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Can Environmental Regulation Improve High-Quality Economic Development in China? The Mediating Effects of Digital Economy

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Abstract: Environmental regulation is an effective environmental policy tool, which can balance the interests of the government, enterprises, and the public and can effectively address the internalization of environmental externalities. The digital economy has emerged as a brand-new force for the advancement of high-quality economic development. In order to successfully come true to high-quality economic development based on coordinated development of environmental protection and economic growth, the primary objective of this paper is to investigate whether environmental regulation promotes high-quality economic development from a digital economy perspective. This paper empirically analyzed the impact of environmental regulation on high-quality economic development in 236 Chinese cities from 2011 to 2019, using the mediation effect model, threshold regression model, and spatial Durbin model. The results demonstrated that environmental regulation has a significant positive effect on the general high-quality economic development. Specifically, formal environmental regulation has a positive nonlinear effect with decreasing marginal effect on high-quality economic development, whereas informal environmental regulation has a positive nonlinear effect with increasing marginal effects. The digital economy is an important path for environmental regulation to strengthen high-quality economic development. Environmental regulation and the digital economy jointly promote high-quality economic development. In spatial effects, formal environmental regulation has a negative spatial spillover effect on high-quality economic development, whereas informal environmental regulation has a positive spatial spillover effect. Based on these conclusions, it is proposed that the government should actively develop and strengthen the interaction mechanism between formal and informal environmental regulation, enhance the integration of digital platforms and environmental regulation, and develop a coordinated development mechanism for the environment and economy across regions.

Keywords: environmental regulation; high-quality economic development; digital economy; mediation effect; threshold effect; spatial spillover effect

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1. Introduction

Since the reform and opening up, China's economy has developed fast and has become the world's second-largest economic entity [1]. However, in the past, economic development relied on higher inputs of production factors and energy, resulting in serious environmental pollution problems. This unsustainable development pattern was at the expense of environmental quality, resulting in increased resource and environmental constraints on economic development [2]. Therefore, China's economic development has entered a new normal period as the shortcomings of the extensive pattern of economic growth become increasingly apparent. Economic growth shows a structural deceleration

and gradually enters a period of medium-high economic growth by enhancing high efficiency, low cost, and sustainability [3]. It can be seen that after entering the new normal, high-quality economic development with the pursuit of high efficiency, green development, and sustainable growth as the core content is the goal of China's economic development and reform. To achieve this goal, the Chinese government has been strengthening and improving environmental regulation in recent years, effectively reducing environmental pollution, repairing damaged ecosystems, and improving environmental quality. The 19th National Congress of the Communist Party of China and the 14th Five-Year Plan of China both propose a new path of high-quality development giving priority to ecological conservation and green development [4].

However, in concrete practice, environmental regulation not only increases the production costs of enterprises but also has high supervision and management costs for the government and society [5]. At the same time, due to the imperfect environmental policy system, there are a series of problems in environmental regulation, including low efficiency in implementing policies and regulations, difficulty in coordinating environmental policies between regions, and insufficient public participation [6]. The digital economy has the advantages of low transaction costs, wide coverage of the population, and effective radiation to less developed regions. It can strengthen the mechanism of environmental regulation on high-quality economic development from three aspects. First, it provides new directions and ways for the rational formulation and smooth implementation of environmental regulation, effectively reduces regulatory costs and deeply explores the potential of public participation, and jointly promotes high-quality economic development [7]. Second, environmental regulation encourages enterprises to improve production methods through technological innovation, promotes industrial upgrading, optimizes industrial structure, and enhances production efficiency [8]. The digital economy promotes enterprises' innovation mainly from two aspects: digital technology and digital finance. It can provide technical support and financial security for enterprises to enhance their production and management [9]. This not only enhances the competitiveness of enterprises but also internalizes the cost of external pollution. Third, it provides an application platform for the integration of the digital economy and traditional industries, promotes the optimization and upgrading of industrial structure, and enhances the quality of economic development. In short, with the goal of green, low-carbon, and sustainable development, environmental regulation and the digital economy have a significant impact on high-quality economic development.

High-quality economic development is led by the concepts of innovation, coordination, green, openness, and sharing and is judged by meeting the growing needs of the people for a better life, which has a multi-dimensional connotation [10]. In the economy, innovation is considered the first driving force, and the "quality" and "quantity" of economic development should be well balanced [11]. In terms of social governance and services, fairness, effectiveness, and comprehensiveness of development are valued, and social welfare and the well-being of residents are enhanced. In terms of the ecological environment, we should improve the policy system of environmental protection and governance, promote green technology innovation, and achieve the goal of green development [12].

The digital economy is one of the positive forces driving high-quality economic development, and it is gradually penetrating into social, economic, and environmental fields. In 2020, the size of China's digital economy accounted for nearly 40% of GDP, with an average annual growth rate exceeding the GDP growth rate in the same period. It plays a supporting role in socioeconomic development [13]. Combining the digital economy with the real economy will achieve the goals of converting economic growth, improving social welfare, and narrowing regional development gaps by promoting industrial change and accelerating factor flow [14]. Using the advantages of accurate identification, real-time tracking, and intelligent monitoring of the digital economy in ecological, environmental protection, it provides a realization path to improve the ecological and environmental

governance system, and enhance modern governance capacity and promote the synergistic development of the digital economy and the green economy.

In the critical context of China's economic development, from rapid growth to high-quality development, the goal of economic development has moved from economic speed and scale to economic quality and efficiency; thus, environmental regulation and high-quality economic development are important research themes. However, the existing studies on environmental regulation and economic growth are no longer applicable to China's current development stage. At the same time, the impact of environmental regulation and the digital economy on high-quality economic development is not clear. Therefore, it is of great theoretical and practical significance to analyze the impact of environmental regulation and the digital economy on high-quality economic development. Specifically, in theory, it can enrich the path of environmental regulation's impact on high-quality economic development; in practice, it can promote the participation of the digital economy in the process of environmental governance and crack the problem that economic development is difficult to take into account environmental protection. Based on the data of 236 cities in China from 2011 to 2019, this paper constructs balanced panel data and uses mediating effects model, threshold model, and spatial Durbin model to empirically analyze the relationship between environmental regulation, digital economy, and high-quality economic development.

2. Literature Review

The environmental policy system, to achieve harmonious development of the economy and the environment, focuses on the formulation and implementation of policies and regulations related to environmental protection and forms an effective monitoring mechanism [15]. Research on environmental regulation, digital economy, and high-quality economic development has received much attention, but the mechanisms by which the three work together are unclear. Based on the principle of mediating effects, it is necessary to analyze step by step the mechanisms of environmental regulation and high-quality economic development, digital economy and high-quality economic development, and environmental regulation and digital economy in a logical sequence of the causal steps approach. Therefore, the literature review is conducted from these three aspects.

The first one is the research on environmental regulation to economic development. Specifically, the relevant studies can be divided into three categories. First, environmental regulation can promote economic growth. Environmental regulation can promote technological innovation, reduce the cost of pollution control, improve production efficiency, and enhance the competitiveness and profitability of enterprises [16]. Second, environmental regulation can restrain economic growth. Environmental regulation increases the cost of pollution control and environmental compliance for enterprises and then has a negative impact on technological innovation, extended reproduction, and economic quality [17]. Third, previous studies have also indicated that the relationship between environmental regulation and economic growth is nonlinear. This may be due to the existence of a dynamic equilibrium between environmental regulation and economic growth [18,19] or the fact that different types of environmental regulation have different effects on economic development [20–22]. In addition, since the new normal, scholars' attention has begun to turn to the study of environmental regulation and economic quality development, but it is still in the exploratory stage. Some literature has argued that environmental regulation can promote high-quality economic development [23,24], while others have also demonstrated a nonlinear relationship between them [12,25,26].

The second research is on the digital economy to high-quality economic development. Data, as a carrier of the digital economy, is a new factor of production and represents the current direction of innovation development and technological progress. According to endogenous growth theory, innovation is the engine of economic growth. Therefore, the digital economy has become an important driver for improving economic quality [27]. Zhang et al. (2021) found that the digital economy has improved high-quality economic

development [28]. Shangguan and Ge (2021) confirmed that digital finance has a positive effect on economic quality by constructing the Spatial Durbin Model [23].

The third kind is the research on the relationship between environmental regulation and the digital economy. As environmental regulation is gradually strengthened, the digital economy plays an important role in both technological innovation and public participation [14]. Specifically, reasonable environmental regulation increases the production demand of enterprises to reduce emissions and consumption, which provides development space for the deep integration of the digital economy and traditional industries and provides new momentum and new ways for industrial optimization and upgrading [29]. At the same time, while the public's willingness to participate in environmental governance has gradually stronger, the Internet and digital technology have become important channels to promote public governance [30].

Few studies have combined environmental regulation, digital economy, and high-quality economic development to explore their impacts and mechanisms. Shangguan and Ge (2021) analyzed the impact mechanisms and spatial effects of digital finance, environmental regulation, and high-quality economic development [23]. Li et al. (2022) analyzed the mechanisms of environmental regulation, digital finance on urban industrial upgrading, digital finance plays a mediating role and threshold effect [31].

Based on the above analysis, it can be found that most of the existing studies focus on the relationship between environmental regulation and economic growth. The research on the effect of environmental regulation on economic quality development is still immature. There are even fewer studies on environmental regulation, digital economy, and high-quality economic development. In addition, related studies mainly analyze static effects, ignoring the issue of time lag of impacts while less considering the effect of different environmental regulation types on high-quality economic development.

On this basis, this paper attempts to discuss the following aspects. Firstly, this paper classifies environmental regulation into two categories, namely, formal environmental regulation and informal environmental regulation, and analyzes the impacts of dual environmental regulations on high-quality economic development by constructing the regression models. Secondly, based on relevant theoretical analysis, this paper analyzes the effects of environmental regulation, digital economy, and high-quality economic development by constructing a unified research framework and using the mediation model and the threshold model. Thirdly, for the consideration of dynamic analysis and spatial correlation, this paper constructs the dynamic spatial Durbin model to explore the dynamic characteristics and spatial spillover effects of dual environmental regulations on high-quality economic development.

3. Theoretical Analysis and Research Hypotheses

How to achieve coordinated development among economy, society, resources, and environment, balance the interests among government, enterprise, and the public, and solve the dilemma of market failure of ecological resources has been the concern of society and the academic community [10,16]. This paper analyzes the impact of dual environmental regulations on high-quality economic development from two aspects: influence mechanism and spatial effect.

3.1. Environmental Regulation and High-Quality Economic Development

3.1.1. Formal Environmental Regulation

Formal environmental regulation, as a policy instrument, has been the main element of environmental regulation for a long time, which takes the government as the leading force in promoting environmental governance through the formulation and implementation of environmental policies [32]. There are two different views. First, based on Porter's hypothesis, formal environmental regulation can promote technological innovation, reduce pollution emissions and energy consumption, improve the allocation efficiency of production factors, optimize the industrial structure, promote industrial transformation

and upgrading, eliminate backward production capacity, and enhance the economic quality [16]. Second, based on neoclassical growth theory, environmental governance increases the production costs of enterprises, reduces innovation input funds, and is not helpful in improving production efficiency and promoting economic growth [17]. However, from the perspective of high-quality economic development, formal environmental regulation has a temporary negative effect on economic growth but internalizes the cost of pollution through government macro-regulation to mitigate the market failure of ecological capital. Moreover, the decomposition and dissipation of pollutants is a long-term process that requires huge financial and social costs, which are often neglected under the neoclassical theory system. Therefore, environmental protection is as important as economic development. Clear waters and green mountains are as good as mountains of gold and silver [22]. In summary, formal environmental regulation increases the opportunity cost of environmental management and hinders economic growth, but contributes to environmental quality, industrial structure, and the well-being of residents, and generally encourages high-quality economic development. The gradual improvement of formal regulation is beneficial to the harmonious development of ecology, environment, society, and economy.

3.1.2. Informal Environmental Regulation

With improving the living environment and life quality as a goal, informal environmental regulation mainly takes advantage of public participation to negotiate or put pressure on the company and government. With the popularity of the Internet and information technology, public attention and participation has been increasing through mass media platforms, so informal environmental regulation has become an important supplement to formal environmental regulation [33]. Specifically, there are two ways in which informal environmental regulation affects high-quality economic development. Firstly, public scrutiny. With public participation, due to improper production management and excessive pollution, the risk of enterprises being exposed to the media increases dramatically. The pressure of public opinion increases the hidden costs of enterprises, such as damaged social image and difficulties in investment and financing [34]. Public scrutiny forces companies to transform and upgrade their industries to achieve the goal of shifting from dealing with pollution to reducing it and reducing the ecological deficit [21]. At the same time, public scrutiny reduces the cost of government regulation, alleviates the crowding-out effect of environmental governance opportunity costs on technological innovation, and improves the efficiency of environmental governance [35]. Secondly, ecological product preference. The combination of ecological resources and market mechanisms has encouraged the approach of valued ecological products. The public's preference for green-certified products promotes not only local governments to continuously improve environmental quality standards but also facilitates relevant enterprises to actively enhance green production technologies [32]. We, therefore, propose the first hypothesis:

Hypothesis 1. *Dual Environmental Regulation plays a direct and positive role in promoting high-quality economic development.*

3.2. Digital Economy and High-Quality Economic Development

A digital economy is a technical approach and an important engine for achieving high-quality economic development, but its specific mechanism needs to be further explored [29]. Based on multi-dimensional perspectives, the existing theoretical analysis mainly includes micro, meso, and macro dimensions. At the micro level, based on "Metcalfe's Law" and the network effect, digital technology and digital finance can improve supply and demand allocation and market mechanism and enhance economic efficiency by accelerating the flow of factors, decreasing costs, and promoting information transparency [36]. At the meso level, the digital economy provides the impetus for high-quality development from two aspects: digital industrialization and industrial digitization. Specifically, on the one hand, the digital economy accelerates the commercialization of data by improving the

value-added data chain and creating strategic new digital industries. On the other hand, based on advanced digital technologies such as big data and cloud computing, the digital economy realizes the integration of traditional industries with the digital economy by promoting the transformation and upgrading of traditional industries in terms of data, the Internet, and intelligence [37]. At the macro level, digital technologies enhance total factor productivity and narrow the development gap between regions by compressing time costs and spatial distances and accelerating the diffusion of advanced technologies [28]. At the same time, the superimposed effect of the digital economy promotes the marginal incremental and spatial spillover effect of economic quality [38]. We, therefore, propose the second hypothesis as follows:

Hypothesis 2. *Digital economy promotes high-quality economic development.*

3.3. Environmental Regulation, Digital Economy, and High-Quality Economic Development

3.3.1. Formal Environmental Regulation

Based on the "innovation compensation effect", formal environmental regulation promotes enterprise technological innovation and industrial upgrading [22]. However, in the vertical direction of the industry, due to time and space barriers and differential land rent, it is difficult to form large-scale, cross-regional business cooperation and industrial chain. The fragmentation of the industrial chain not only increases the cost of intermediate production but also is not good for the advantages of scale. In the regional horizontal direction, the high cost of factor flow leads to local protection barriers and is not conducive to technology innovation and inter-regional cooperation in environmental protection. However, the digital economy can realize virtual agglomeration via the Internet and maximize the spatial and temporal separation of production, supply, and marketing, which promotes effective division of labor in specialization, integration of upstream and downstream industries, and reduces resource and energy consumption in intermediate production process [39]. The digital economy pushes companies to accelerate the pace of innovation by increasing the speed of technology spillover and industry threshold [23]. From a regional perspective, digital technology can provide technical support to unify environmental protection standards between regions, which avoids the phenomenon of "pollution sanctuaries". At the same time, the digital economy can facilitate the marketization of ecological capital across regions by building ecological compensation mechanisms and trading platforms for ecological products [40]. In addition, formal environmental regulation temporarily increases the financial burden on SMEs and capital-weak regions. Digital finance with inclusiveness advantages effectively alleviates the "cost of compliance", which provides opportunities for SMEs and underdeveloped regions [31].

3.3.2. Informal Environmental Regulation

In the past, it was limited that informal environmental regulation promoted environmental protection and environmental supervision in scope and implementation. There are some shortcomings of informal environmental regulation, including asymmetric information, limited channels of public scrutiny, and low interactivity between the public, government, and enterprise [41]. However, on the one hand, the digital economy has the advantage of releasing the potential of public scrutiny and pressure of public opinion, which promotes investment in environmental protection and science and technology [42]. On the other hand, with the digital platform, the digital economy can enhance the valorization of ecological products and improve the inter-regional trading mechanism of ecological products [43]. Meanwhile, big data and remote sensing technology provide technical support for quantifying and dynamically monitoring ecological assets, which provides a guarantee for the sustainability of ecological protection and has a positive effect on high-quality development [44]. We, therefore, propose the third hypothesis as follows:

Hypothesis 3. *Digital economy has a significant mediating effect on the impacts of dual environmental regulations on high-quality economic development.*

3.4. Spatial Spillover Effect of Environmental Regulation on High-Quality Economic Development

Based on the first law of geography, the similarities between neighboring regions in terms of resource allocation [38,45], industrial structure, and industry types encourage the high relevance of inter-regional environmental regulation in the process of concrete formulation and implementation [46,47]. Meanwhile, since the new normal, China has paid more attention to the harmonious development of the environment and economy and to the importance of environmental quality in the performance assessment of local governments, which has led to imitation and gaming among adjacent regions [12]. We, therefore, propose the fourth hypothesis as follows:

Hypothesis 4. *Environmental regulation affects the high-quality economic development of neighboring regions through spatial spillover effects.*

4. Methods, Variables, and Data

4.1. Methods

4.1.1. Mediation Model

The test for mediating effects usually consists of two steps. First, the basic model is constructed to determine whether the effect of dual environmental regulations on high-quality economic development is significant. Then, based on significance, the digital economy is added to the basic model to determine the significance of dual environmental regulations indirectly affecting high-quality economic development through the digital economy [38].

Based on the research hypothesis, the basic models of dual environmental regulations on high-quality economic development were constructed to measure the direct effects.

$$lnHiqu_{i,t} = \alpha_0 + \alpha_1 lnForm_{i,t} + \alpha_k lnX_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \quad (1)$$

$$lnHiqu_{i,t} = \alpha_0 + \alpha_2 lnInForm_{i,t} + \alpha_k lnX_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \quad (2)$$

In Equations (1) and (2), $Hiqu_{i,t}$ represents the index of high-quality economic development in the city i in period t. $Form_{i,t}$ indicates formal environmental regulation. $InForm_{i,t}$ represents informal environmental regulation. $X_{i,t}$ denotes control variables. μ_i, δ_t and $\varepsilon_{i,t}$, respectively, represent individual fixed effects, time fixed effects, and random error terms. When considering the elimination of heteroskedasticity to ensure data smoothness, the indicators were logarithmized.

Then the mediating effect model was constructed to verify the indirect effect of environmental regulation on economic quality development, which was the mediating effect of digital economy. Specifically, there were two models. One was the regression model of environmental regulation on the digital economy. The second was the regression model of environmental regulation and digital economy simultaneously on high-quality economic development. Taking formal environmental regulation as an example, the model is written as follows:

$$lnDigeco_{i,t} = \beta_0 + \beta_1 lnForm_{i,t} + \beta_k lnX_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \quad (3)$$

$$lnHiqu_{i,t} = \gamma_0 + \gamma_1 lnForm_{i,t} + \gamma_2 lnDigeco_{i,t} + \gamma_k lnX_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \quad (4)$$

In Equations (3) and (4), $Digeco_{i,t}$ represents digital economy. For informal environmental regulation, the model is constructed as above.

4.1.2. Threshold Model

The threshold model is usually used to analyze the nonlinear characteristics of the influence of the independent variable on the dependent variable. When the independent variable exceeds a certain threshold, it will cause a sudden structural change in the dependent variable. With the abrupt change as the threshold, the effect of the independent

variable on the dependent variable may change significantly. In this paper, it is specifically shown as the nonlinear characteristics of the impact of environmental regulation on high-quality economic development [32]. When using the digital economy as the threshold value, this paper verified the threshold effect of dual environmental regulations on high-quality economic development in the context of the digital economy. The model is written as follows:

$$lnHiqu_{i,t} = \varphi_0 + \varphi_1 lnForm_{i,t} \times I(lnDigeco_{i,t} \leq \theta_1) + \varphi_2 lnForm_{i,t} \times I(\theta_1 < lnDigeco_{i,t} \leq \theta_2) + \varphi_3 lnForm_{i,t} \times I(lnDigeco_{i,t} > \theta_2) + \varphi_k X_{i,t} + \mu_i + \varepsilon_{i,t} \quad (5)$$

$$lnHiqu_{i,t} = \varphi_0 + \varphi_1 lnInForm_{i,t} \times I(lnDigeco_{i,t} \leq \theta_1) + \varphi_2 lnInForm_{i,t} \times I(\theta_1 < lnDigeco_{i,t} \leq \theta_2) + \varphi_3 lnInForm_{i,t} \times I(lnDigeco_{i,t} > \theta_2) + \varphi_k X_{i,t} + \mu_i + \varepsilon_{i,t} \quad (6)$$

Equations (5) and (6), respectively, represent the triple threshold regression models for formal and informal environmental regulation. $I(\cdot)$ is an indicator function. When the digital economy meets the conditions, the value is 1; otherwise, it is 0.

4.1.3. Spatial Durbin Model

Compared with the traditional measurement model, the spatial measurement model adds a matrix of spatial elements to consider the spatial correlation between spatially neighboring subjects [29]. When considering the time lag of the effect, this paper constructed a dynamic panel spatial Durbin model and tested the spatial effect of dual environmental regulations on high-quality economic development. The model is written as follows:

$$lnHiqu_{i,t} = \rho_0 + \rho_1 lnHiqu_{i,t-1} + \rho_2 (WlnHiqu_{i,t}) + \rho_3 lnForm_{i,t} + \rho_4 (WlnForm_{i,t}) + \rho_5 lnX_{i,t} + \rho_6 (WlnX_{i,t}) + \mu_i + \delta_t + \varepsilon_{i,t} \quad (7)$$

$$lnHiqu_{i,t} = \rho_0 + \rho_1 lnHiqu_{i,t-1} + \rho_2 (WlnHiqu_{i,t}) + \rho_3 lnInForm_{i,t} + \rho_4 (WlnInForm_{i,t}) + \rho_5 lnX_{i,t} + \rho_6 (WlnX_{i,t}) + \mu_i + \delta_t + \varepsilon_{i,t} \quad (8)$$

Equations (7) and (8), respectively, represent the dynamic panel Spatial Durbin Models with dual environmental regulations. W donates the spatial weight matrix.

4.2. Variables

4.2.1. High-Quality Economic Development

High-quality economic development is a multi-dimensional and comprehensive concept. It is necessary to construct a multi-level evaluation index system [38,48]. Drawing on relevant studies and considering the availability of statistical data, high-quality economic development can be divided into five dimensions, including economic efficiency and equity, industrial development quality, scientific innovation, residents' welfare, and environmental quality [10,12,29,49]. This paper used principal component analysis to comprehensively measure high-quality economic development.

The details are as follows: (1) economic efficiency and equity (EEE). Maintaining sustained economic growth and sharing the fruits of economic development are both core components of high-quality economic development. This indicator is measured by inclusive TFP [38]. Specifically, this study adopts the Hicks–Moorsteen index to measure inclusive TFP based on the amount of capital and the number of employees as input factors, GDP per capita as desired output, and the urban–rural income gap as non-desired output. (2) Industrial development quality (IDQ). Industrial structure and industrial distribution are important to support high-quality economic development. In order to measure the level of industrial development quality, this study focuses on three aspects: the optimization of industrial structure, the rationalization of industrial structure, and the level of productive service industry [37]. Specifically, the optimization of industrial structure is measured by a ratio of the tertiary industry to secondary industry. The rationalization of industrial structure is obtained by the Thile index, based on the number of employees and output value in the three industries. The productive service industry is expressed by the proportion of the number of employees. (3) Scientific innovation (SI). Scientific innovation is the

endogenous driving force of high-quality economic development, which determines the improvement of social productivity and the absolute advantage in industrial competition. This indicator is measured by total expenditures on science and technology [49]. (4) residents' welfare (RW). Improving the welfare of residents is the goal of pursuing high-quality development, which is essentially human development. Based on a combination of resident income, education expenditure, and healthcare allocation, this indicator is expressed by GDP per capita, education expenditure per capita, and hospital beds per capita [38]. (5) Environmental quality (EQ). The ecosystem and natural environment are the guarantee of ecological security and the source of resources and energy, as well as the important element of green development. Specifically, solid waste utilization, sewage treatment, and PM2.5 concentration are chosen to measure environmental quality comprehensively [50].

4.2.2. Dual Environmental Regulation

Usually, there are two ways to measure formal environmental regulation. One is obtained by the number of administrative punishment cases, completed investment in pollution, or environmental infrastructure investment [32,47]. However, it lacks long-term, continuous panel data in the city dimension. The other is expressed by the reduction of air pollutants, solid waste utilization rate, and waste-water treatment rate [33]. However, if we represent environmental governance as environmental regulation, we will not distinguish the effects of different types of environmental regulation. Based on this, formal environmental regulation selects the proportion of environment-related word frequencies in city government work reports as the proxy indicator.

Traditional informal environmental regulation is measured by the number of petition letters and environmental proposals [50]. With the advent of the digital economy, the public is more inclined to monitor environmental quality through digital platforms such as the Internet and mass media. Based on this, informal environmental regulation selects the search index of environment-related terms in the Baidu index as the proxy indicator.

4.2.3. Digital Economy

The digital economy is measured by the Internet and digital transactions. On the one hand, the Internet and information technology have become the basic medium and technical basis for the rapid development of the digital economy [38]. This study draws on four aspects: the level of Internet penetration, the proportion of related employees, Internet-related output, and the level of cell phone penetration. On the other hand, the combination of the traditional financial service industry with big data and cloud computing has given rise to the digital finance industry [51]. Digital finance can effectively reduce transaction costs and provide development opportunities for SMEs and less developed regions [23]. It is measured by the published Digital Financial Inclusion Index.

4.2.4. Control Variables

The control variables include five indicators such as government intervention (Govern), foreign trade openness (Fore), urbanization (Urban), financial development (Finan), and infrastructure construction (Infras).

Specifically, government intervention is measured by the ratio of local government fiscal expenditure to local GDP. This study uses the ratio of foreign investment to local GDP as the proxy for Fore. The share of the urban population in the total population is used to measure urbanization. This paper adopts the ratio of deposits and loans to GDP to measure financial development. The level of infrastructure construction is measured by the road area per capita.

The variables and the measurement of each variable are displayed in Table 1.

Table 1. Description of variables.

Variables	Measurement	
Formal environmental regulation (Form)	The proportion of environment-related word frequencies in city government work reports	
Informal environmental regulation (Inform)	The search index of environment-related terms in the Baidu index	
Digital economy (Digeco)	The development of the Internet	The level of Internet penetration The proportion of related employees Internet-related output
	Digital transactions	The level of cell phone penetration The published Digital Financial Inclusion Index
High-quality economic development (Hiqu)	economic efficiency and equity	Inclusive TFP
	industrial development quality	The optimization of industrial structure
		The rationalization of industrial structure
		The level of productive service industry
	scientific innovation	Total expenditures on science and technology
	residents' welfare	GDP per capita
		education expenditure per capita
		hospital beds per capita
	environmental quality	solid waste utilization
		sewage treatment
		PM2.5 concentration

4.3. Data

Given the lack of statistical data for some cities, we selected the panel data of 236 cities in China from 2011 to 2019 for research. The data in this paper were obtained mainly from the China City Statistical Yearbook (2012–2020) [52], government work reports, Baidu index (2011–2019) [53], Peking University Digital Inclusive Finance Index (2011–2020) [54], and Wind database (2011–2019) [55]. The government work reports mainly include the annual municipal government work reports issued by 236 cities for the period 2011–2019, and they can be downloaded from their official government websites. These government work reports are generally published at the beginning of each year and show a summary of the previous year's government work and plans for the current year. The indicators about currency are deflated to avoid the interference of inflation, taking 2011 as the base year. The calculation results of the high-quality economic development indicators are shown in Figure 1. High-quality economic development has maintained a gradual growth trend, but the growth rate has fluctuating characteristics.

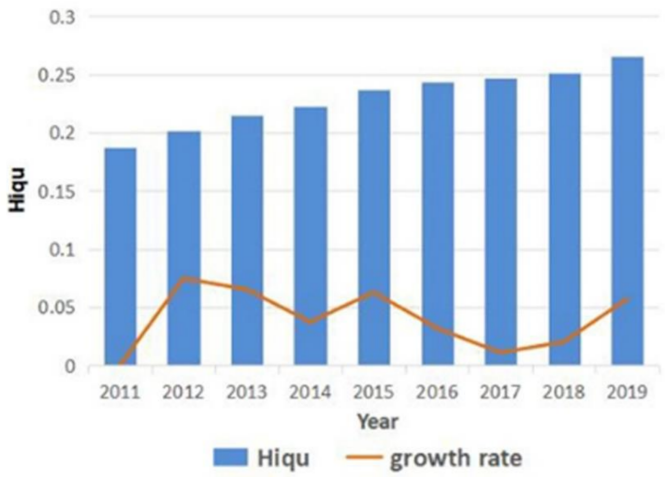

Figure 1. China's high-quality economic development index and growth rate from 2011 to 2019.

To eliminate the effect of heteroskedasticity, we carry on logarithmic processing to the correlation data. According to descriptive statistics, there is a large variability in the indicators. The maximum value of the logarithm of the economic quality development is −0.547, the minimum value is −2.389, and the mean value is −1.477. This indicates a large variation in development between different cities (Table 2). There are also significant differences in other indicators.

Table 2. Descriptive statistics of variables.

Variable		Obs	Mean	Std	Min	Max
Explained variables	lnHiqu	2 124	−1.477	0.239	−2.389	−0.547
Explanatory variables	lnForm	2 124	−7.516	0.419	−9.099	−6.331
	lnInform	2 124	3.273	1.131	1.099	6.230
Mediating variables	lnDigeco	2 124	−1.671	0.450	−3.948	−0.319
Control variables	lnGovern	2 124	−1.847	0.455	−4.321	0.302
	lnFore	2 124	−6.584	1.128	−9.199	−3.660
	lnUrban	2 124	−1.245	0.632	−3.060	0.134
	lnFinan	2 124	−0.157	0.490	−2.136	2.008
	lnInfras	2 124	1.204	0.828	−1.708	3.688

5. Empirical Results

This paper used the Stata14 statistical software to perform Mediation Model and Threshold Model analysis and adopted GeoDa and Stata14 to examine Spatial Durbin Model.

5.1. Analysis of Mediating Effects

Based on the basic regression model, the estimated parameters of formal and informal environmental regulations are 0.058 and 0.041, both reaching the 1% significance level (Table 3). This indicates that the dual environmental regulations have a facilitating effect on high-quality economic development, which verifies hypothesis H1. For the control variables, the coefficients of government intervention, urbanization, financial development, and infrastructure construction are positive and significant, indicating that these factors play important roles in developing the high-quality development pattern. The coefficient of foreign trade openness is negative and significant, indicating that foreign capital may crowd out the local self-innovation and R&D, which leads to the dependence on mature foreign technology.

In the mediation model, on the one hand, the estimated parameters of dual environmental regulations on the digital economy are 0.235 and 0.129, reaching the 1% significant level. On the other hand, after adding the digital economy as a mediator to the model, the estimated parameters of dual environmental regulations on high-quality economic development are −0.002 and 0.009, which are smaller than the corresponding coefficients of the benchmark model. Based on this, it can be judged that the digital economy plays a mediating effect in the path of environmental regulation, indirectly promoting high-quality economic development. Further, based on the Sobel test, the Sobel statistics of dual environmental regulations all reject the original hypothesis at a 1% significance level, and the mediating effect of the digital economy is verified again. In addition, the impact of the digital economy on high-quality economic development is also positive and significant. The result supports hypotheses H2 and H3.

Table 3. Estimates of the impact of dual environmental regulations on high-quality economic development.

Variable	Formal Environmental Regulation			Informal Environmental Regulation		
	lnHiqu	**lnDigeco**	**lnHiqu**	**lnHiqu**	**lnDigeco**	**lnHiqu**
lnForm	0.058 *** (6.16)	0.235 *** (10.80)	−0.002 (−0.21)			
lnInform				0.041 *** (7.86)	0.129 *** (10.56)	0.009 ** (2.05)
lnDigeco			0.254 *** (31.44)			0.250 *** (30.98)
lnGovern	0.108 *** (6.40)	0.161 *** (4.13)	0.067 *** (4.88)	0.101 *** (6.01)	0.129 *** (3.32)	0.068 *** (5.00)
lnFore	−0.019 *** (−4.86)	−0.015 (−1.61)	−0.015 *** (−4.83)	−0.020 *** (−4.97)	−0.017 * (−1.82)	−0.015 *** (−4.80)
lnUrban	0.084 *** (5.52)	0.144 *** (4.12)	0.047 *** (3.82)	0.076 *** (5.03)	0.123 *** (3.49)	0.045 *** (3.68)
lnFinan	0.223 *** (19.27)	0.702 *** (26.27)	0.045 *** (4.07)	0.211 *** (17.99)	0.680 *** (24.89)	0.041 *** (3.75)
lnInfras	0.118 *** (11.81)	0.395 *** (17.19)	0.017 ** (1.97)	0.106 *** (10.50)	0.363 *** (15.49)	0.015 * (1.73)
Constant	−0.969 *** (−11.11)	0.113 (0.56)	−0.998 *** (−14.12)	−1.555 *** (−32.91)	−2.143 *** (−19.15)	−1.019 *** (−24.17)
Fix Effects	Yes	Yes	Yes	Yes	Yes	Yes
Period	9	9	9	9	9	9
N	236	236	236	236	236	236
R-square	0.370	0.516	0.568	0.454	0.554	0.589

t-statistics or z-statistics in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The same below tables.

5.2. Analysis of Threshold Effects

First, determine the threshold effect and the number of thresholds. Based on the Bootstrap method, the model passes the single and double threshold effect tests at the 1% significance level, but the triple threshold effect is not significant (Table 4). Thus, there is a double threshold effect. In the analysis of formal environmental regulation, the digital economy's threshold values are −2.1125 and −1.3829, and in informal environmental regulation, the thresholds are −2.1125 and −1.2602 (Table 5). Based on the threshold value of the digital economy, cities are divided into three groups: high, medium, and low. It is found that more than 80% of cities belong to the medium level of the digital economy, and the high level of the digital economy is in the second place, which basically conforms to the normal distribution characteristics. In terms of spatial distribution, cities with high digital economy levels are mainly located in municipalities directly under the central government, provincial capitals, and developed cities, especially in the east, while cities with low digital economy levels are mostly located in less developed areas in the west (Figures 2 and 3). The digital economy index of cities has generally been improved. More and more cities have entered the stage of a high digital economy, and the level of the digital economy in the central and western regions has been greatly improved. The digital economy plays an important role in the impact of environmental regulation on high-quality economic development.

Table 4. Results of the threshold effect test.

Explanatory Variable	Threshold Variable	Threshold Type	F-Statistic	*p* Value	Bootstrap	Crit10	Crit5	Crit1
lnForm	lnDigeco	Single	262.72	0.000	300	40.4895	45.0650	52.5770
		Double	153.58	0.000	300	29.9799	35.5802	47.2357
		Triple	114.62	0.763	300	189.8428	201.8964	221.4062
lnInfrom	lnDigeco	Single	265.72	0.000	300	58.0153	63.6067	84.7343
		Double	128.96	0.000	300	25.7757	28.8882	37.8720
		Triple	86.49	0.833	300	141.6841	155.6759	179.2047

Table 5. Threshold estimation and confidence intervals.

Explanatory Variables	Threshold Value	95% Confidence Interval
lnForm	−2.1125	(−2.1300, −2.0943)
	−1.3829	(−1.3838, −1.3805)
lnInfrom	−2.1125	(−2.1169, −2.1062)
	−1.2602	(−1.2691, −1.2583)

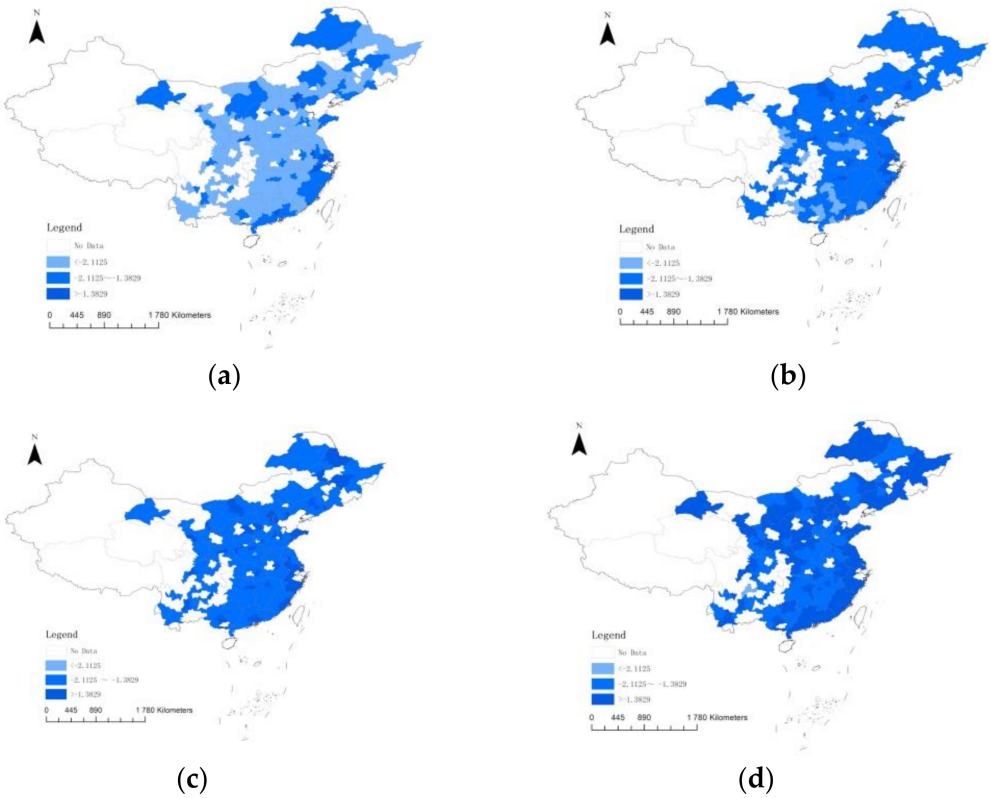

Figure 2. Spatial distribution map of cities with different digital economy thresholds in the impact of formal environmental regulation on high-quality economic development. (**a**) 2011; (**b**) 2014; (**c**) 2016; (**d**) 2019.

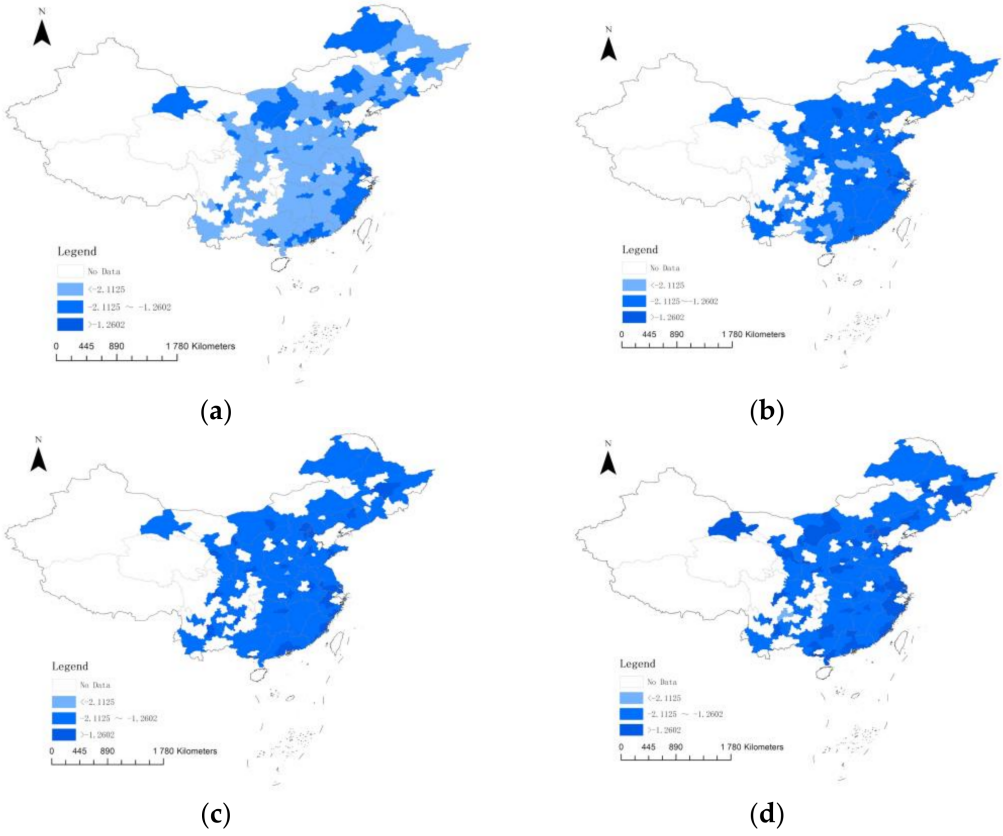

Figure 3. Spatial distribution map of cities with different digital economy thresholds in the impact of informal environmental regulation on high-quality economic development. (**a**) 2011; (**b**) 2014; (**c**) 2016; (**d**) 2019.

Then, verify the nonlinear effect of dual environmental regulations on high-quality economic development. According to the threshold regression results, the heterogeneity of the digital economy is critical to the impacts of dual environmental regulations on high-quality economic development. With the enhancement of the digital economy, the impact of formal environmental regulation on high-quality economic development shows decreasing marginal utility, and informal environmental regulation shows the characteristic of increasing marginal utility (Table 6). The result supports Hypothesis H3. For cities with superior economic development, the digital economy has reached a high level of participation in government-led environmental governance. However, for cities with low and medium economic development levels, the digital economy with the advantages of radiation and linkage can add new paths for formal environmental regulation to enhance high-quality economic development. However, for informal environmental regulation, in cities with favorable economic conditions, residents usually have high demands on their living environment, which leads to strong motivation for public participation in environmental protection through digital media platforms.

5.3. Analysis of Spatial Spillover Effects

First, based on the Moran index, we analyzed the spatial correlation of high-quality economic development. From 2011 to 2019, based on three different spatial weight matrices, all global Moran's I indexes are positive at the significance level, indicating that high-quality economic development has a strong spatial correlation (Table 7). Then, based on the LR test and Hausman test, the spatial Durbin model with fixed effects was selected. In this section, the geographic weight matrix is used for spatial analysis.

Table 6. Results of the threshold regression model.

Variable	Formal Environmental Regulation	Variable	Informal Environmental Regulation
lnForm (lnDigeco < −2.1125)	0.037 *** (4.30)	lnInfrom (lnDigeco < −2.1125)	0.0004 (0.08)
lnForm (−2.1125 ≤ lnDigeco ≤ −1.3829)	0.022 ** (2.46)	lnInfrom (−2.1125 ≤ lnDigeco ≤ −1.2602)	0.041 *** (8.48)
lnForm (lnDigeco > −1.3829)	0.011 (1.25)	lnInfrom (lnDigeco > −1.2602)	0.062 *** (12.43)
lnGovern	0.098 *** (6.36)	lnGovern	0.086 *** (5.63)
lnFore	−0.018 *** (−4.93)	lnFore	−0.021 *** (−5.91)
lnUrban	0.069*** (4.97)	lnUrban	0.050*** (3.62)
lnFinan	0.140 *** (12.32)	lnFinan	0.138 *** (12.03)
lnInfras	0.065 *** (6.88)	lnInfras	0.063 *** (6.64)
constant	−1.223 *** (−15.14)	constant	−1.583 *** (−36.45)
N	236	N	236
R-square	0.442	R-square	0.532

t-statistics or z-statistics in parentheses, *** $p < 0.01$, ** $p < 0.05$.

Table 7. Global Moran Index.

Year	The Geographic Matrix (W1)	Proximity Weight Matrix (W2)	Economic-Distance Matrix (W3)
2011	0.250 *** (5.956)	0.065 *** (8.977)	0.226 *** (29.859)
2012	0.257 *** (5.567)	0.067 *** (9.348)	0.243 *** (32.124)
2013	0.301 *** (6.503)	0.044 *** (6.306)	0.260 *** (34.314)
2014	0.266 *** (5.778)	0.033 *** (4.851)	0.281 *** (37.138)
2015	0.266 *** (5.763)	0.022 *** (3.461)	0.269 *** (35.500)
2016	0.272 *** (5.892)	0.043 *** (6.210)	0.263 *** (34.775)
2017	0.265 *** (5.733)	0.034 *** (4.986)	0.257 *** (33.984)
2018	0.312 *** (6.740)	0.046 *** (6.584)	0.278 *** (36.654)
2019	0.275 *** (5.956)	0.039 *** (5.592)	0.261 *** (34.444)

t-statistics or z-statistics in parentheses, *** $p < 0.01$.

The spatial autocorrelation coefficients ρ are all significant at the 1% level, verifying that high-quality economic development is strongly correlated in space (Table 8). The coefficients of dual environmental regulations are significant, indicating that dual environmental regulations have positive effects on high-quality economic development. The lagged coefficients of high-quality economic development are significantly positive, indicating that the impact of high-quality economic development on environmental regulation is persistent.

The spatial spillover effect of formal environmental regulation is negative, and informal environmental regulation is positive, and they both pass the significance test, which supports Hypothesis H4. Enhancing formal environmental regulation can have a negative effect on the high-quality development of neighboring regions, while upgrading informal environmental regulation facilitates neighboring regions to achieve high-quality economic development. As formal environmental regulation raises the environmental entry threshold, extensive and polluting industries are forced to move out of their original regions. However, based on industrial inertia, these enterprises have to choose to relocate nearby, which increases the environmental pressure on neighboring areas, reduces the incentive for technological innovation, and is not beneficial to the improvement of economic quality in adjacent areas. However, informal environmental regulation relies heavily on public participation and Internet technology, which enhances information transfer, technology diffusion, and public supervision between regions, and is good for forming the interaction and competition mechanisms of regional environmental governance.

Table 8. Results of the Spatial Durban Model.

Variable	lnForm	lnInform	Variable	lnForm	lnInform
y-1	1.050 *** (91.01)	0.526 *** (28.83)	SR_Dire	0.001 (0.26)	0.009 ** (2.26)
lnForm	0.002 (0.40)	-	SR_Indi	−0.023 *** (−2.57)	0.013 * (1.76)
lnInform	-	0.009 ** (1.99)	SR_Total	−0.022 * (−2.18)	0.022 *** (3.04)
WlnX_	−0.021 ** (−2.39)	0.007 * (1.70)	LR_Dire	0.826 (0.05)	0.023 *** (2.59)
ρ	0.087 *** (5.40)	0.265 *** (11.35)	LR_Indi	−0.682 (−0.04)	0.055 ** (2.26)
Control	yes	yes	LR_Total	0.144 ** (2.12)	0.078 *** (2.91)
R-square	0.610	0.662	Log L	2101.202	2629.291

t-statistics or z-statistics in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Further, the spatial effects are decomposed into direct and indirect effects by partial differencing methods, which denote the effects of local and neighboring regions' explanatory variables on local dependent variables. In both the short and long term, the dual environmental regulations have positive impacts on local, high-quality economic development. The spatial indirect effect of formal environmental regulation is negative, and that of informal environmental regulation is positive.

5.4. Robustness Tests

In order to ensure the validity of the above regression results, robustness tests were conducted from three aspects.

First, to replace the spatial weight matrix. The proximity weight matrix and economic-distance matrix are used to construct a spatial Durbin model for analyzing the impact of dual environmental regulations on high-quality economic development. The results show that, although the significance of the coefficients has decreased, the spatial effects and mechanisms of dual environmental regulations on high-quality economic development basically remain stable (Table 9).

Table 9. Results of the Spatial Durban Model under different spatial weight matrices.

Variables	Proximity Weight Matrix		Economic-Distance Matrix	
	lnForm	lnInform	lnForm	lnInform
y-1	0.533 *** (26.94)	0.562 *** (28.60)	0.533 *** (26.68)	0.533 *** (26.65)
lnForm	0.003 (0.48)	-	0.002 (0.28)	-
lnInform	-	0.003 (0.66)	-	0.001 (0.03)
Wlnx_	−0.240 (−0.27)	0.037 *** (3.41)	−0.093 (−0.84)	0.084 *** (6.46)
ρ	0.534 *** (7.35)	0.712 *** (11.24)	0.286 * (1.89)	0.477 *** (7.70)
Control	Yes	Yes	Yes	Yes
R2	0.680	0.685	0.566	0.684
Log L	2650.634	2639.890	2462.422	2653.728

t-statistics or z-statistics in parentheses, *** $p < 0.01$, * $p < 0.1$.

Second, to control the fixed effects. Based on the consideration of systematic changes in the macroenvironment, it is necessary to judge the robustness of the impact of environmental regulation on high-quality economic development by controlling fixed effects. Specifically, by setting province fixed effects, the disturbances due to differences in economic and social development contexts and resource endowments can be excluded. By setting province-time double fixed effects, the effects of individual differences and time trends can be controlled. The results show that the effect of dual environmental regulations on high-quality economic development remains robust under individual fixed effects and individual-time fixed effects (Table 10).

Table 10. Results of fixed effects and instrumental variable.

Variables	Control Fixed Effects				Instrumental Variable	
lnForm	0.051 *** (5.90)	0.059 *** (6.55)				
lnInform			0.048 *** (10.08)	0.054 *** (11.44)		
L.lnForm					0.059 *** (5.98)	
L.lnInform					-	0.048 *** (9.34)
Control	Yes	Yes	Yes	Yes	Yes	Yes
Province fixed effect	Yes	Yes	Yes	Yes	No	No
Province × Year fixed effect	No	Yes	No	Yes	No	No
City fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	236	236	236	236	236	236
Period	9	9	9	9	9	9
R-squared	0.487	0.487	0.495	0.494	0.438	0.455

t-statistics or z-statistics in parentheses, *** $p < 0.01$.

The third is the instrumental variable analysis. In order to address possible endogeneity problems in the model, the lagged terms of dual environmental regulations are selected as an instrumental variable to judge the robustness of the model. The lagged term's coefficients of formal and informal environmental regulations are positive and significant, indicating that the model's analytical results are reliable (Table 10).

5.5. Discussion of Results

The main conclusions obtained from the above empirical analysis are: Dual environmental regulations and digital economy have a direct contribution to high-quality economic development, respectively, which is consistent with the findings of Wang et al. (2022) [56] and Ding (2022) [29]. In the impact of dual environmental regulations on high-quality economic development, the digital economy has an indirect effect. Similar studies have been conducted using digital finance as an example [23], but few studies have taken the perspective of the digital economy, and the impact of dual environmental regulations on high-quality economic development has a spatial spillover effect. These conclusions were verified by the studies of Shangguan and Ge (2020, 2021) [23,24].

In the analysis methods, the mediation model uses the causal steps approach to analyze the mediation effect, but it presupposes a significant relationship between the dependent and independent variables and cannot analyze weak correlations. The threshold model does not need to set the form of nonlinear equations, and the number of thresholds and the number of study subjects in the corresponding interval are determined according to the data attributes, but the threshold variables are required to be exogenous. The spatial Durbin model considers the spatial effects of the dependent and independent variables, avoiding the endogeneity problem that arises when traditional econometric models do not consider spatial spillover effects, but requires some preparatory work, including constructing a spatial weight matrix, testing spatial correlation, and judging the model type.

6. Conclusions and Policy Recommendations

6.1. Discussion and Concluding Remarks

Under the background of the new normal and the pursuit of sustainable development, environmental regulation is an important aspect of promoting high-quality economic development. Based on panel data of 236 cities in China from 2011 to 2019, this paper systematically examined the impact mechanism of dual environmental regulations and

digital economy on high-quality economic development through the mediation model, threshold model, and dynamic spatial Durbin model. The results show that:

First, there were clear promotion impacts of formal environmental regulation and informal environmental regulation on high-quality economic development. The impact and mechanism were still valid under the robustness test, including using different spatial weight matrices and instrumental variables estimation and analyzing province fixed effects and province-time dual fixed effects. The result supports Hypothesis H1. The direct effect of environmental regulation on high-quality economic development has been verified in existing studies [56].

Second, the digital economy is conducive to high-quality economic development. Hypothesis H2 is supported. The digital economy is the core driver for building a high-quality development pattern [37]. This view has been proven in many studies.

Third, the digital economy and dual environmental regulations can create a driving force for the construction of high-quality development patterns. This paper also innovatively points out that as a mediator variable, the digital economy reinforced the indirect path of environmental regulation on the quality development of the economy. With the enhancement of the digital economy, the impact of formal and informal environmental regulations on high-quality economic development had a positive nonlinear effect, which was characterized by diminishing marginal utility and increasing marginal utility. The complexity of the mechanisms of environmental regulation and digital economy on quality development has also been verified (Hypothesis H3). Shangguan and Ge (2021) also found that digital finance and formal environmental regulation have a significant impact on high-quality development, which is consistent with the findings of this study [23]. The effective integration of the digital economy and dual environmental regulations opens up new paths for environmental regulation to enhance economic quality.

Fourth, the spatial spillover effects of the impact of dual environmental regulations on high-quality economic development were significant. The spatial spillover effect of formal environmental regulation was positive, and that of informal environmental regulation was negative. The result supports Hypothesis H4. This view is also endorsed in the study by Shangguan and Ge (2020,2021) [23,24].

This paper provides empirical evidence for the research on environmental regulation and high-quality economic development, but there are still some limitations. We measure the digital economy from the Internet and digital finance but ignore the value of numbers as a new factor of production in the market. In the future, we will improve the measurement system to reflect the characteristics of the digital economy. Additionally, the research on environmental regulation is only concentrated on formal and informal environmental regulations. We can classify the types of environmental regulation more specifically based on the government, the market, and the public and can further explore the impact of environmental regulation on high-quality economic development. Furthermore, the other indirect impact between environmental regulation and high-quality economic development needs to be investigated.

6.2. Policy Implications

This paper proposes the following policy recommendations:

First, construct and deepen the interaction mechanism between formal environmental regulation and informal environmental regulation, and improve the policy system of coordinated environmental and economic development. On the one hand, the government should pay attention to the innovation of formal environmental regulation to improve the efficiency of the policies and regulations related to environmental protection. On the other hand, the potential of public participation in social governance should be fully released to form an environmental regulatory system consisting of the government, enterprises, and the public.

Second, government departments should accelerate the construction of digital platforms to promote the interface between the digital economy and environmental regulation.

On the one hand, by building digital platforms such as big data and artificial intelligence, we could track environmental events of public concern in real time and optimize the public monitoring mechanism to improve environmental quality. On the other hand, we should build a data center combining the 5G cloud with the Internet to provide technical support for a collaborative and cooperative mechanism of cross-regional environmental regulation.

Third, local governments should develop a regional joint mechanism for collaborative management of environmental pollution and coordinated management of ecological resources. For ecosystems covering a large area and involving many cities, it is necessary to establish a systematic and complete implementation system of environmental regulation, which can integrate ecological resources and industrial systems, release the potential of spatial spillover and correlation and improve the quality of economic development.

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