplier, customer, and consumer rights responsibility; and public responsibility. It is logarithmically processed on the basis of the exclusion of nonpositive values.

3.2.2. Explanatory Variables: Digital Transformation of Different Value Chain Segments of the Enterprise

At present, there is no unified definition for the measurement of the digital transformation of enterprises, and the measurement of enterprise digitalization is mainly based on the text analysis to construct the indicators of enterprise digital transformation [70]. This study is different from the existing studies in that we distinguish the digital transformation feature lexicon into different value chains based on the specific application of digital technology in each activity in the value chains by the text mining method. The specific processing steps are as follows. First, we construct the feature thesaurus of digital transformation of value chains based on the academic research, Chinese policy documents, and research reports about relevant themes and business fields in China, such as the White Paper on the Development of China's Digital Economy, the White Paper on Digital Transformation,

and the China Artificial Intelligence Development Report, which are related to "digital manufacturing", "digital marketing", and "digital management". The final thesaurus of digital transformation of value chains is presented in Table 1. Second, based on the feature words in Table 1, we search and extract the feature words in the text of annual reports of listed companies using Python. Third, negative words, such as "no", "none", "not", etc., are excluded; the digital transformation not implemented by the enterprises themself (mainly implemented by their shareholders, customers, suppliers, and senior management profiles) are also excluded. Fourth, we sum the word frequencies of key value chains to form the final summed word frequencies of the corresponding value chain and logarithmize the summed data to overcome the question of "right-skewed".

Table 1. Feature words related to digital transformation in different value chain segments of enterprises.

Dimensionality	Feature Words
Digital Manufacturing Transformation	intelligent manufacturing, big data manufacturing, intelligent production, intelligent factory, intelligent site, intelligent workshop, digital workshop, digital factory, digital manufacturing, digital site, industrial intelligence, production line intelligence, intelligent production line, intelligent operation, intelligent operation, intelligent scheduling, intelligent detection, intelligent automation, intelligent control products, intelligent maintenance monitoring, industrial internet, intelligent processing, intelligent identification, intelligent monitoring, intelligent freight, intelligent warehousing, intelligent logistics, intelligent warehouse management, digitally driven inventory, digital procurement
Digital Marketing Transformation	marketing intelligence, intelligent marketing, intelligent services, digital marketing, marketing digitalization, retail digitalization, digital precision marketing, big data marketing, digital services, intelligent customer service, services to provide big data support, intelligent service means, intelligent stores, intelligent business services, intelligent supply chain, digital consumer experience, digital media, omnichannel digitalization, content + social + product, interactive integration of online and offline platforms, online and offline integration
Digital Management Transformation	intelligent control, intelligent operation, intelligent management, intelligent office, intelligent statistics, intelligent scheduling of data, intelligent operation and maintenance, intelligent analysis of data, intelligent integrated management information platform, intelligent acquisition of information, intelligent information extraction, intelligent business operation control, intelligent enterprise governance, intelligent middle office, intelligent information interconnection, intelligent wind control, intelligent application, intelligent operation, intelligent control, intelligent decision support, digital control, digital integration, digital operation, digital management, big data operation and maintenance, big data utilization, intelligent execution, intelligent security, intelligent research and judgment, intelligent analysis and recording

After the above four steps, we obtained the indicators of the digital transformation of each value chain. Digital manufacturing transformation and digital marketing transformation are used to measure the digital transformation in the main activities about manufacturing and marketing, and digital management transformation is used to measure the digital transformation in the management, which is the supporting activities in value chains. The larger the logarithm value is, the higher the degree of digital transformation. We also revised the processing of the data in the text to make it clear and understandable.

3.2.3. Moderating Variables

Based on resource dependence theory, the implementation of corporate social responsibility strategy constrained by these resources and the degree of government intervention and market factors have a significant impact on the implementation of corporate social responsibility [11,26]. In China, both the government and market play important roles in resource allocation, so we chose property ownership and market dependence as moderating variables. We used 1−(affiliate transactions/operating revenue) to measure market dependence. Higher market dependence means that the more the company needs to obtain external resources for its own development, the more it focuses on its own relationship with stakeholders.

3.2.4. Control Variables

The implementation of CSR strategies is influenced by the level of corporate governance and financial performance [11,26]; the better the corporate's financial performance

and governance are, the greater the ability and the better performance of social responsibility fulfillment are [11,24]. Based on the viewpoint, we selected control variables of corporate governance and financial performance referring to existing research [23,40,60], which are property ownership, company size, gearing ratio, cash flow ratio, operating income growth rate, years since company establishment, book-to-market ratio, number of directors, proportion of independent directors, dual position, and equity concentration. Table 2 presents the definitions and measurements of the variables.

Table 2. Variable definitions.

Variable Name	Variable Symbols	Measurement Method
Social responsibility	CSR	ln(1 + total score of social responsibility evaluation index)
Total degree of digital transformation	Dig	ln(1 + total number of digital-related words)
Degree of digital manufacturing transformation	Dig_manu	ln(1 + total frequency of words related to digital manufacturing)
Degree of digital marketing transformation	Dig_market	ln(1 + total frequency of words related to digital marketing)
Degree of digital management transformation	Dig_manage	ln(1 + total frequency of words related to digital management)
Property ownership	SOE	State-owned enterprises take the value of 1, others take the value of 0
Market dependence	Mak	1−(internally related transactions/operating income)
Company size	Size	Natural logarithm of total assets of listed companies
Gearing ratio	Lev	Total liabilities/total assets
Cash flow ratio	Cashflow	Net cash flows from operating activities divided by total assets
Operating income growth rate	Growth	(Current year's operating income/prior year's operating income) − 1
Year of company establishment	FirmAge	ln(current year − year of company establishment + 1)
Book-to-market ratio	BM	Book value/market value
Number of directors	Board	Number of board members taken as the natural logarithm
Percentage of independent directors	Indep	Independent directors divided by the number of directors
Two jobs in one	Dual	If the chairman and the general manager are the same person, then the value is 1; otherwise, it is 0
Shareholding concentration	Top1	Number of shares held by the largest shareholder/total number of shares

3.3. Econometric Regression Model

To validate H1–H3, we set up three econometric regression models:

$$\text{CSR} = \alpha_0 + \alpha_1 \text{Dig}_i + \sum \text{Control} + \mu \tag{1}$$

$$\text{CSR} = \beta_0 + \beta_1 \text{Dig}_i + \beta_2 \text{Dig}_i \times \text{SOE} + \sum \text{Control} + \sigma \tag{2}$$

$$\text{CSR} = \gamma_0 + \gamma_1 \text{Dig}_i + \gamma_2 \text{Dig}_i \times \text{Mak} + \sum \text{Control} + \delta \tag{3}$$

In the above model, we use OLS, GMM, and fixed effects models at the same time. For OLS estimation, we control both year and industry effects; for GMM estimation, we use both industrial average digital transformation level and regional average digital transformation level as instrumental variables; and for fixed effects model estimation, we control both firm and year effects. CSR represents social responsibility performance; Dig_i represents the degree of digital transformation of value chains, which includes the degree of total digital transformation(Dig), degree of digital manufacturing transformation(Dig_manu), degree of digital marketing transformation(Dig_market) and degree of digital management transformation(Dig_manage); and $\sum \text{Control}$ is the control variable.

Model (1) is used to test H1a, H1b, and H2. Model (2) is based on Model (1) with the addition of the cross product of Dig_i and SOE to test H3. Model (3) is based on model (1) with the addition of the cross product of Dig_i and Mak to test H4.

4. Analysis and Discussion of Empirical Results

4.1. Results of Descriptive Statistical Analysis

Table 3 presents the descriptive statistics of the variables. The mean value of CSR is 3.096, the variance is 0.614, the minimum value is 0.010, and the maximum value is 4.520. These outcomes indicate some variations in the social responsibility performance of the listed companies. The mean value of Dig is 0.667, the minimum value is 0, the maximum value is 6.082, and the standard deviation is 0.994, indicating a wide variation in the overall degree of digitization of listed companies. The mean value of Dig_manu is 0.454, the maximum value is 6.047, and the standard deviation is 0.851, accounting for 68% of the total number of digitally transformed enterprises. This indicates that the number of companies implementing digital manufacturing transformation accounts for a relatively large number and that there are large differences in the degree of digital manufacturing of different enterprises. The mean value of Dig_market is 0.089, accounting for 13% among digitally transformed enterprises. The mean value of Dig_manage is 0.206, the maximum value is 6.019, and the standard deviation is 0.537, indicating that about 30% of digitally transformed companies have implemented digital management transformation and that there is a large difference in the degree of digital management transformation among different companies. The statistical analysis results show that the degree of digital transformation of the different value chain segments of enterprises is inconsistent and varies greatly, particularly among different enterprises.

Table 3. Descriptive statistics.

Variable	Mean	p25	p50	p75	Min	Max	SD	N
CSR	3.096	2.903	3.148	3.346	0.010	4.520	0.614	28,574
Dig	0.667	0.000	0.000	1.099	0.000	6.082	0.994	28,574
Dig_manu	0.454	0.000	0.000	0.693	0.000	6.047	0.851	28,574
Dig_market	0.089	0.000	0.000	0.000	0.000	4.060	0.333	28,574
Dig_manage	0.206	0.000	0.000	0.000	0.000	6.019	0.537	28,574
SOE	0.344	0.000	0.000	1.000	0.000	1.000	0.475	28,574
Mak	0.794	0.683	0.927	0.997	0.205	1.000	0.205	28,574
Size	22.130	21.190	21.950	22.870	19.870	25.940	1.289	28,574
Lev	0.414	0.245	0.405	0.570	0.055	0.898	0.206	28,574
Cashflow	0.046	0.008	0.046	0.087	−0.224	0.258	0.07	28,574
Growth	0.164	−0.002	0.093	0.256	−0.554	2.208	0.377	28,574
FirmAge	2.834	2.639	2.890	3.091	1.609	3.466	0.362	28,574
BM	0.986	0.358	0.629	1.160	0.095	6.121	1.056	28,574
Board	2.131	1.946	2.197	2.197	1.609	2.639	0.196	28,574
Indep	0.375	0.333	0.333	0.429	0.333	0.571	0.053	28,574
Dual	0.280	0.000	0.000	1.000	0.000	1.000	0.449	28,574
Top1	0.349	0.233	0.330	0.450	0.090	0.730	0.148	28,574

As for the moderating variables, the mean value of SOE is 0.334, indicating a high percentage of non-SOEs in the sample companies. The mean value of market dependence is 0.794 and the median value is 0.927, indicating that the business development of the listed companies is more dependent on the market economy. Among the control variables of company characteristics, the distribution of the values of the variables is consistent with the actual situation of the listed companies, and no abnormalities are found.

As for the control variables, the mean of Size is 22.130 and the median is 21.195, indicating that the overall size of listed companies does not vary much; the mean of Lev is 0.414, indicating that the overall asset:liability ratio of listed companies is around 40% and the debt level is moderate; the means of Cashflow and FirmAge are close to the median, indicating that the cash flow and listing time of listed companies are normally distributed; the mean of Growth is 0.164 and the median is 0.093, indicating that the growth rate of listed companies is fast; the mean value of BM is 0.986 and the median is 0.629, indicating that the market value of listed companies is greater than the book value. The values of the above variables in the financial situation of companies are basically consistent with the

existing literature about China [23,40]. The values of Board Indep, Dual, and Top1 are also consistent with the existing studies about China [60,70].

In addition, we performed correlation analysis and cointegration tests between the variables, and the results show that there was no cointegration between the variables. In order to avoid the "pseudo-regression" problem and to ensure the validity of the estimates, we also conducted unit root tests on the explained variables by the Fisher method, and the test results show that the panel data in this study are stationary.

4.2. Multivariate Analysis Results

Table 4 shows the results of least squares (OLS), estimated GMM, and fixed effects (FE) based on Model (1). Column (1)–(3) show that the coefficient of Dig is significantly positive at the 1% level in all estimations, indicating that digital transformation can significantly improve CSR performance and promote the fulfillment of social responsibility. This is consistent with the findings of existing studies. Columns (4)–(9) show that the coefficients of Dig_manu, Dig_market, and Dig_manage are significantly positive, indicating that the digital transformation of the manufacturing, marketing, and management processes of enterprises can significantly improve CSR performance. These findings support hypothesis H1a.

Table 4. Digital transformation and social responsibility in different value chain segments of enterprises.

Variable	OLS	FE	GMM		OLS			FE	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	CSR	CSR	CSR	CSR	CSR	CSR	CSR	CSR	CSR
Dig	0.015 ***	0.024 ***	0.180 ***						
	(5.05)	(5.56)	(30.70)						
Dig_manu				0.009 ***			0.012 ***		
				(2.80)			(2.62)		
Dig_market					0.021 **			0.014 *	
					(2.51)			(1.90)	
Dig_manage						0.020 ***			0.015 **
						(4.17)			(2.01)
Size	0.114 ***	0.145 ***	0.115 ***	0.115 ***	0.115 ***	0.115 ***	0.186 ***	0.184 ***	0.183 ***
	(32.32)	(18.30)	(29.93)	(32.59)	(32.55)	(32.82)	(22.59)	(22.32)	(22.29)
Lev	−0.177 ***	−0.083 **	−0.075 ***	−0.176 ***	−0.174 ***	−0.175 ***	−0.183 ***	−0.185 ***	−0.186 ***
	(−8.47)	(−2.56)	(−3.49)	(−8.40)	(−8.34)	(−8.38)	(−5.56)	(−5.62)	(−5.63)
SOE	0.033 ***	−0.003	0.032 ***	0.033 ***	0.033 ***	0.033 ***	−0.015	−0.015	−0.015
	(4.40)	(−0.11)	(4.00)	(4.33)	(4.31)	(4.36)	(−0.60)	(−0.59)	(−0.60)
FirmAge	0.023 **	−0.593 ***	−0.026 ***	0.022 **	0.021 **	0.023 **	0.089 **	0.085 *	0.082 *
	(2.55)	(−25.44)	(−3.00)	(2.44)	(2.42)	(2.57)	(2.02)	(1.95)	(1.87)
BM	0.022 ***	0.010 *	0.032 ***	0.021 ***	0.021 ***	0.022 ***	0.002	0.003	0.003
	(4.56)	(1.66)	(6.62)	(4.43)	(4.42)	(4.45)	(0.25)	(0.42)	(0.42)
ROA	6.546 ***	6.459 ***	6.808 ***	6.548 ***	6.553 ***	6.551 ***	6.490 ***	6.491 ***	6.491 ***
	(69.47)	(56.88)	(69.43)	(69.45)	(69.47)	(69.50)	(57.80)	(57.80)	(57.81)
Cashflow	−0.144 ***	−0.100 **	−0.355 ***	−0.147 ***	−0.148 ***	−0.146 ***	−0.160 ***	−0.159 ***	−0.160 ***
	(−3.03)	(−1.99)	(−7.20)	(−3.09)	(−3.11)	(−3.06)	(−3.22)	(−3.20)	(−3.22)
Growth	−0.000	0.019 **	0.009	−0.000	0.000	−0.000	0.014 *	0.015 *	0.015 *
	(−0.02)	(2.29)	(1.04)	(−0.03)	(0.03)	(−0.03)	(1.78)	(1.81)	(1.80)
Board	0.038 **	0.001	0.073 ***	0.039 **	0.038 **	0.038 **	−0.044	−0.045	−0.045
	(1.98)	(0.03)	(3.53)	(2.01)	(1.97)	(1.97)	(−1.30)	(−1.33)	(−1.32)
Indep	0.050	0.016	0.158 **	0.053	0.052	0.053	−0.006	−0.004	−0.004
	(0.74)	(0.15)	(2.16)	(0.78)	(0.77)	(0.78)	(−0.06)	(−0.04)	(−0.04)
Dual	−0.001	−0.017 *	−0.004	−0.001	−0.001	−0.002	−0.015	−0.015	−0.015
	(−0.22)	(−1.73)	(−0.59)	(−0.18)	(−0.23)	(−0.25)	(−1.50)	(−1.51)	(−1.49)

Table 4. *Cont.*

Variable	OLS	FE	GMM	OLS			FE		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
	CSR	CSR	CSR	CSR	CSR	CSR	CSR	CSR	CSR
Top1	0.090 ***	0.132 ***	0.081 ***	0.090 ***	0.090 ***	0.092 ***	0.116 **	0.119 **	0.120 **
	(4.53)	(2.62)	(3.79)	(4.49)	(4.49)	(4.59)	(2.30)	(2.37)	(2.40)
_cons	0.079		0.176 *	0.059	0.060	0.050			
	(0.86)		(1.88)	(0.64)	(0.65)	(0.55)			
F (Wald chi2)	290.863	474.553	9226.22	290.854	290.996	290.779	354.062	353.389	353.839
R^2	0.431	0.611	0.326	0.430	0.430	0.431	0.630	0.630	0.630
N	28,574	28,177	28,574	28,574	28,574	28,574	28,177	28,177	28,177

Variable	OLS	FE
	(10)	**(11)**
	CSR	CSR
Dig_manu	0.006 *	0.008 *
	(1.67)	(3.04)
Dig_market	0.015 *	0.012 *
	(1.69)	(1.70)
Dig_manage	0.017 ***	0.017 **
	(3.22)	(2.24)
Size	0.114 ***	0.184 ***
	(32.27)	(22.32)
Lev	−0.176 ***	−0.183 ***
	(−8.42)	(−5.57)
SOE	0.033 ***	−0.015
	(4.39)	(−0.61)
FirmAge	0.023 **	0.087 **
	(2.54)	(1.97)
BM	0.022 ***	0.002
	(4.56)	(0.31)
ROA	6.550 ***	6.496 ***
	(69.53)	(57.87)
Cashflow	−0.145 ***	−0.160 ***
	(−3.04)	(−3.22)
Growth	−0.000	0.015 *
	(−0.01)	(1.82)
Board	0.038 **	−0.046
	(1.97)	(−1.34)
Indep	0.051	−0.008
	(0.75)	(−0.08)
Dual	−0.002	−0.015
	(−0.27)	(−1.49)
Top1	0.092 ***	0.115 **
	(4.58)	(2.30)
_cons	0.072	
	(0.78)	
F (Wald chi2)	278.621	307.841
R^2	0.431	0.631
N	28,574	28,177

Note: T values are in brackets; ***, ** and * indicate $p < 0.001$, $p < 0.01$ and $p < 0.05$, respectively.

Columns (10) and (11) shows the regression results of simultaneously adding Dig_manu, Dig_market, and Dig_manage to Model (1). The results of OLS and FE estimation show that the coefficients of all three variables are significantly positive, and the coefficient of Dig_manage is the largest, indicating that digital management transformation plays a

greater role than digital manufacturing transformation and digital marketing transformation when the enterprise carries out digital transformation of the three value chain activities at the same time, which supports hypothesis H2.

4.3. Robustness Tests

4.3.1. Variable Substitution Method

First, we replace the measurement method of CSR. Drawing on Marquis and Qian [71], we replaced the dependent variable with the social responsibility index from the Rankins database for robustness testing, and we set whether listed companies disclose social responsibility reports as a dummy variable that takes the value of 1 when disclosure is made and 0 otherwise. Regression analysis is conducted using Model (1). The regression results are shown in columns (1)–(3) of Table 5. After replacing the explanatory variables, CSR still shows a significant positive relationship with Dig_manu, Dig_market, and Dig_manage, which is consistent with previous findings and again supports hypothesis H1a of this study.

Table 5. Variable substitution method.

Variable	Replacing Explanatory Variable			Replace Control Variables		
	(1)	(2)	(3)	(4)	(5)	(6)
Dig_manu	0.005 *			0.007 **		
	(1.95)			(2.21)		
Dig_market		0.016 **			0.023 ***	
		(2.20)			(2.61)	
Dig_manage			0.015 ***			0.017 ***
			(3.65)			(3.38)
Size	0.162 ***	0.162 ***	0.163 ***	0.112 ***	0.112 ***	0.113 ***
	(58.10)	(58.18)	(58.32)	(30.73)	(30.65)	(30.93)
Lev	−0.154 ***	−0.153 ***	−0.153 ***	−0.193 ***	−0.192 ***	−0.193 ***
	(−10.81)	(−10.74)	(−10.80)	(−8.94)	(−8.89)	(−8.93)
SOE	0.104 ***	0.104 ***	0.104 ***	0.038 ***	0.038 ***	0.038 ***
	(16.58)	(16.58)	(16.62)	(4.88)	(4.88)	(4.90)
FirmAge	0.049 ***	0.048 ***	0.049 ***	0.018 *	0.018 *	0.019 **
	(7.25)	(7.24)	(7.38)	(1.90)	(1.89)	(2.00)
BM	−0.022 ***	−0.022 ***	−0.022 ***	0.027 ***	0.027 ***	0.027 ***
	(−5.75)	(−5.74)	(−5.72)	(5.47)	(5.50)	(5.49)
ROA	−0.172 ***	−0.168 ***	−0.169 ***	6.741 ***	6.745 ***	6.744 ***
	(−3.35)	(−3.28)	(−3.30)	(67.83)	(67.86)	(67.86)
Cashflow	0.183 ***	0.182 ***	0.184 ***	−0.200 ***	−0.202 ***	−0.199 ***
	(5.19)	(5.17)	(5.23)	(−3.98)	(−4.01)	(−3.96)
Growth	−0.052 ***	−0.052 ***	−0.053 ***	−0.013	−0.013	−0.013
	(−9.14)	(−9.08)	(−9.15)	(−1.62)	(−1.55)	(−1.62)
Board	0.063 ***	0.062 ***	0.062 ***	0.042 **	0.041 **	0.041 **
	(4.13)	(4.09)	(4.09)	(2.07)	(2.04)	(2.04)
Indep	0.294 ***	0.293 ***	0.294 ***	0.069	0.067	0.068
	(5.72)	(5.70)	(5.71)	(0.97)	(0.95)	(0.96)
Dual	−0.010 **	−0.010 **	−0.010 **	−0.005	−0.005	−0.005
	(−2.12)	(−2.17)	(−2.19)	(−0.74)	(−0.80)	(−0.79)
Top1	−0.074 ***	−0.074 ***	−0.073 ***	0.091 ***	0.091 ***	0.093 ***
	(−4.61)	(−4.61)	(−4.50)	(4.36)	(4.36)	(4.44)
GDP				0.014 **	0.014 *	0.014 **
				(1.98)	(1.96)	(1.97)
Market				0.015 ***	0.016 ***	0.015 ***
				(8.89)	(8.95)	(8.82)
_cons	−3.567 ***	−3.564 ***	−3.571 ***	0.052	0.057	0.045
	(−49.57)	(−49.54)	(−49.76)	(0.54)	(0.59)	(0.47)

Table 5. *Cont.*

Variable	Replacing Explanatory Variable			Replace Control Variables		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
F	241.242	241.209	241.657	278.709	278.802	278.485
R^2	0.251	0.251	0.251	0.441	0.441	0.441
N	28,574	28,574	28,574	26,755	26,755	26,755

Note: T values are in brackets; ***, ** and * indicate $p < 0.001$, $p < 0.01$ and $p < 0.05$, respectively.

Second, we control for area-level factors. The legitimacy motive argues that firms' behavior is constrained by the pressure of the external institutional environment and that compliance with social expectations and norms for CSR fulfillment gives firms legitimacy and the necessary resources needed for survival [72]. When the degree of marketization is higher, stakeholders will demand more from companies in terms of product quality or environmental protection, and monitoring will be more effective, which will motivate companies to maintain higher operational efficiency and normality in the fulfillment of social responsibility. Therefore, on the basis of Model (1), we further controlled for the effects of regional economic level (gross domestic product, GDP) and the degree of marketization (Market). The regression results are shown in columns (4)–(6) of Table 5, where the regression coefficients of CSR and Dig_manu, Dig_market, and Dig_manage are still significantly positive after controlling for GDP and Market. Therefore, the hypothesis H1a is further supported. In addition, we also conducted a series of robustness tests with some of the control variables, and the hypothesis H1a is still supported.

4.3.2. Instrumental Variable Method

To mitigate the endogeneity problem that may result from reverse causality, we adopted the instrumental variable approach. Typically, the degree of digital transformation in the same industry and in the same region will have an impact on whether the company implements digital transformation, but it does not directly affect the social responsibility performance of the company, logically satisfying the requirements of the correlation and exogeneity needed for instrumental variables. Therefore, in this study, the average degree of digital manufacturing transformation in the same industry (Dig_manu_IND_IV), the average degree of digital marketing transformation in the same industry (Dig_market_IND_IV), the average degree of digital management transformation in the same industry (Dig_manage_IND_IV), and the degree of digital transformation in the same region (Area _IV) are substituted into Model (1) as instrumental variables for retesting. The empirical results are shown in Table 6. Columns (1), (3), and (5) show the first-stage regression results, which indicate that the regression coefficients of Dig_manu_IND_IV, Area_IV, and Dig_manu; Dig_market_IND_IV, Area_IV, and Dig_market; and Dig_manage_IND_IV, Area_IV, and Dig_manage are significantly positively correlated. The F-value of the weak instrumental variable test is much greater than 10, thus rejecting the weak instrumental variable hypothesis and passing the instrumental variable test. Columns (2), (4), and (6) show the second-stage regression results, which indicate that the regression coefficients of CSR and Dig_manu, Dig_market, and Dig_manage are significantly positively correlated, indicating that the digital transformations of manufacturing, marketing, and management processes still significantly improve CSR performance after the endogeneity problem is solved. This result again supports hypothesis H1a of this study.

4.4. Moderating Role of Property Ownership

Table 7 shows the test results based on Model (2) using OLS and FE estimation. The regression results in columns (1)–(6) indicate that the coefficients of the interaction terms SOE × Dig_manu, SOE × Dig_market, and SOE × Dig_manage are significantly negative. This outcome implies that the improvement in CSR performance by the digital transformations of manufacturing, marketing, and management processes is more significant for

non-SOEs than for SOEs. This is mainly because non-SOEs face greater resource constraints and market pressures and are more sensitive to stakeholder demands, and the digital transformation of value chains enhance their ability to fulfill social responsibility, which will facilitate the improvement of their social responsibility performance of non-SOEs. That is, digital transformation in different value chains of enterprises helps non-SOEs build favorable social networks, enhance their legitimacy, gain more recognition and support from stakeholders, and improve their social responsibility performance to a greater extent. This conclusion supports hypothesis H3.

Table 6. Instrumental variable method.

Variables	(1) Dig_Manu	(2) CSR	(3) Dig_Market	(4) CSR	(5) Dig_Manage	(6) CSR
Dig_manu_IND_IV	0.921 *** (0.026)					
Dig_manu		0.128 *** (0.023)				
Dig_market_IND_IV			0.822 *** (0.027)			
Dig_market				0.313 *** (0.061)		
Dig_manage_IND_IV					0.575 *** (0.051)	
Dig_manage						0.147 *** (0.045)
Area_IV	0.068 *** (0.025)		0.043 *** (0.011)		0.299 *** (0.018)	
Size	0.077 *** (0.005)	0.142 *** (0.005)	0.032 *** (0.002)	0.141 *** (0.005)	0.020 *** (0.004)	0.112 *** (0.004)
Lev	0.104 *** (0.030)	−0.056 ** (0.024)	−0.001 (0.013)	−0.033 (0.024)	0.040 * (0.021)	−0.182 *** (0.019)
SOE	−0.043 *** (0.011)	0.133 *** (0.009)	−0.010 ** (0.005)	0.132 *** (0.009)	−0.025 *** (0.008)	0.036 *** (0.007)
FirmAge	−0.023 (0.014)	0.028 ** (0.012)	0.006 (0.006)	0.025 ** (0.012)	−0.055 *** (0.010)	0.030 *** (0.010)
BM	−0.034 *** (0.007)	−0.047 *** (0.005)	−0.020 *** (0.003)	−0.048 *** (0.005)	−0.023 *** (0.005)	0.025 *** (0.004)
ROA	0.347 *** (0.102)	0.545 *** (0.084)	−0.034 (0.044)	0.618 *** (0.083)	0.006 (0.071)	6.552 *** (0.066)
Cashflow	−0.246 *** (0.071)	0.259 *** (0.057)	0.014 (0.030)	0.241 *** (0.057)	−0.146 *** (0.049)	−0.127 *** (0.046)
Growth	0.013 (0.012)	0.037 *** (0.010)	−0.010 ** (0.005)	0.045 *** (0.010)	0.011 (0.008)	−0.002 (0.008)
Board	−0.028 (0.028)	0.040 * (0.023)	0.021 * (0.012)	0.030 (0.023)	0.031 (0.020)	0.035 * (0.018)
Indep	0.062 (0.097)	0.348 *** (0.079)	0.100 ** (0.041)	0.329 *** (0.079)	0.030 (0.068)	0.044 (0.063)
Dual	−0.005 (0.010)	−0.011 (0.008)	0.008 * (0.004)	−0.016 * (0.008)	0.013 * (0.007)	−0.004 (0.007)
Top1	0.008 (0.031)	−0.165 *** (0.025)	−0.012 (0.013)	−0.165 *** (0.025)	−0.112 *** (0.022)	0.106 *** (0.021)
Constant	−1.594 *** (0.134)	−2.225 *** (0.118)	−0.782 *** (0.057)	−2.206 *** (0.121)	−0.361 *** (0.093)	0.107 (0.089)
Weak identification test	608.8	608.8	487.7	487.7	213.0	213.0
R^2	0.286	0.144	0.151	0.144	0.131	0.420
N	28,574	28,574	28,574	28,574	28,574	28,574

Note: T values are in brackets; ***, ** and * indicate $p < 0.001$, $p < 0.01$ and $p < 0.05$, respectively.

Table 7. Moderating effects of property ownership.

	OLS			FE		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Variable	**CSR**	**CSR**	**CSR**	**CSR**	**CSR**	**CSR**
Dig_manu	0.020 ***			−0.012 **		
	(5.93)			(−2.45)		
SOE × Dig_manu	−0.051 ***			−0.065 ***		
	(−7.07)			(−6.55)		
Dig_market		0.030 ***			0.013	
		(2.92)			(1.07)	
SOE × Dig_market		−0.031 *			−0.066 ***	
		(−1.90)			(−3.32)	
Dig_manage			−0.017 ***			0.016 *
			(−3.41)			(1.91)
SOE × Dig_manage			−0.027 *			−0.052 ***
			(−1.88)			(−3.12)
Size	0.115 ***	0.115 ***	0.083 ***	0.143 ***	0.139 ***	0.139 ***
	(32.83)	(32.54)	(23.28)	(18.13)	(17.69)	(17.68)
Lev	−0.180 ***	−0.175 ***	−0.039 *	−0.098 ***	−0.087 ***	−0.084 ***
	(−8.62)	(−8.38)	(−1.85)	(−3.02)	(−2.68)	(−2.60)
SOE	0.053 ***	0.035 ***	0.083 ***	0.027	0.005	0.009
	(6.22)	(4.52)	(10.31)	(1.03)	(0.20)	(0.36)
FirmAge	0.022 **	0.022 **	−0.086 ***	−0.584 ***	−0.626 ***	−0.628 ***
	(2.43)	(2.43)	(−10.69)	(−25.32)	(−27.79)	(−27.77)
BM	0.022 ***	0.022 ***	0.048 ***	0.012 *	0.011 *	0.010 *
	(4.54)	(4.45)	(10.05)	(1.94)	(1.76)	(1.75)
ROA	6.555 ***	6.554 ***	6.842 ***	6.485 ***	6.457 ***	6.460 ***
	(69.55)	(69.50)	(71.41)	(57.15)	(56.83)	(56.90)
Cashflow	−0.156 ***	−0.149 ***	−0.363 ***	−0.104 **	−0.102 **	−0.101 **
	(−3.28)	(−3.13)	(−7.54)	(−2.08)	(−2.03)	(−2.02)
Growth	−0.000	0.000	0.016 *	0.019 **	0.019 **	0.020 **
	(−0.02)	(0.03)	(1.95)	(2.39)	(2.39)	(2.41)
Board	0.042 **	0.039 **	0.130 ***	0.002	0.001	0.002
	(2.15)	(1.99)	(6.39)	(0.06)	(0.02)	(0.06)
Indep	0.060	0.053	0.139 *	0.025	0.024	0.022
	(0.89)	(0.78)	(1.92)	(0.24)	(0.22)	(0.20)
Dual	−0.002	−0.002	−0.024 ***	−0.017 *	−0.017 *	−0.017 *
	(−0.34)	(−0.25)	(−3.71)	(−1.72)	(−1.70)	(−1.70)
Top1	0.088 ***	0.090 ***	0.139 ***	0.143 ***	0.145 ***	0.146 ***
	(4.39)	(4.49)	(6.69)	(2.83)	(2.88)	(2.90)
_cons	0.026	0.058	0.746 ***			
	(0.28)	(0.63)	(8.24)			
F	285.572	284.682	612.285	445.230	438.201	438.617
R²	0.431	0.431	0.370	0.612	0.611	0.611
N	28,574	28,574	28,574	28,177	28,177	28,177

Note: T values are in brackets; ***, ** and * indicate $p < 0.001$, $p < 0.01$ and $p < 0.05$, respectively.

4.5. Moderating effect of Market Dependence

Table 8 shows the test results based on Model (3) using OLS and FE estimation. The regression results of columns (1)–(6) show that the regression coefficients of the interaction terms Mak × Dig_manu, Mak × Dig_market, and Mak × Dig_manage are significantly positive, indicating that the digital transformation of the different parts of the enterprise value chain has a more significant effect on market-dependent enterprises than on less market-dependent enterprises. This is mainly because enterprises with higher market dependency can use the opportunity of digital transformation of value chains to convey their stronger desire to fulfill CSR to the outside world, and are more likely to gain the trust and support of their stakeholders. In addition, the digital transformation of value chains help enterprises with high market dependency to capture stakeholders' needs

sensitively, strengthen the interaction and stickiness with their stakeholders, enhance the efficiency of CSR performance, and thus promote their social responsibility performance. In other words, relative to enterprises with low market dependence, enterprises with high market dependence are able to enhance their legitimacy, build social networks, improve the efficiency of CSR performance, and thus promote social responsibility performance as a result of the digital transformation of the different value chain links. This conclusion supports hypothesis H4.

Table 8. Moderating effects of market dependence.

Variable	OLS			FE		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	CSR	**CSR**	**CSR**	**CSR**	**CSR**	**CSR**
Dig_manu	−0.038 ***			−0.073 ***		
	(−3.63)			(−5.91)		
Mak × Dig_manu	0.058 ***			0.054 ***		
	(4.96)			(3.89)		
Dig_market		−0.040			−0.106 ***	
		(−1.20)			(−3.02)	
Mak × Dig_market		0.071 *			0.119 ***	
		(1.86)			(2.91)	
Dig_manage			−0.054 ***			−0.008 ***
			(−2.85)			(−2.42)
Mak × Dig_manage			0.038 *			0.114 **
			(1.75)			(2.63)
Mak	0.035 **	0.056 ***	0.042 ***	0.006	0.019	0.026
	(2.52)	(4.40)	(3.07)	(0.37)	(1.26)	(1.60)
Size	0.117 ***	0.116 ***	0.085 ***	0.146 ***	0.141 ***	0.141 ***
	(33.05)	(32.90)	(23.64)	(18.40)	(17.82)	(17.78)
Lev	−0.163 ***	−0.160 ***	−0.027	−0.078 **	−0.076 **	−0.076 **
	(−7.69)	(−7.57)	(−1.26)	(−2.40)	(−2.34)	(−2.33)
SOE	0.034 ***	0.032 ***	0.078 ***	−0.003	−0.003	−0.003
	(4.45)	(4.25)	(10.26)	(−0.13)	(−0.12)	(−0.13)
FirmAge	0.024 ***	0.024 ***	−0.083 ***	−0.595 ***	−0.627 ***	−0.629 ***
	(2.67)	(2.70)	(−10.36)	(−25.81)	(−27.80)	(−27.80)
BM	0.020 ***	0.021 ***	0.047 ***	0.010	0.010	0.009
	(4.22)	(4.26)	(9.82)	(1.61)	(1.62)	(1.57)
ROA	6.511 ***	6.520 ***	6.811 ***	6.459 ***	6.450 ***	6.449 ***
	(68.97)	(68.99)	(70.81)	(56.88)	(56.70)	(56.69)
Cashflow	−0.162 ***	−0.165 ***	−0.377 ***	−0.101 **	−0.101 **	−0.102 **
	(−3.39)	(−3.44)	(−7.79)	(−2.02)	(−2.03)	(−2.04)
Growth	−0.000	0.001	0.017 **	0.018 **	0.019 **	0.019 **
	(−0.01)	(0.07)	(2.03)	(2.24)	(2.32)	(2.34)
Board	0.039 **	0.039 **	0.129 ***	−0.002	−0.002	−0.002
	(2.01)	(2.00)	(6.36)	(−0.05)	(−0.06)	(−0.06)
Indep	0.052	0.052	0.137 *	0.009	0.013	0.014
	(0.77)	(0.77)	(1.90)	(0.08)	(0.12)	(0.13)
Dual	−0.002	−0.002	−0.024 ***	−0.016 *	−0.017 *	−0.017 *
	(−0.24)	(−0.31)	(−3.71)	(−1.65)	(−1.71)	(−1.69)
Top1	0.083 ***	0.084 ***	0.134 ***	0.123 **	0.137 ***	0.137 ***
	(4.13)	(4.18)	(6.45)	(2.45)	(2.72)	(2.72)
_cons	−0.022	−0.030	0.671 ***			
	(−0.24)	(−0.32)	(7.22)			

Table 8. *Cont.*

| Variable | OLS | | | FE | | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
	CSR	CSR	CSR	CSR	CSR	CSR
F	279.890	279.232	572.164	414.573	408.510	407.989
R^2	0.431	0.431	0.370	0.612	0.611	0.611
N	28,574	28,574	28,574	28,177	28,177	28,177

Note: T values are in brackets; ***, ** and * indicate $p < 0.001$, $p < 0.01$ and $p < 0.05$, respectively.

5. Further Research

Although digital transformation in different value chain segments can significantly improve overall CSR performance, its impact on the dimensions of social responsibility may differ. For example, digital manufacturing transformation focuses on product manufacturing, R&D design, process flow, and resource utilization [9]; digital marketing transformation focuses on the expansion of marketing network, construction of digital experience environment, and implementation of precision marketing [6]; and digital management transformation provides general support to digital manufacturing and digital marketing through digital technology innovation for process flow, business processes, and management processes [18]. To examine the impact of the digital transformation of value chains on the different types of social responsibility, we refer to the five dimensions of social responsibility measured by Hexun, namely, shareholder responsibility (CSR_shr); employee responsibility (CSR_emp); supplier, customer, and consumer rights responsibility (CSR_cus); environmental responsibility (CSR_env); and public responsibility (CSR_pub). The impact of CSR_shr, CSR_emp, CSR_cus, CSR_env, and CSR_pub and the variables Dig_manu, Dig_market, and Dig_manage are simultaneously substituted into Model (1) to examine the impact of digital transformation in different parts of the value chain on the different dimensions of CSR.

The regression results in columns (1)–(5) of Table 9 show that Dig_manu has a significantly positive coefficient with CSR_shr only, Dig_market has a significantly positive coefficient with CSR_pub only, and Dig_manage has a significantly positive coefficient with CSR_shr and CSR_emp only. These results indicate that digital manufacturing transformation can significantly enhance shareholder responsibility but has no significant impact on the other types of social responsibility performance. As for digital marketing transformation, it can significantly improve public responsibility, but it does not exert a significant effect on the other types of social responsibility performance. Meanwhile, digital management transformation can significantly improve shareholder responsibility and employee responsibility, but it has no significant effect on the other types of social responsibility performance.

For example, digital manufacturing transformation should make a significant contribution to environmental responsibility, in addition to shareholder responsibility. Digital marketing transformation should focus not only on public responsibility, such as public welfare donations and tax contributions, but also on the impact on shareholder responsibility and supplier, customer, and consumer responsibility. Digital management transformation, which runs through all aspects of the corporate value chain, should contribute significantly to social responsibility performance in other areas, in addition to shareholder and employee responsibility. The above analysis shows that there is a certain degree of value mismatch between the digital transformation of the value chain and social responsibility performance in different dimensions. This may be due to the insufficient strength and depth of transformation of some enterprises, resulting in inconsistent and large differences in the degree of digital transformation of different value chain links and in an uneven overall quality of transformation. The value mismatch may also be attributed to the condition in which effective integration and efficient synergy among various business systems of the value

chain have yet to be achieved. The results imply that the digital transformation of enterprise value chains needs continuous improvement and optimization.

Table 9. Impact of digital transformation of value chains on different types of social responsibility.

VARIABLE	(1) CSR_shr	(2) CSR_emp	(3) CSR_cus	(4) CSR_env	(5) CSR_pub
Dig_manu	0.021 ***	−0.003	0.006	−0.002	0.004
	(5.96)	(−0.27)	(0.69)	(−0.10)	(0.64)
Dig_market	−0.006	−0.066	0.012	−0.005	0.040 **
	(−0.78)	(−1.58)	(0.68)	(−0.15)	(2.54)
Dig_manage	0.014 ***	0.073 ***	−0.005	−0.004	−0.007
	(2.83)	(2.59)	(−0.46)	(−0.23)	(−0.78)
Size	0.058 ***	0.746 ***	0.015 ***	0.024 ***	0.041 ***
	(17.03)	(35.59)	(2.92)	(3.70)	(7.11)
Lev	−0.271 ***	−0.044	−0.057 *	0.017	−0.010
	(−12.97)	(−0.42)	(−1.74)	(0.38)	(−0.28)
SOE	−0.004	0.594 ***	−0.025 **	0.032 **	−0.017
	(−0.63)	(13.42)	(−2.56)	(2.27)	(−1.43)
FirmAge	−0.028 ***	0.098 *	0.020	−0.071 ***	0.099 ***
	(−3.43)	(1.80)	(1.47)	(−3.82)	(6.82)
BM	0.057 ***	−0.243 ***	−0.011 *	0.013 *	0.035 ***
	(11.74)	(−8.95)	(−1.94)	(1.89)	(4.72)
ROA	9.665 ***	2.089 ***	0.468 ***	−0.359 **	3.661 ***
	(78.44)	(5.76)	(4.15)	(−2.32)	(28.14)
Cashflow	−0.483 ***	0.932 ***	0.111	0.188 **	−0.052
	(−9.97)	(3.59)	(1.55)	(2.06)	(−0.67)
Growth	0.011	0.032	−0.005	0.056 ***	0.015
	(1.33)	(0.73)	(−0.39)	(3.16)	(1.06)
Board	0.045 **	0.206 *	0.004	0.029	−0.093 ***
	(2.55)	(1.81)	(0.15)	(0.85)	(−2.90)
Indep	−0.209 ***	1.502 ***	0.042	0.053	−0.065
	(−3.49)	(3.87)	(0.50)	(0.50)	(−0.59)
Dual	−0.000	−0.037	0.013	−0.009	−0.001
	(−0.07)	(−1.10)	(1.16)	(−0.56)	(−0.06)
Top1	0.146 ***	−0.583 ***	−0.002	−0.021	0.112 ***
	(8.07)	(−4.98)	(−0.05)	(−0.52)	(3.43)
_cons	0.786 ***	−14.468 ***	2.271 ***	1.995 ***	−0.008
	(9.39)	(−26.17)	(19.20)	(12.75)	(−0.05)
F	227.240	102.398	44.489	81.070	138.312
R^2	0.586	0.205	0.323	0.435	0.176
N	28,572	28,574	2997	2998	28,336

Note: T values are in brackets; ***, ** and * indicate $p < 0.001$, $p < 0.01$ and $p < 0.05$, respectively.

6. Conclusions and Discussion

6.1. Conclusions

Using a sample of Chinese A-share listed companies from 2010 to 2020, we empirically examined the impact of the digital transformation of value chains on CSR performance and the moderating roles of property ownership and market dependence based on stakeholder theory, signaling theory, and resource dependence theory. The findings show that the digital transformation of value chains can promote CSR performance. Specifically, the digital transformations of manufacturing, marketing, and management processes can significantly improve CSR performance, but digital management transformation has a greater enhancement effect when the three types of digital transformation are conducted at the same time. Non-SOEs and enterprises with higher market dependency show greater improvement in their CSR performance than SOEs and enterprises with lower market dependency as a result of the digital transformation of value chains. Further analysis reveals that digital manufacturing transformation only significantly affects shareholder responsibility, digital marketing transformation only significantly affects public responsibility, and digital man-

agement transformation significantly affects both shareholder responsibility and employee responsibility. This result indicates a certain degree of value mismatch between the digital transformation of the different parts of the enterprise value chain and social responsibility performance in different dimensions.

6.2. Theoretical Implications

Based on the existing research on digitalization, this study extends the scope of digital transformation, and theoretically demonstrates the unique value created by combining digitalization with core physical elements, which enriches the research on digital transformation. In addition, this study deepens the research on digital transformation and corporate social responsibility. Although existing studies have proved the positive effects of digital transformation on CSR performance, they have not placed digitalization in the specific business processes of enterprises, and stakeholders' demands still need to be translated into practical actions to fulfill CSR through digital transformation. We investigated the positive effects of digital transformation and internal value chain activities, and unveiled the "black box" of digital transformation to enhance corporate social responsibility. Furthermore, we considered the effects of property ownership and market dependence, which remedies the existing studies.

6.3. Practical Implications

This study offers important policy insights and practical implications. First, building a digital nation has become a global consensus, and digital competitiveness has become the focus of a new round of competition among countries worldwide. Enhancing the digital competitiveness of enterprises requires a continuous search for the fit between the digital and physical aspects of business, as well as systematic and consistent implementation. In this way, digitalization can penetrate deeply into the core production factors; connect front-end demand and back-end production; realize the integration and digitalization of R&D, production, supply, marketing, and services; and facilitate the overall digital transformation of the whole value chain. The ultimate goal of digital transformation is to achieve a harmonious alignment of corporate and social interests.

Second, this study identifies the current mismatch between the digital transformation of the different value chain links and the value of social responsibility performance in different dimensions, which has strong practical significance. Enterprises should, on the one hand, actively promote and optimize the precision and depth of the combination of digital technology and production factors to enhance their own digital transformation capabilities. On the other hand, they should actively promote effective integration and efficient collaboration among various business systems in the value chain to realize value chain-matched social responsibility value. The government should, on the one hand, improve and perfect the data security supervision system, accelerate the reserve and training of digital talents, innovate the way to support the digital transformation of enterprises, and build a whole-chain and whole-process digital ecology, so as to effectively accelerate the digital transformation of the whole value chain of enterprises. On the other hand, it should establish an effective CSR supervision system, which helps to improve the fulfillment and assessment mechanism of social responsibility. It should also build a diversified social responsibility incentive and compensation system, which helps to guide the willingness of enterprises to fulfill their social responsibility, and ensure that enterprises with better fulfillment of social responsibility obtain more high-quality resources, so as to effectively promote sustainable development of society.

6.4. Limitations and Extensions

We empirically examined the impact of the digital transformation of the value chain on CSR performance, and thoroughly explored the moderating role of property ownership and market dependency. This study offers theoretical support and empirical reference for enterprises

to accelerate the strength and depth of the digital transformation of the value chain, and promote enterprises to realize the two-wheel drive of business value and social value.

There are also some limitations to this study. Firstly, this study focuses on Chinese listed companies, and the findings may be more applicable to countries in emerging economies with high digital economy development rather than all countries, which makes the generalization of the findings somewhat limited. Future research will be extended to various economies around the world to compare the different impacts of digital transformation on CSR in different economic systems. Secondly, the study of digital transformation of the value chain needs to be extended. Enterprises' internal value chain activities not only include manufacturing, marketing, and management, but also involve R&D, procurement, inventory, and logistics. However, because the digital transformation of enterprises involving such links has only begun, the data that can be crawled are limited, and a large sample study cannot be conducted. Therefore, only digital manufacturing, marketing, and management of the key business links of the value chain are selected as the research objects in this study. With a continuous follow-up and deepening of the digital transformation of each business link in the enterprise value chain, the research on digital R&D and procurement can be further expanded. In addition, digital transformation involves not only the enterprise value chain but also the supply chain and industrial chain, all of which form a digital ecosystem containing technology, talent, organization, strategy, and other elements. This study is conducted only from the perspective of the value chain and will thus be expanded to deepen the research in this area in the future.

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