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Can China's Digital Economy and Green Economy Achieve Coordinated Development?

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Abstract: The coordinated development of the digital economy and green economy is a key issue that needs to be addressed. Based on the statistical data of 30 provincial-level regions in China from 2014 to 2019, this study empirically analyzed whether China's digital economy and green economy can achieve coordinated development. In this study, a coupling coordination degree model was used to evaluate the degree of coordinated development of the digital economy and green economy in provincial regions of China. A fuzzy-set qualitative comparative analysis method was adopted to identify the realization path of the coordinated development of the digital economy and green economy. The results show the following: (1) the coordinated development degree of the digital economy and green economy in China shows an upward trend from primary coordination in 2014 to intermediate-level coordination in 2019, with great differences between different regions; (2) there are five paths to achieve coordinated development of the digital economy and green economy, which are divided into two categories (technology–environment dual-drive type, and technology–organization–environment linkage drive type); (3) technological innovation capability and government financial support can substitute for one another under certain conditions to achieve the coordinated development of the digital economy and green economy. These conclusions provide a theoretical basis for countries to formulate policies to promote the coordinated development of their digital economy and green economy.

Keywords: digital economy; green economy; coordinated development; driving path

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1. Introduction

In recent years, with the rapid development of big data, cloud computing, 5G, and other digital technologies, the digital economy has become an important engine for the economic development of countries around the world [1]. More importantly, the control of the COVID-19 pandemic has intensified the development of the digital economy. Meanwhile, the global call to shift to a greener economy has intensified due to increasing environmental concerns, especially during the COVID-19 pandemic [2]. The digital economy has green value, which can improve green total-factor productivity and promote energy transition [3,4]. However, digital infrastructure—the carrier of digital economic development—is not always green and environmentally friendly, often being labelled as "steel mills that do not smoke" and "energy giants" [5,6]. The development of the digital economy can consume a lot of resources and cause environmental pollution; hence, the digital economy and environmental protection inhibit one another [7]. Therefore, how to drive the coordinated development of the digital economy and green economy is an imperative and noteworthy issue. According to the 2021 Digital China Development Report released by the Cyberspace Administration of China, the size of China's digital economy increased from CNY 27.2 trillion to CNY 45.5 trillion from 2017 to 2021, ranking second in the world. The Chinese government put forward a dual carbon target at the UN General

Assembly in 2020, showing that China is eager to develop its green economy. This indicates that it is very representative to take China as an example to explore the driving path of the coordinated development of the digital economy and green economy, as well as providing practical experience for other developing countries.

The emergence and popularization of advanced technologies such as the Internet of things, big data, and artificial intelligence have brought about the era of the digital economy. Based on information and communications technology (ICT), the digital economy has become the main economic form after the agricultural economy and industrial economy [8]. The central characteristic of the digital economy is that it takes the integrated application of information and communications technology as significant driving forces, and a modern information network as the main carrier, making the digital economy the main force in changing the global pattern of competition [4,9,10]. The digital economy enables all aspects of society to carry out digital transformation, meaning that people's lives and production change significantly. The development of the digital economy can bring many advantages to society. For example, the digital economy can improve information processing and decision-making efficiency, save costs, and improve profits in business organizations. For the whole society, the digital economy offers new opportunities for businesses and job markets. Moreover, the digital economy contributes to the provision of equitable public services such as healthcare and education, and it affects social governance mechanisms by enhancing the quality of interactions between governments and their citizens [11].

The digital economy not only drives the development of the green economy, but also inhibits the development of the green economy to some extent. On the one hand, digital technologies can power the green transformation of economies. Digital technology can promote the green transformation of manufacturing enterprises by integrating digital technology such as 5G and the Internet of things into the processes of green innovation and green production [12]. Moreover, the digital economy can reduce energy consumption in the commercial building sector, optimize power and infrastructure systems, and enhance energy efficiency [3,13,14]. The digital economy can improve green economic efficiency and green economic growth through technological innovation and industrial structure optimization [15–17]. On the other hand, the development of the digital economy depends on data centers, Internet platforms, and other infrastructure, which consume a lot of electricity. The 24-h operation of data centers is bound to increase energy consumption, and high energy consumption is one of the great challenges facing data centers [6]. The China Academy of Information and Communications Technology estimates that the energy consumption of data centers in 2020 was 57.67 billion kWh, based on relevant industry data. It is urgent to save energy and reduce emissions in 5G infrastructure, big data centers, industrial Internet, and other new infrastructure, which requires strengthening the use of clean energy and green equipment/technologies [5]. Therefore, the coordinated development of the digital economy and green economy is an urgent issue for governments of all countries. In terms of the coordinated development of the digital economy and green economy, existing research has explored the degree of their coordinated development by taking 30 provincial-level regions in China as research samples [1,18]. However, the factors and mechanisms influencing the coordinated development of the digital economy and green economy are still uncertain based on the existing research. How can China harmonize the development of the digital economy and green economy? This is the key scientific question that this study needs to address. Therefore, it is of great theoretical value and practical significance to reveal the driving mechanism of the coordinated development of the digital economy and green economy.

Before understanding the driving mechanism of the coordinated development of the digital economy and green economy, it is necessary to scientifically measure the degree of their coordinated development. The coupling coordination degree model is often used to assess the degree of coordination of two systems [19–21]. The concept of coupling and coordination comes from physics, which emphasizes the linkage, action law, and action result of internal elements of two or more systems and the comprehensiveness of action results between systems [22]. The coupling coordination degree model can reveal the relationships of interaction and coordination symbiosis among system elements. Therefore, this study uses the coupling coordination degree model to evaluate the degree of coordinated development of the digital economy and green economy in 30 provincial-level regions in China. In this study, the fuzzy-set qualitative comparative analysis (fsQCA) method is adopted to explore the driving mechanism of the coordinated development of the digital economy and green economy from a configuration perspective. Based on set theory, the fsQCA method regards cases as configurations of causal attributes and analyzes the causal complexity underlying economic phenomena [23]. The fsQCA method can identify the configuration of antecedent conditions for achieving the coordinated development of the digital economy and green economy. The occurrence of a phenomenon does not depend on only one condition, but on the result of the joint action of multiple antecedent conditions. The founding idea of the fsQCA method conforms to the operation law of economic phenomena. Therefore, the fsQCA method is used to reveal the realization path (the configuration of the antecedent conditions) for the coordinated development of the digital economy and green economy in this study.

The purpose of this study is to reveal the realization path of coordinated development of the digital economy and green economy from a configurational perspective. This study makes the following three marginal contributions to extend the existing research: Firstly, the evaluation index systems of the digital economy and green economy for provincial regions in China are established, and then they are weighted by using the vertical and horizontal scatter degree method, which is suitable for panel data. The coupling coordination degree model is adopted to assess the degree of coordinated development of the digital economy and green economy. This is the first time that the vertical and horizontal scatter degree method has been added to the calculation process of the coupling coordination degree model, solving the limitation that the entropy weight method is only applicable to cross-sectional data. Secondly, the antecedent conditions for the coordinated development of the digital economy and green economy are selected from the technology–organization–environment (TOE) research framework, which is widely used to determine the influencing factors of certain economic phenomena. Finally, the driving path of the coordinated development of the digital economy and green economy is identified by using the fsQCA method from a configuration perspective. Moreover, the alternative relationship between conditions is revealed in achieving the coordinated development of the digital economy and green economy. The conclusions provide a new perspective to understand the realization path of the coordinated development of the digital economy and green economy, providing a theoretical basis for China and other developing countries to implement digital and green development strategies.

The rest of this paper is arranged as follows: Section 2 describes the theoretical basis and conceptual framework of this study. The establishment of the evaluation index systems of the digital economy and green economy, along with the evaluation of the degree of coordinated development, is presented in Section 3. Section 4 presents the fsQCA method and the driving path of the coordination degree of the digital economy and green economy. Section 5 presents the conclusions and implications of this study.

2. Theoretical Basis

Tornatizky and Fleischer proposed the technology–organization–environment (TOE) framework, which is a highly generalized theoretical model [24]. The TOE framework emphasizes the impact of the multilevel technology application context on the effects of technology application, including technological conditions, organizational conditions, and environmental conditions [25]. Technological conditions refer to the characteristics of the technology itself and its relationship with the organization, with a focus on the alignment between technology and the organization, and whether technology can bring benefits to the organization [26]. Organizational conditions indicate the degree of influence of organizational characteristics on the application of technology, including organizational scale and institutional arrangement [27,28]. Environmental conditions refer to the degree of demand for technology by external environmental factors such as market demand and competition intensity [29]. Today, the TOE framework is applied not only at the firm level, but also at the government and regional levels [25,28,29]. In this study, the TOE framework is extended and applied to the regional economic system to explore the driving factors of the coordinated development of the digital economy and green economy, as shown in Figure 1.

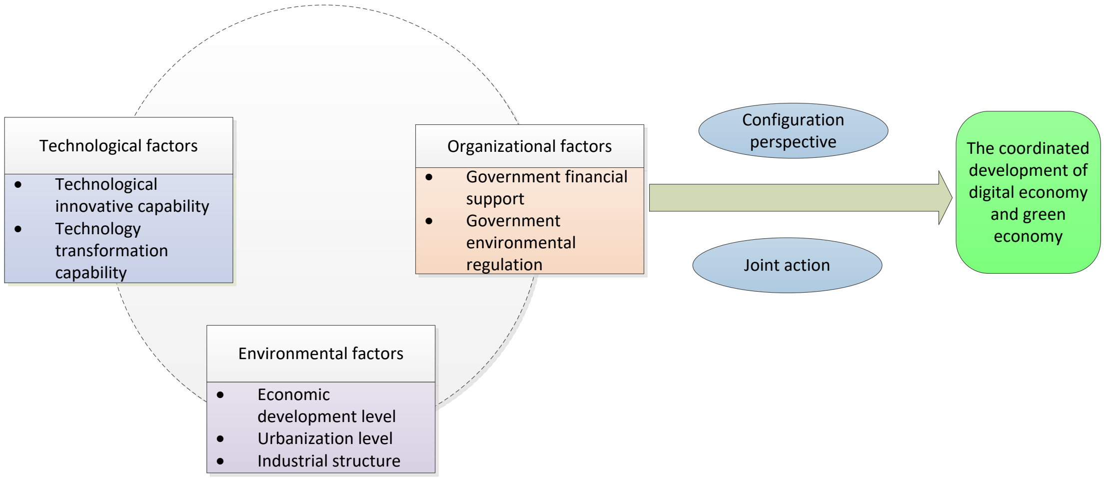

Figure 1. The conceptual framework.

In terms of technological factors, technological innovation capability and technological transformation capability are essential to provide technical guarantees for the coordinated development of the digital economy and green economy. The green economy focuses on green production and consumption through the invention of green technologies as well as clean energy use [30]; it requires green technological innovation to improve clean production capacity and reduce pollutant emissions [31]. The digital economy requires technological innovation to continuously update and improve digital technologies such as big data and artificial intelligence. Regional technological innovation capability reflects the ability of regions to develop new technologies or improve traditional technology. Technological transformation capacity refers to the ability of regions to transform new technologies into productivity, truly representing the role of technological innovation activities in the coordinated development of the green economy and digital economy. Therefore, technological innovation capability and technology transformation capability are regarded as technological factors affecting the coordinated development of the digital economy and green economy in this study.

In terms of organizational factors, the government is undoubtedly the most important organizer in the regional economic system. The levels of the economic system can be influenced by government interventions to facilitate societal innovations towards the digital economy and green economy [32]. The role of government in the coordinated development of the regional digital economy and green economy is mainly reflected in two aspects: financial support and policy support. The government can provide financial support for the coordinated development of the digital economy and green economy, such as government investment in education, healthcare, and digital infrastructure. In addition, the government determines the development direction of the digital economy and green economy by making relevant policies; for example, environmental regulations and the confirmation of data rights. Achievement of green development goals in the economy depends on the local government's decision-making preferences and reasonable environmental regulatory instruments [33]. Therefore, governmental financial support and environmental regulations are regarded as organizational factors affecting the coordinated development of the digital economy and green economy in this study.

In this study, environmental factors are not factors outside the regional economic system; rather, they are factors that affect the coordinated development of the digital economy and green economy, in addition to organizational factors and technological factors. In terms of environmental factors, the economic development level, urbanization level, and industrial structure have an important impact on the coordinated development of the digital economy and green economy. The economic development level is the basis for the development of the digital economy and green economy. Regions with high levels of economic development tend to pursue high-quality economic growth, have digital infrastructure for digital economic development, and have a strong desire to develop a green economy [34]. Conversely, the conditions and willingness to develop the digital economy and green economy are relatively low in regions with low levels of economic development. When the level of urbanization in a region is high, it indicates that the region is in a high development stage. Its population quality and infrastructure are at excellent levels, which is conducive to the coordinated development of the digital economy and green economy [35]. The development of the digital economy and green economy is closely related to the level of industrial structure [34]. Different industrial structures mean that there are great differences in the development levels of the regional digital economy and green economy. It is generally recognized that a high proportion of tertiary industry is often more conducive to the development of the digital economy and green economy, because the tertiary industry tends to be environmentally friendly and is the pillar industry in the development of the digital economy.

According to the above analysis, based on the TOE framework, regional technological innovation capacity, technology transformation capacity, government financial support, government environmental regulations, economic development level, urbanization level, and industrial structure can be seen as antecedent conditions for the coordinated development of the digital economy and green economy. By using the fsQCA method, this study explores the realization path of the coordinated development of the digital economy and green economy under the joint action of these factors from the perspective of configuration.

3. Evaluation of the Coordination Degree of the Digital Economy and Green Economy

3.1. Measurement of the Digital Economy and Green Economy

The concept of the digital economy appeared in the 1990s, when Tapscott first proposed the concept of a "digital economy era" in his work [36]. The digital economy is based on information and communications technology and the Internet as a carrier platform to promote the exchange of goods and services in digital form [37,38]. With respect to the measurement of the digital economy, existing studies have established some index systems from different aspects. The Organization for Economic Co-operation and Development built a measure of digital economy with four aspects: investing in smart infrastructure, empowering society, unleashing creativity and innovation, and delivering growth and jobs [39]. The U.S. Bureau of Economic Analysis evaluated the development of the digital economy from three perspectives: digital-enabling infrastructure, e-commerce, and digital media [40]. Chen and Wu built a measure of digital economy using six metrics: digital infrastructure construction level, digitalization level of the society advanced by ICT, digital technological innovation capability, economic growth promoted by ICT, development level of emerging digital economy industries, and the capitalization level of digital economy enterprises [41]. Liu et al. constructed an evaluation index system for the digital economy with three dimensions: informatization development, Internet development, and digital transaction development [34]. On the basis of comprehensive consideration of international authoritative indicators and data availability, this study evaluates the levels of development of the digital economy in three respects: informatization development, Internet development, and digital transaction development [34]. The established measurement index for the digital economy is shown in Table 1A.

Table 1. (**A**) Measurement Index of Digital Economy. (**B**) Measurement Index of Green Economy.

(A)			
First-Level Indicators	**Second-Level Indicators**	**Measurement Index**	**Unit**
Informatization development index	The foundation of informatization	The proportion of information-based workers (+)	%
	The effect of informatization	Proportion of total telecom service in GDP (+)	%
		Proportion of software revenue in GDP (+)	%
Internet development index	The foundation of fixed-end Internet	Number of Internet broadband access ports per capita (+)	Items/person
	The foundation of mobile Internet	Popularization rate of mobile telephones (+)	%
	The effect of fixed-end Internet	Proportion of broadband Internet users (+)	%
	The effect of mobile Internet	Proportion of mobile Internet users (+)	%
Digital transaction development index	The foundation of digital transactions	Number of websites per 100 enterprises (+)	Items
		Number of computers used by enterprises per 100 people (+)	Items
		Proportion of enterprises with e-commerce transactions (+)	%
	The effect of digital transactions	Proportion of e-commerce sales in GDP (+)	%

(B)		
Three Dimensions	**Measurement Index**	**Unit**
Green life	Number of public transport vehicles per 10,000 people (+)	Items
	Number of public toilets per 10,000 people (+)	Items
Green production	Comprehensive utilization rate of general industrial solid waste (+)	%
	Energy consumption per GDP (−)	10,000 tons of standard coal/100 million CNY
	Emissions of exhaust pollutants per unit of GDP (−)	Tons/100 million CNY
	Discharge of wastewater pollutants per unit of GDP (−)	10,000 tons/100 million CNY
Green ecology	Carbon emissions per capita (−)	Tons/person
	Park green space per capita (+)	Square meters/person
	Forest coverage rate (+)	%
	Green coverage rate of built-up area (+)	%

Note: (+) positive dimensions; (−) negative dimensions. The raw data are sourced from the *China Energy Statistical Yearbook* and the *China Statistical Yearbook*.

With respect to the measurement of the green economy, there are two measurement methods in the existing research: one is to build an index system to comprehensively measure the development level of the green economy [18,42,43]; the other is to measure the development efficiency of the green economy through the data envelopment analysis method, which measures the operational efficiency of the green economic system [31,44,45]. The aim of this study is to comprehensively evaluate the green economy system, so this study evaluates the development level of the green economy by establishing an indicator system. Based on the study of Xu and Liu [18], this study measures the green economy in three dimensions: green life, green production, and green ecology, as shown in Table 1B.

3.2. Measurement of the Degree of Coordination between the Digital Economy and Green Economy

In this study, the coupling coordination degree model is used to calculate the degree of coordination between the digital economy and green economy. Before applying the coupling coordination degree model, it is necessary to use the weighting method to separately calculate the development levels of the digital economy and green economy in each region [46]. Commonly used weighting methods mainly include the subjective weighting method, principal component analysis method, entropy method, and vertical and horizontal scatter degree method. The subjective weighting method mainly assigns weights to indicators based on the subjective understanding of experts, which cannot objectively reflect the real level of the evaluation object. The practical significance of the principal components determined by principal component analysis is often difficult to explain, and there are usually negative weight coefficients. The entropy method is a static weighting method, which is more suitable for determining the weights of cross-sectional data [47]. However, the vertical and horizontal scatter degree method can effectively make up for the shortcomings of the above methods, as it can not only objectively assign weights according to the evaluation data but also be suitable for the dynamic evaluation of the "vertical and horizontal" panel data [48]. Therefore, the vertical and horizontal scatter degree method is used to weight the indicators in this study.

The basic principle of the vertical and horizontal scatter degree method is to show the differences between the evaluation objects as much as possible [48]. By using the vertical and horizontal scatter degree method for weighting, the calculation process of the coupling coordination degree model is as follows:

(1) Making each indicator dimensionless using extreme value processing methods

In order to ensure the comparability of index data, the data are dimensionless before weighting, and the extreme value processing method is used in this paper [49].

Among these indicators, for the bigger the better, there are

$$x_{ij}^{*} = \frac{x_{ij} - x_{i\min}}{x_{i\max} - x_{i\min}} \quad (1)$$

Meanwhile, for the smaller the better, there are

$$x_{ij}^{*} = \frac{x_{i\max} - x_{ij}}{x_{i\max} - x_{i\min}} \quad (2)$$

where γ_{ij} is the normalized value of the j-th indicator of the i-th object, x_{ij} is the original value of the j-th indicator of the i-th object before standardization, and $x_{i\min}$ and $x_{i\max}$ are the minimal and the maximal values of the j-th indicator, respectively.

$$y_i(t_k) = \sum_{j=1}^{m} w_j x_{ij}^{*}(t_k) \quad (3)$$

where $y_i(t_k)$ means the comprehensive evaluation value of the i-th province in the period t_k. $w_j = \{w_1, w_2, \cdots, w_m\}$ is the weight coefficient of each evaluation index. The original value of the j-th indicator in the i-th province in period t_k is $x_{ij}(t_k)$ and $x_{ij}^{*}(t_k)$ is the data value of $x_{ij}(t_k)$ after the extreme value method is processed. Suppose that there are n evaluation objects $s_i = \{s_1, s_2, \cdots, s_n\}$; m evaluation indicators $x_j = \{x_1, x_2, \cdots, x_m\}$; evaluation period $t_k = \{t_1, t_2, \cdots, t_p\}$.

(2) Weighting the indicators using the vertical and horizontal scatter degree method

The overall difference between the evaluation objects s_i can be described by $\sigma^2 = \sum_{k=1}^{p} \sum_{i=1}^{n} [y_i(t_k) - \bar{y}]^2$, which is the sum of squared total deviations of the comprehensive evaluation value $y_i(t_k)$, where, $\overline{y} = \frac{1}{p}\sum_{k=1}^{p}\left(\frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{m} w_j x_{ij}^*(t_k)\right) = 0$, so $\sigma^2 = \sum_{k=1}^{p}\sum_{i=1}^{n}(y_i(t_k))^2 = \sum_{k=1}^{p}[w^T H_k w] = w^T\sum_{k=1}^{p} H_k w = w^T H w$. $H = \sum_{k=1}^{p} H_k$ is the symmetric matrix of $m \times m$. $w = (w_1, w_2, \cdots, w_m)^T$, $H_k = A_k^T A_k$, and $A_k = [x_{ij}^*(t_k)]_{n\times m}$. If we suppose that $w^T w = 1$, when w is the standard eigenvector corresponding to the largest eigenvalue of matrix H, σ^2 takes the maximum value. Meanwhile, when $w > 0$, the weight coefficient can be calculated from the programming model of Formula (4). In general, the sum of the weight coefficients of all indicators should be 1; thus, the final weight coefficient $w_j^* = w_j / \sum_{j=1}^{m} w_j$.

$$\max w^T H w \quad \text{s.t.} \quad w^T w = 1 \; w > 0 \tag{4}$$

Finally, according to the determined index weight coefficient and index value, the linear weighting method is used to calculate the comprehensive evaluation index of the digital economy and green economy of each province in different years.

(3) Calculating the degree of coordination between the digital economy and green economy

According to the coupling degree model of multiple subsystems, the coupling model of two subsystems used in this paper is Formula (5) [20]:

$$C_{ab} = 2[U_a U_b / (U_a + U_b)^2]^{1/2} \tag{5}$$

where U_a represents the digital economy system, U_b represents the green economic system, and C is between [0, 1]; the smaller C is, the smaller the coupling degree between the two subsystems, and vice versa. However, the coupling degree can only represent the degree of interaction between the two systems; it cannot show the quality of coordination. Therefore, we further introduce the coupling coordination degree function, which is shown as Formula (6):

$$F_{ab} = \alpha U_a + \beta U_b$$

$$T_{ab} = \sqrt{C_{ab} \times F_{ab}} \tag{6}$$

where F is the comprehensive value of the digital economy and green economy and T is the coordination degree. α and β represent the weights of two subsystems on the degree of coordination, respectively—usually $\alpha = \beta = 0.5$, which is due to the fact that the two systems of digital economy and green economy are equally important [50].

Referring to the studies by Zhou and Zhao [21,51], this study uses the uniform distribution function method to classify the coupling coordination degree of the digital economy and green economy into 10 levels, as shown in Table 2.

Table 2. Hierarchical division of coupling coordination relationships.

Coupling Coordination Degree Value Interval	**(0.0~0.1)**	**[0.1~0.2)**	**[0.2~0.3)**	**[0.3~0.4)**	**[0.4~0.5)**
Level of coordination	1	2	3	4	5
Degree of coupling coordination	Extreme dissonance	Serious dissonance	Moderate dissonance	Mild dissonance	On the verge of dissonance
Coupling coordination degree value interval	[0.5~0.6)	[0.6~0.7)	[0.7~0.8)	[0.8~0.9)	[0.9~1.0)
Level of coordination	6	7	8	9	10
Degree of coupling coordination	Barely coordinated	Primary coordination	Intermediate level coordination	Good coordination	Quality coordination

3.3. Sample and Data Sources

In this study, 30 provincial-level regions in China (excluding Tibet, Taiwan, Hong Kong, and Macau, because of data shortages) were considered as the research sample. In China, these 30 provincial-level regions are controlled by local provincial governments, each with its own geographical location and economic development characteristics. In addition, data can be easily collected in these 30 provincial regions. The raw data in this study were sourced from the *China Energy Statistical Yearbook*, the *China Statistical Yearbook*, and the *China Statistical Yearbook on Science and Technology*. Since 2014, China's Bureau of Statistics has released the numbers of mobile Internet users; therefore, this study assesses the degree of coordinated development of the digital economy and green economy from 2014 to 2019.

3.4. The Coordination Degrees of the Digital Economy and Green Economy

In this study, a coupling coordination degree model is used to measure the degree of coordination between the digital economy and green economy, as shown in Table 3, where it can be seen that the coordination degree of the digital economy and green economy in China shows a steady upward trend from 0.623 in 2014 to 0.740 in 2019, at an average annual growth rate of 4.39%. The degree of coupling coordination developed from primary coordination in 2014 to intermediate-level coordination in 2019. This indicates that China's digital economy and green economy are developing well in coordination. Under the macro control of the Chinese government, China's digital economy has developed rapidly and strictly practiced the concept of green development.

Table 3. Coordination degree of the digital economy and green economy in each province of China.

Regions		2014	2015	2016	2017	2018	2019	Mean Value	Ranking
Eastern China	Beijing	0.850	0.878	0.886	0.904	0.909	0.915	0.890	1
	Tianjin	0.642	0.670	0.699	0.727	0.739	0.760	0.706	10
	Hebei	0.605	0.641	0.681	0.698	0.718	0.734	0.679	16
	Shanghai	0.777	0.791	0.804	0.813	0.813	0.830	0.805	2
	Jiangsu	0.708	0.746	0.760	0.782	0.793	0.805	0.766	5
	Zhejiang	0.749	0.793	0.803	0.815	0.827	0.836	0.804	3
	Fujian	0.707	0.732	0.743	0.758	0.779	0.785	0.751	7
	Shandong	0.635	0.670	0.705	0.723	0.752	0.762	0.708	9
	Guangdong	0.745	0.771	0.785	0.794	0.813	0.818	0.788	4
	Hainan	0.699	0.729	0.763	0.769	0.784	0.798	0.757	6
	Mean value	0.712	0.742	0.763	0.778	0.793	0.804	0.765	First
Central China	Shanxi	0.562	0.594	0.621	0.635	0.657	0.670	0.623	28
	Anhui	0.622	0.676	0.698	0.720	0.742	0.760	0.703	12
	Jiangxi	0.600	0.655	0.650	0.677	0.709	0.731	0.670	17
	Henan	0.564	0.603	0.630	0.656	0.688	0.698	0.640	25
	Hubei	0.622	0.657	0.688	0.698	0.721	0.737	0.687	14
	Hunan	0.599	0.631	0.664	0.674	0.706	0.719	0.666	18
	Mean value	0.595	0.636	0.659	0.677	0.704	0.719	0.665	Third
Western China	Inner Mongolia	0.579	0.598	0.643	0.669	0.680	0.681	0.642	24
	Guangxi	0.571	0.534	0.575	0.612	0.671	0.705	0.611	29
	Chongqing	0.644	0.681	0.713	0.737	0.770	0.783	0.721	8
	Sichuan	0.620	0.669	0.705	0.722	0.749	0.772	0.706	11
	Guizhou	0.552	0.587	0.633	0.653	0.693	0.720	0.640	26
	Yunnan	0.586	0.629	0.655	0.672	0.698	0.715	0.659	20
	Shaanxi	0.619	0.652	0.687	0.692	0.710	0.721	0.680	15
	Gansu	0.542	0.584	0.634	0.657	0.689	0.718	0.637	27
	Qinghai	0.544	0.596	0.652	0.674	0.716	0.728	0.652	21
	Ningxia	0.580	0.597	0.644	0.668	0.695	0.703	0.648	23
	Xinjiang	0.533	0.566	0.589	0.604	0.639	0.660	0.599	30
	Mean value	0.579	0.608	0.648	0.669	0.701	0.719	0.654	Fourth

Table 3. *Cont.*

Regions		2014	2015	2016	2017	2018	2019	Mean Value	Ranking
Northeast China	Liaoning	0.633	0.665	0.700	0.716	0.725	0.736	0.696	13
	Jilin	0.603	0.616	0.651	0.678	0.698	0.716	0.660	19
	Heilongjiang	0.578	0.599	0.651	0.667	0.695	0.706	0.649	22
	Mean value	0.604	0.627	0.667	0.687	0.706	0.719	0.668	Second
Whole China	Mean value	0.623	0.653	0.684	0.703	0.726	0.740	0.688	—

From 2014 to 2019, the coordination degrees of the digital economy and green economy in the 30 provincial-level regions varied greatly. Beijing (mean value of 0.890) had the highest degree of coordination between the digital economy and green economy, while Xinjiang (mean value of 0.599) had the lowest degree of coordination, and the former was 1.48 times that of the latter. The top five provinces were Beijing, Shanghai, Zhejiang, Guangdong, and Jiangsu, all of which are located in the eastern part of China. The bottom five provinces were Guizhou, Gansu, Shanxi, Guangxi, and Xinjiang, which are located in the central and western regions of China. Among the four regions, the coordinated development level of the digital economy and green economy showed great differences. The coordinated development level of the eastern region was the highest (mean value of 0.765), followed by the northeastern region (mean value of 0.668), central region (mean value of 0.665), and western region (mean value of 0.654). By comparing the coordination degree values of the 30 provinces in 2014 and 2019, we found that the provinces with the fastest development of the coordination degree were Qinghai, Gansu, Guizhou, and Sichuan, which are all located in the western region. The coordination between the digital economy and green economy is rising slowly in Beijing, Shanghai, and Guangdong, which originally had a high degree of coordination.

From the development trend of the coordination degree of the digital economy and green economy in 4 major regions and 30 provincial regions of China, we can find that the coordinated development degree of the digital economy and green economy in the eastern, central, western, and northeastern regions of China showed a trend of steady increase. Compared with the national average, the coordinated development of the digital economy and green economy in the eastern region was much higher than the national average, while that of the northeastern region, central region, and western region was lower than the national average. Moreover, the coordinated development degrees of the digital economy and green economy in northeast China, central China, and western China are relatively similar. Moreover, the coordinated development degree of the digital economy and green economy in China's 30 provincial regions is unbalanced. However, from 2014 to 2019, the coordinated development degree of the digital economy and green economy in the 30 provincial-level regions in China continued to rise every year. This indicates that China's digital economy and green economy have shown a good momentum of development. During the period of 2014 to 2019, the degree of coordination between the digital economy and green economy in Beijing was in a stage of good coordination, while the degree of coordination between the digital economy and green economy in Shanghai, Jiangsu, Zhejiang, Fujian, Guangdong, and Hainan was in the intermediate coordination stage. The coordination degree of the digital economy and green economy in Hunan, Guangxi, Guizhou, Gansu, Qinghai, Ningxia, and Heilongjiang was greatly improved, from the barely coordinated level in 2014 to the intermediate coordination level in 2019. This shows that these provinces have made great efforts in the coordinated development of the digital economy and green economy.

4. The Driving Path of the Coordination Degree of the Digital Economy and Green Economy

4.1. Fuzzy-Set Qualitative Comparative Analysis

The fuzzy-set qualitative comparative analysis method is one of many qualitative comparative analysis methods. Qualitative comparative analysis (QCA) is a method proposed by the American sociologist Ragin in 1987 to analyze the causal complexity of social phenomena based on set theory [52]. The QCA method regards the case studied as the conditional configuration and analyzes the relationship between the conditional configuration and the outcome variable of the case from the perspective of configuration [53]. The QCA method has the dual advantages of quantitative and qualitative analysis, enabling it not only to analyze large sample cases, but also to carry out systematic analysis of the conditional configuration of a case. The QCA method can reveal various combinations of different conditions to achieve a certain result and clarify the substitution relationships of different condition variables in the process. This method can also effectively determine the causal relationships between the combination of antecedent conditions and the coordinated development of the digital economy and green economy from the perspective of configuration. Therefore, the QCA method is very suitable for analyzing the driving path of the coordinated development of the digital economy and green economy.

According to different data coding methods, the QCA method can be divided into clear-set qualitative comparative analysis (csQCA), multi-value qualitative comparative analysis (mvQCA), and fuzzy-set qualitative comparative analysis (fsQCA) [54]. The csQCA method uses dichotomous variables and only allows the values of the variables to be 0 or 1, which may lead to the loss of information carried by the variables [55]. The mvQCA method uses multiple values to partition variables, but the multiple values are not continuous. In order to analyze continuous variables, Ragin developed fuzzy-set qualitative comparative analysis based on fuzzy set theory, which can convert equidistant scale data into fuzzy membership scores (values that vary between 0 and 1) through calibration [56]. Based on the fuzzy set theory, the fsQCA method transforms variables into fuzzy numbers between 0 and 1, which can express the case information more accurately than the csQCA and mvQCA methods. Since the original data of each variable used in this paper are continuous, this paper uses the fsQCA method to explore the driving path of the coordinated development of the digital economy and green economy.

Calibration of data requires researchers to determine three qualitative breakpoints based on theoretical and practical knowledge: full membership, full non-membership, and crossing point [52]. The fsQCA method can produce three solutions: a "complex solution", "parsimonious solution", and "intermediate solution". Complex solutions provide less information and are often unnecessary [57]. Parsimonious solutions often eliminate necessary conditions. Intermediate solutions do not allow the elimination of necessary conditions, and they generally outperform both parsimonious solutions and complex solutions [54]. Therefore, the results presented in this paper are all intermediate solutions.

The fsQCA method needs to use the index of consistency and coverage to determine the relationships between antecedent conditions and outcome variables. In the result analysis of the configurations of conditions, the consistency index represents the closeness of the subset relationship between the configurations of conditions and the result variable, and a consistency value of configurations of conditions higher than 0.8 is generally accepted [57,58]. Coverage can explain the proportion of all cases that fit this configuration, and it is divided into raw coverage and unique coverage, where larger coverage tends to be better [54]. Consistency can determine whether the conditions are sufficient and necessary for the outcome. The consistency formula for condition X being a sufficient condition for outcome Y is as follows:

$$Consistency(X_i \leq Y_i) = \sum(\min(X_i, Y_i))/\sum(X_i) \tag{7}$$

where X_i denotes the membership of case i in the antecedent condition and Y_i denotes the membership of case i in the result variable. When all Y_i values are less than or equal to the corresponding X_i values, the consistency value of this condition equals 1. If the consistency value of a condition exceeds 0.9 and the coverage value exceeds 0.5, this condition is considered to be a necessary condition for the result [59,60]. In the application of the fsQCA method, the necessity of individual conditions and the adequacy of combinations of conditions are usually analyzed and described [61].

4.2. Measurement and Calibration of Variables

4.2.1. Result Variable

The purpose of this study is to reveal the driving path of the coordinated development of the digital economy and green economy; therefore, the degree of coordinated development of the digital economy and green economy is the result variable in this paper.

4.2.2. Antecedent Variables

Based on the TOE framework, this study considers regional technological innovation capacity, technology transformation capacity, government financial support, government environmental regulation, economic development level, urbanization level, and industrial structure as antecedent variables. Since patents are a reliable measure of technological innovation capability, this study uses the number of invention patents granted to measure technological innovation capacity [62]. Technology market turnover can reflect technology transformation and application capability; therefore, technology market turnover is used to measure technology transformation capability in this study [63]. Government financial support can provide financial support for the coordinated development of the digital economy and green economy, which is measured by the proportion of fiscal general budget expenditure in regional GDP. General budget expenditures involve education, medical care, environmental protection, transportation, public services, and security, which can effectively describe governmental support for the coordinated development of the digital economy and green economy. Government environmental regulation is an essential policy tool for the economic development towards the direction of green ecology; this paper measures the level of regional environmental regulation from the perspective of the final effect of the environmental regulation, and it uses the harmless disposal rate of household garbage for measurement [64–66]. In order to eliminate the influence of the regional population size on economic development, the level of regional economic development is measured by per capita regional GDP. The proportion of urban population in the total population is used to measure the level of urbanization [67]. The tertiary industry is the main industry for the development of the digital economy. Moreover, the development of the tertiary industry emits less pollution to the environment and is economically friendly. Therefore, this study uses the ratio of the added value of the tertiary industry to regional GDP to measure industrial structure. The raw data of antecedent variables were sourced from the *China Statistical Yearbook* (2018–2020).

4.2.3. Calibration of Data

Calibration of data is a very critical step in the application of the fsQCA method. Through calibration, the data of isometric scales can be converted into fuzzy set scores between 0 and 1. Since the fsQCA method cannot analyze the panel data, and in order to avoid the contingency caused by using the data of a certain year, this study learns from the practice of Khedhaouria and Thurik to use the average value of the 30 provincial regions in the years of 2017, 2018, and 2019 to conduct empirical analysis. The fs/QCA 3.0 software was used to calibrate the data using a direct method [68]. Following the study of Khedhaouria and Thurik, the 90th, 50th, and 10th percentiles of each variable were considered as the full membership, crossover point, and full non-membership, respectively. Three qualitative anchors of each variable are shown in Table 4.

Table 4. Three qualitative anchors of each variable.

Variable Type	Variable Name	Abbreviation	Full Membership	Crossover Point	Full Non-Membership
Result variable	Coordination degree	CO	0.8177	0.7123	0.6641
Technological factors	Technological innovation capacity	TI	40,140.6	6031.8333	687.1333
	Technology transformation capacity	TA	1217.222	215.2667	12.1683
Organizational factors	Government financial support	GOV	0.4050	0.2292	0.1503
	Government environmental regulation	ER	99.9967	98.8833	88.0233
Environmental factors	Economic development level	ECO	108,292.2	52,668.1667	39,716.3333
	Urbanization level	URB	0.8272	0.6032	0.4981
	Industrial structure	IND	0.6220	0.5055	0.4646

4.2.4. Analysis of Necessary Conditions

A necessary condition for the coordinated development of the regional digital economy and green economy means that when the region realizes the coordinated development of the digital economy and green economy, the condition must exist. Before determining the driving path of the coordinated development of the digital economy and green economy, it is necessary to first analyze whether a single condition variable is a necessary condition for the coordinated development of the digital economy and green economy. In this study, fs/QCA 3.0 software was used to calculate the consistency and coverage of individual antecedents for the presence or absence of outcome variables; the results are shown in Table 5. From Table 5, we can see that the consistency value of "~TI" for "~CO" is higher than 0.9 and the coverage value exceeds 0.5, which means that "~TI" is a necessary condition for "~CO". This indicates that when the degree of coordination between the digital economy and green economy in a region is low, the technological innovation capacity of the region is also low. The consistency values of the remaining conditions are all less than 0.9, indicating that the remaining conditions are not necessary to achieve a high or low degree of coordination between the digital economy and green economy.

Table 5. Analysis of necessary conditions.

Variables	CO		~CO	
	Consistency	Coverage	Consistency	Coverage
TI	0.7602	0.8867	0.4015	0.4726
~TI	0.5479	0.4756	0.9038	0.7918
TA	0.7763	0.7960	0.4645	0.4808
~TA	0.4936	0.4773	0.8029	0.7837
GOV	0.5218	0.5000	0.8109	0.7843
~GOV	0.7749	0.8023	0.4831	0.5048
ER	0.8433	0.7375	0.5945	0.5249
~ER	0.4568	0.5274	0.7027	0.8190
ECO	0.8145	0.8386	0.4499	0.4676
~ECO	0.4829	0.4652	0.8447	0.8213
URB	0.7649	0.8093	0.4824	0.5152
~URB	0.5419	0.5091	0.8215	0.7791
IND	0.7542	0.7379	0.5833	0.5760
~IND	0.5666	0.5739	0.7346	0.7510

4.3. Configuration of Conditions for Achieving the Coordinated Development of the Digital Economy and Green Economy

4.3.1. Configuration Analysis and Typical Case Analysis

By running a truth table on the software fs/QCA 3.0, configurations of conditions for achieving a high coordination degree of the digital economy and green economy were obtained, as presented in Table 6. The intermediate solution generated by the software operation was regarded as the realization path of the coordinated development of the digital economy and green economy, and the core conditions and peripheral conditions in each realization path were determined by comprehensively considering the intermediate solution and the parsimonious solution. In the analysis of configuration adequacy, we set the case frequency threshold as 1, and a more restrictive consistency threshold for the solution was chosen as 0.80, which exceeds the minimum recommended value of 0.75 [54]. Meanwhile, Table 6 also shows some parameters that describe the characteristics of each path, such as consistency, raw coverage, unique coverage, overall solution consistency, and overall solution coverage. Raw coverage is the proportion of cases that fit this configuration, unique coverage is the proportion of cases that fit only this configuration and no other configurations, and overall solution coverage explains the combined coverage of all cases.

Table 6. Configuration of conditions for a high coordination degree.

Variables	H1	H2	H3	H4	H5
TI	●	●	●	●	⊕
TA	⊕	●	●	●	●
GOV	⊕	⊕	⊕	⊕	●
ER	●		⊕	●	⊕
ECO	●	●	⊕	●	●
URB	●	●	⊕	⊕	●
IND		●	●	⊕	●
Consistency	0.9660	0.9812	0.9446	0.9151	0.9405
Raw coverage	0.2284	0.4199	0.1828	0.3034	0.1695
Unique coverage	0.0522	0.1648	0.0275	0.0663	0.0167
Overall solution consistency	0.9491				
Overall solution coverage	0.6249				
Frequency cutoff	1				
Consistency cutoff	0.9151				

Note: Full circles (●) and crossed-out circles (⊕) indicate the presence and the absence of causal conditions, respectively. Green circles (● and ⊕) indicate the core conditions, while red circles (● and ⊕) indicate the peripheral conditions, and the blank cells represent those conditions that do not matter for the outcome.

Table 6 shows that there are five configurations of conditions (paths) to achieve the coordinated development of the digital economy and green economy: configuration H1, configuration H2, configuration H3, configuration H4, and configuration H5. Previous studies have proven that the acceptable standard of sufficient conditional consistency is 0.8 [57,69]. The consistencies of these five configurations all exceed 0.8, indicating that they are sufficient conditions for the coordinated development of the digital economy and green economy.

Under the joint action of multiple antecedents, the five configurations H1–H5 can all enable the coordinated development of the digital economy and green economy, and each configuration includes multiple antecedent conditions. This indicates that a single condition is not sufficient to achieve the coordinated development of the digital economy and green economy, and the configurations of the coordinated development of the digital economy and green economy have the characteristics of equivalence and multiple concurrency.

The overall consistency of the five configurations is 0.9271, indicating that 92.71% of the regions that meet the five configurations have a high degree of coordinated development of the digital economy and green economy. Meanwhile, the overall solution coverage of these five configurations is 0.6726, indicating that these five configurations can explain 67.26% of the regions with coordinated development of the digital economy and green economy.

Configuration H1 (raw coverage of 0.2284 and consistency of 0.9660) shows that the presence of technological innovation capacity, government environmental regulations, economic development level, urbanization level, and the absence of technology transformation capacity and government financial support can achieve the coordinated development of the digital economy and green economy. This indicates that a region with high levels of technological innovation capacity, government environmental regulations, economic development, and urbanization, along with low levels of technology transformation capacity and government financial support, can achieve a high degree of coordination between the digital economy and green economy, in which these conditions all serve as the peripheral conditions. Figure 2 shows that the regions that correspond to configuration H1 are Fujian and Chongqing. The Evaluation Report on China's Regional Innovation Capacity (2021) shows that Chongqing and Fujian rank 12th and 13th among the 31 provincial-level regions in terms of innovation capacity, respectively. Strong technological innovation ability provides strong technical support for the coordinated development of the digital economy and green economy. Digital facilities adopt green technology, and digital technology promotes green transformation of the traditional economy. Chongqing and Fujian have a high intensity of environmental regulation, which provides a supporting tool for economic transformation towards green development. The high levels of economic development and urbanization in Chongqing and Fujian provide a foundation for the coordinated development of the digital economy and green economy.

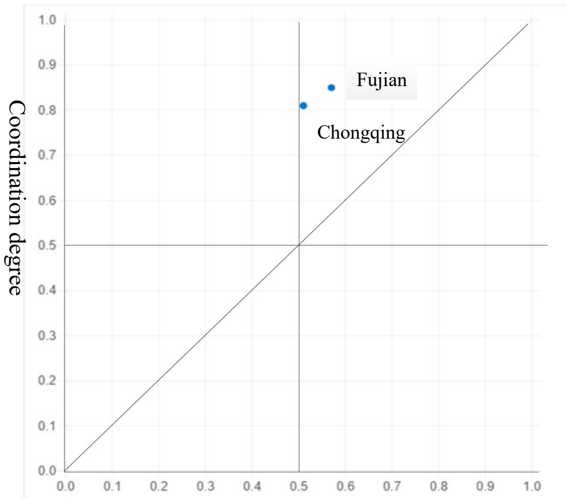

Figure 2. Configuration H1.

Configuration H2 (raw coverage of 0.4199 and consistency of 0.9812) has the highest consistency, raw coverage, and unique coverage among all of the configurations, indicating that configuration H2 is the primary configuration for regions to achieve a high degree of coordination between the digital economy and green economy. Configuration H2 shows that high levels of technological innovation capacity, technology transformation capacity, economic development, urbanization, and industrial structure, along with low levels of government financial support, can together lead to the coordinated development of the digital economy and green economy, in which the economic development level, urbanization level, and industrial structure are the core conditions, while the other conditions are the peripheral conditions. Figure 3 shows that the regions that correspond to configuration H2 are Beijing, Guangdong, Shanghai, Zhejiang, Shandong, and Liaoning, which are all located on the east coast of China. Rich universities, research institutes, and enterprises in these regions strengthen their technological innovation capability and technology transformation capacity. Moreover, these regions have high levels of economic development and urbanization, and their tertiary industry has been well developed, accounting for a relatively high proportion of regional GDP.

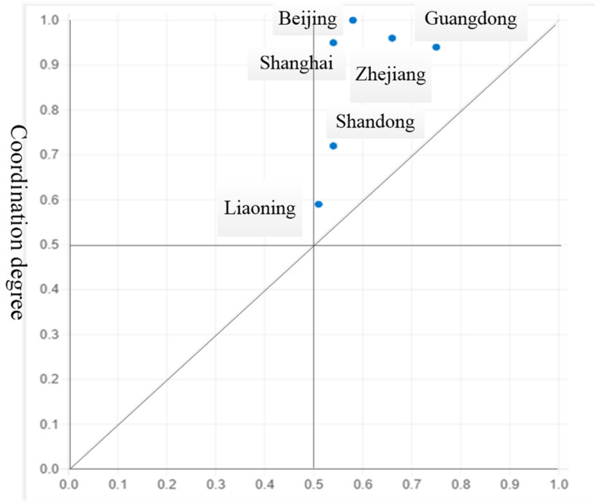

Figure 3. Configuration H2.

Configuration H3 (raw coverage of 0.1828 and consistency of 0.9446) shows that the combination of the presence of technological innovation capacity, technology transformation capacity, and industrial structure, in the absence of government financial support, government environmental regulation, economic development level, and urbanization level, can generate sufficient conditions for the coordinated development of the digital economy and green economy. This indicates that high levels of technological innovation capacity, technology transformation capacity, and industrial structure, along with low levels of government financial support, government environmental regulation, economic development, and urbanization, can lead to a high degree of coordination between the digital economy and green economy. In configuration H3, technological innovation capacity, government environmental regulations, and industrial structure serve as the core conditions, while the other conditions are the peripheral conditions. Figure 4 shows that the typical case that fits configuration H3 is Sichuan, which is in the southwest of China. Sichuan has a large number of strong colleges and universities, providing it with strong technological innovation capacity and technology transformation capacity. In recent years, tertiary industry has developed into the leading industry in Sichuan; therefore, tertiary industry accounts for a relatively high proportion of Sichuan's GDP.

Configuration H4 (raw coverage of 0.3034 and consistency of 0.9151) shows that the combination of the presence of technological innovation capacity, technology transformation capacity, government environmental regulations, and economic development level, in the absence of government financial support, urbanization level, and industrial structure, can lead to the coordinated development of the digital economy and green economy. This indicates that high levels of technological innovation capacity, technology transformation capacity, government environmental regulation, and economic development, along with low levels of government financial support, urbanization, and industrial structure, can together lead to a high level of coordinated development between the digital economy and green economy, in which technological innovation capacity, government environmental regulations, economic development level, and industrial structure are the core conditions, while the other conditions are the peripheral conditions. Figure 5 shows that the typical case that fits configuration H4 is Anhui, which is located in the hinterland of central China. Anhui attaches great importance to innovation activities, and the R&D investment intensity there in the past two years has been more than 2%. According to the Evaluation Report of China's Regional Innovation Ability, Anhui's comprehensive innovation ability has been ranked among the top 10 in China in recent years, effectively promoting the development of digital technologies and green technologies. Anhui has strict environmental regulations and implements the third-party treatment of environmental pollution so as to improve the effect of environmental pollution control and effectively promote the development of the green economy. Moreover, the high level of economic development in Anhui provides a material guarantee for the coordinated development of the digital economy and green economy.

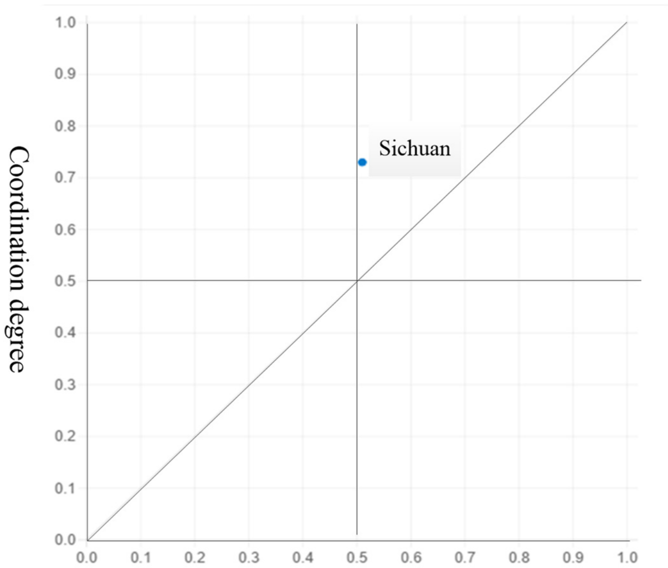

Figure 4. Configuration H3.

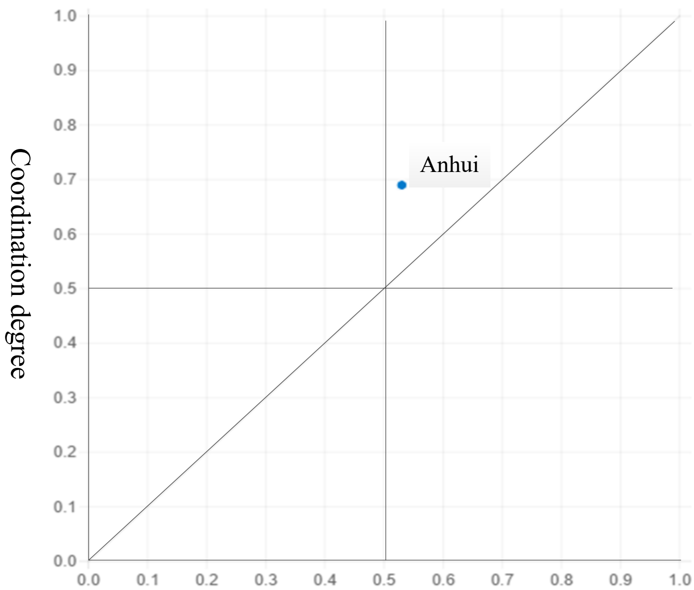

Figure 5. Configuration H4.

Configuration H5 (raw coverage of 0.1695 and consistency of 0.9405) has the lowest consistency, raw coverage, and unique coverage among the five configurations, which shows that configuration H5 is the rarest path for regions to achieve coordinated development of their digital economy and green economy. Configuration H5 shows that high levels of technology transformation capacity, government financial support, economic development, urbanization, and industrial structure, along with low levels of technological innovation capacity and government environmental regulations, can together lead to a high degree of coordination between the digital economy and green economy. In configuration H5, the economic development level, urbanization level, and industrial structure serve as the core conditions, while the other conditions serve as the peripheral conditions. Figure 6 shows that the typical case that fits configuration H5 is Tianjin, which is located in the eastern coastal area of China, with good conditions for economic development. Although Tianjin's technological innovation ability is weak, it has a strong technology transformation ability, with the advantage of being in the Beijing–Tianjin–Hebei region. Moreover, government financial support, high urbanization, and the leading development of tertiary industry provide prerequisites for the coordinated development of the digital economy and green economy.

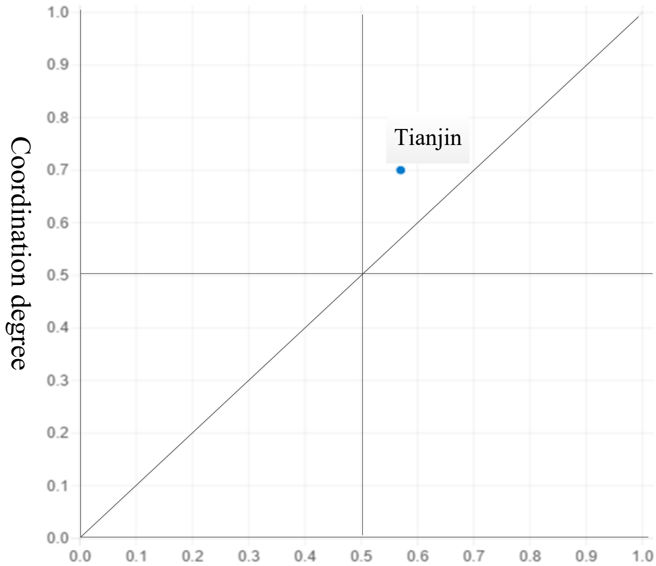

Figure 6. Configuration H5.

Based on the TOE framework, the antecedent conditions for this study were selected from three aspects of technology, organization, and environment. Table 6 shows that the five paths to achieving the coordinated development of the digital economy and green economy consist of conditions from different aspects of technology, organization, and environment. According to the characteristics of the antecedent conditions, the five configurations for achieving the coordinated development of the digital economy and green economy can be divided into two categories: technology–environment dual drive type (configurations H2 and H3), and technology–organization–environment linkage drive type (configurations H1, H4, and H5). In the technology–environment dual drive type (configurations H2 and H3), the high-level antecedent conditions all come from both technological and environmental aspects. Similarly, in the technology–organization–environment linkage drive type (configurations H1, H4, and H5), the high-level antecedent conditions come from three aspects of technology, organization, and environment.

4.3.2. Causal Asymmetry Analysis

The negative set of outcome variables was analyzed to explore "causal asymmetry" [28]. Table 7 shows that there also are five paths to lead to a low degree of coordination between the digital economy and green economy: configurations L1, L2, L3, L4, and L5. By comparing the realization paths with high and low coordination degrees between the digital economy and green economy, we can see that the realization paths to the high and low degrees of coordination of the digital economy and green economy are quite different. This indicates that there is causal asymmetry in the degree of coordination between the digital economy and green economy. The consistency of all five configurations is higher than 0.8, indicating that these five configurations are all sufficient conditions for a low degree of coordination between the digital economy and green economy. The configurations L1 and L2 (with the highest raw coverage of 0.5355 and 0.4904, respectively, and consistency of 0.9865 and 0.9827, respectively) both comprise the presence of the core condition government financial support and the absence of other conditions. This indicates that some regions cannot achieve the coordinated development of the digital economy and green economy by relying solely on government financial support. Configuration L3 shows that the sole presence of the peripheral condition government environmental regulation leads to a low degree of coordination between the digital economy and green economy, which indicates that the coordinated development of the digital economy and green economy cannot be achieved through government environmental regulations alone. From configurations L1, L2, and L3, we can conclude that a high degree of coordination between the digital economy and green economy cannot be achieved through organizational factors alone (i.e., government financial support and government environmental regulation).

Table 7. Configurations of conditions for low coordination degree.

Variables	L1	L2	L3	L4	L5
TI	⊕	⊕	⊕	⊕	⊕
TA	⊕	⊕	⊕	⊕	●
GOV	●	●		●	●
ER		⊕	●	●	⊕
ECO	⊕	⊕	⊕		⊕
URB		⊕	⊕	●	●
IND	⊕		⊕	⊕	●
Consistency	0.9865	0.9827	0.9581	0.9654	0.9669
Raw coverage	0.5355	0.4904	0.3948	0.2780	0.1938
Unique coverage	0.0272	0.0710	0.0564	0.0212	0.0245
Overall solution consistency	0.9548				
Overall solution coverage	0.7153				
Frequency cutoff	1				
Consistency cutoff	0.9478				

Note: the meanings of the symbols in Table 7 are the same as those in Table 6.

Configuration L4 shows that the combination of the presence of the core condition—government financial support—and the peripheral conditions—government environmental regulation and urbanization level—can constitute a sufficient condition for a low degree of coordination between the digital economy and green economy. This indicates that a region cannot achieve the coordinated development of the digital economy and green economy by relying on organizational factors and a high urbanization level. Configuration L5 shows that the combination of the presence of the core condition—government financial support—and the peripheral conditions—technology transformation capacity, urbanization level, and industrial structure—in the absence of the remaining conditions, can lead to a low degree of coordination between the digital economy and green economy. By comparing configuration L5 with configuration H5, we can conclude that a region with high levels of technology transformation capacity, government financial support, urbanization, and industrial structure can achieve a high degree of coordination between the digital economy and green economy on the condition that its economic development level is high. Without the support of economic development, it is difficult for the digital economy and green economy to develop in a coordinated manner under the above conditions.

4.4. Potential Substitution between Conditions

The fsQCA method can not only explore the realization configuration of the coordinated development of the digital economy and green economy, but also identify the mutual substitution relationships between different conditions through the comparison of different configurations [25,70]. By comparing configurations H2 and H5, which achieve the coordinated development of the digital economy and green economy, it can be seen that technological innovation capability and government financial support can replace one another, and the substitution relationship is shown in Figure 7. When the technology transformation capacity, economic development level, urbanization level, and industrial structure of a region are high, that region can achieve the coordinated development of the digital economy and green economy by improving its technological innovation capability (H2) or increasing government financial support (H5). Technological innovation capability can provide technical support for the coordinated development of the digital economy and green economy; however, government financial support can purchase advanced technologies to promote the coordinated development of the digital economy and green economy. Therefore, technological innovation capability and government financial support can replace one another under certain conditions. If a region has a weak technological innovation capability, it can make good use of the advantages of the developed economy to purchase new technologies to develop the digital economy and green economy.

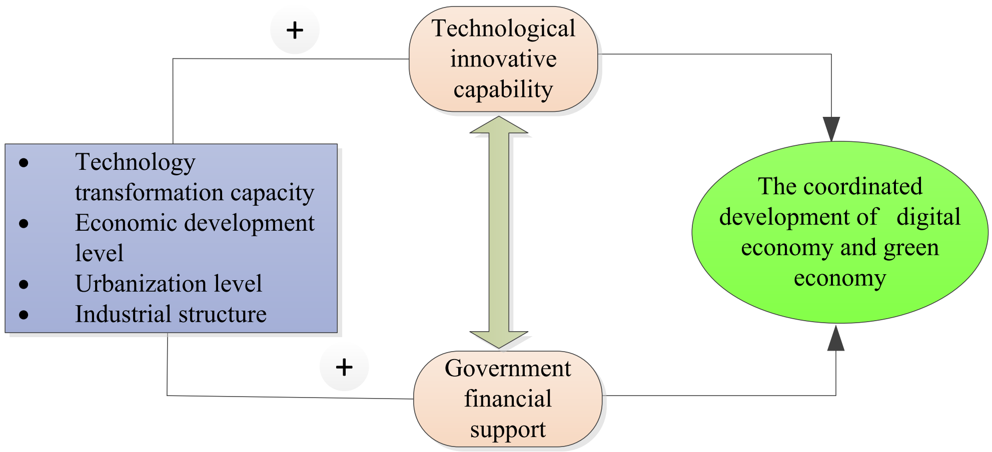

Figure 7. Potential substitution relationships between conditions.

4.5. Robustness Test

This paper tests the robustness of the realization path of a high degree of coordination between the digital economy and green economy. QCA is a set-theoretic method. When slightly changing the operation, there is a subset relationship between the results, which will not change the substantive interpretation of the research findings. In this case, the results can be considered robust [71,72]. In this study, we used three methods to test the robustness of our results. Firstly, we improved the consistency of the PRI from 0.69 to 0.75, yielding two configurations that were exactly consistent with the two solutions in the existing configuration. Secondly, we increased the frequency of cases from 1 to 2, and the resulting configuration was also included in the existing configuration. Finally, we adjusted the crossover point from the median to the 45th quantile, and the resulting configuration after recalibration was essentially consistent with the existing configuration. The above robustness test shows that the results of this paper are relatively robust.

5. Conclusions and Policy Recommendations

5.1. Conclusions

In order to solve the problem of how to achieve coordinated development of the digital economy and green economy, this study explores the realization paths of coordinated development of the digital economy and green economy from a configurational perspective. Based on 30 provincial-level regions in China from 2014 to 2019, we measured the degree of coordination between the digital economy and green economy in China by using the coupling coordination degree model. Moreover, the antecedent conditions were determined according to the TOE framework, and we explored how to drive the coordinated development of the digital economy and green economy by using the fsQCA method. Our research mainly draws the following conclusions: Firstly, the degree of coordination between the digital economy and green economy in China shows a steady upward trend from primary coordination in 2014 to intermediate-level coordination in 2019, and there are great differences in the degree of coordinated development of the digital economy and green economy between the different provincial regions in China, which is consistent with the findings of Hu and Xu [1,18], whose research showed that from the temporal perspective, the degree of coordinated development of China's digital economy and green economy is improving year by year. Moreover, from the spatial perspective, the degree of coordinated development of China's digital economy and green economy is high in the east and low in the west. Secondly, a single condition is not sufficient to achieve the coordinated development of the digital economy and green economy, but combinations of them do lead to the desired outcome, and the realization paths of the coordinated development of the digital economy and green economy have the characteristics of equivalence, multiple concurrency, and causal asymmetry. Thirdly, this study reveals five paths that lead to a high degree of coordination between the digital economy and green economy, which are divided into two categories (technology–environment dual drive type, and technology–organization–environment linkage drive type). Fourthly, the coordinated development of the digital economy and green economy cannot be achieved through organizational factors alone (i.e., government financial support and government environmental regulation). Finally, technological innovation capability and government financial support can replace one another under certain conditions to achieve the coordinated development of the digital economy and green economy.

5.2. Implications

The theoretical contribution of this study is mainly reflected in three aspects: first of all, this is the first time that the vertical and horizontal scatter degree method has been applied to the coupling coordination degree model, which optimizes the coupling coordination degree calculation process and improves its accuracy; secondly, the TOE framework is applied in the selection of the antecedent conditions for the coordinated development of the digital economy and green economy, expanding the understanding of the factors influencing the coordinated development of the digital economy and green economy; thirdly, this study explores the realization paths of the coordinated development of the digital economy and green economy from the perspective of configuration, enriching the perspective to understand the realization paths of the coordinated development of the digital economy and green economy.

The conclusion of this study has the following policy implications for governments to promote the coordinated development of the digital economy and green economy. Firstly, the realization paths of the coordinated development of the digital economy and green economy have multiple concurrency. Regional governments should choose the right path to promote the coordinated development of the digital economy and green economy according to their existing resource endowments and local conditions. Secondly, organizational factors alone cannot achieve the coordinated development of the digital economy and green economy. Regional governments should focus on the joint promotion of technological, organizational, and environmental factors to accelerate the coordinated development of the digital economy and green economy. Finally, the dual driving mode of technology and environment is the main path for regions to achieve the coordinated development of the digital economy and green economy. For regions with weak government financial support and environmental regulations, it is necessary to first improve the levels of digital technology and green technology in the region, as well as the regional environmental conditions.

5.3. Deficiencies and Future Research

Although this study has important theoretical and practical implications, some deficiencies should be presented to be addressed in future research. Firstly, due to the limitation of the fsQCA method on the number of antecedents, only seven antecedent conditions of the coordinated development of the digital economy and green economy were selected. In future studies, the influencing mechanisms of other factors on the coordinated development of the digital economy and green economy should be revealed. Secondly, this study used the fsQCA method to reveal the driving paths of the coordinated development of the digital economy and green economy from a static perspective; future research should attempt to reveal the evolution of driving paths using dynamic QCA methods. Thirdly, the harmless treatment rate of household waste was used to measure environmental regulation in this study, which is not sufficient. In the future, we will choose appropriate indicators or comprehensive indicators to effectively measure environmental regulations. Finally, indicators measuring the digital economy and green economy are incomplete; we will consider adding relevant indicators to comprehensively measure the digital economy and green economy in future studies.

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