sustainability

MDPI

Article

The Promotion Path of Pseudo and Real Human Settlements Environment Coupling Coordination in Resource-Based Cities

Guozhu Li and Meichen Liu *

School of Economics, Hebei Geo University, Shijiazhuang 050031, China
* Correspondence: liumeichen@hgu.edu.cn

Abstract: A suitable living environment is the common aspiration of city residents and the inherent requirement of sustainable development. This paper takes 114 resource-based cities in China as the research objects, constructs a pseudo human settlement environment (PSH) system based on network data, and constructs a real human settlement environment (RSH) system based on traditional data, measures the coupling coordination degree of the pseudo and real human settlement environment, and uses Fuzzy-set Qualitative Comparative Analysis (fsQCA) to analyze its improvement path. The conclusions are as follows: (1) The evaluation index of real human settlements in China's resource-based cities continues to grow, and the evaluation index of pseudo human settlements increases first and then decreases. (2) The coupling coordination degree between the resource-based pseudo city and the real human settlement environment presents an inverted U-shaped change trend, and the overall distribution presents a three-level ladder-like distribution of east-central-west. (3) A single condition has a weak ability to explain the coupling coordination degree of human settlements; the coupling coordination degree of resource-based cities has formed three improvement paths: opening + finance driven model, opening + education + finance driven model, and education + finance driven model.

Keywords: resource-based city; pseudo and real human settlements environment; coupling coordination; qualitative comparative analysis

Citation: Li, G.; Liu, M. The Promotion Path of Pseudo and Real Human Settlements Environment Coupling Coordination in Resource-Based Cities. *Sustainability* **2023**, *15*, 3851. https://doi.org/10.3390/su15043851

Academic Editor: Dan Yan

Received: 3 January 2023
Revised: 12 February 2023
Accepted: 16 February 2023
Published: 20 February 2023

1. Introduction

Over recent decades, the development concept of "economic construction as the center" has led to rapid development of city construction and urbanization in China. However, in the process of rapid economic development, the conflict between people and land has become more and more prominent, and environmental pollution and damage have become serious, leading to a decline in the carrying capacity of cities. The sustainable development of human settlements has reached a bottleneck, exposing a series of problems. In 2013, the United Nations Development Programme and Chinese Academy of Social Sciences jointly wrote "Sustainable and Livable Cities: Toward Ecological Civilization". The report pointed out that China is facing economic, social and resource and environmental challenges on the road to building livable cities. The improvement of living environment is a complex and far-reaching issue. The experience of developed countries shows that various urban diseases occur during industrialization, and China has not escaped this dilemma. The irrational use of natural resources by humans in the process of industrialization for city development has caused serious ecological problems and destroyed the material support and spatial support functions of city natural systems.

Resource-based cities are a special category of cities as national energy resources strategic guarantee bases, and they are numerous and widely distributed, making great historical contributions to the improvement of the national industrial system and national economic recovery since the founding of New China [1]. However, with the depletion of urban resources, the risks of path dependence and lock formation are gradually exposed,

and the urban ecological environment is deteriorating. Resource-based cities thus shoulder a heavier mission of building a living environment and, thus, improving the urban living comfort and happiness index has become an important issue for resource-based cities. With the development of the Internet, information technology is widely used in all aspects of urban development, and the human living environment has changed with the development of technology; cognition of the living environment has also changed. People know the world not only by the real sense of the external real world, but also rely on the mimetic environment constructed by networks, media and various communication devices.

A single form of research on real human settlements cannot fully explain the current human settlement phenomenon, and it is necessary to combine the real human settlement and the pseudo human settlement with the help of a coupled model to explain the increasingly complex changes in the human settlement system [2]. Therefore, based on the current development status of China's resource-based urban human settlements environment system, this paper introduces the concept of coupling coordination into the sustainable development of resource-based cities, constructs the coupling coordination degree model of pseudo and real human settlements' environment system, and analyzes its improvement path, which is of great value to break the weaknesses of the habitat environment construction in resource-based cities and promote the coordinated development of cities.

The structure of the rest of the paper is as follows. Section 2 is a literature review. Section 3 provides the methodological description and explains the data sources. Section 4 presents the measurement results of pseudo and reality human settlement environment measurement, and analyzes the improvement of the quasi-coupling coordination of human settlement. Section 5 mainly discusses the conclusions and policy implications.

2. Literature Review

The 'reality' human settlements are the traditional human settlements based on the perspective of geographical science, the surface space where human beings live together, and the main place for the utilization and transformation of nature. The concept of human settlements was born in the context of the completion of the second industrial revolution. The urbanization process of European countries was accelerating, and the influx of large numbers of people compressed the living space of cities. Howard proposed the "garden city" after studying the functional division of cities [3]. The concept of human settlements was a prelude to the study of human settlements. Doxiadis put forward the theory of human agglomeration, and believed that human, society, nature, architecture and network are the five elements of human settlements [4]. On this basis, Wu founded the science of human settlements and initiated the research on the real human settlements in China. At present, the evaluation system of reality human settlements is mostly based on five major systems [5,6]. Some scholars use the PSR (pressure, state, response) model to evaluate the quality of human settlements [7]. In addition, Dong took the Shandong Peninsula as the research object, and constructed a human settlements environment quality index system from four dimensions: human, economy, ecology, and society [8]. Sheng explored the relationship between habitat environment quality and economic development from three aspects: living conditions, infrastructure, and ecological environment [9]. From the perspective of human settlements assessment methods, the most commonly used methods are entropy value method, principal component analysis method and analytic hierarchy process. Some scholars have used the entropy method and the fuzzy analytic hierarchy process to analyze the level of human settlements in 30 cities, and concluded that Beijing and Shanghai have greater advantages in human settlements than other cities [10]. Others used the analytic hierarchy process to evaluate the living environment of Shanxi Province. Some scholars have combined the BP neural network and genetic algorithm to construct an urban living environment quality evaluation system, reflecting the nonlinear characteristics of the system [11,12].

The 'pseudo' human settlements environment is a symbolic information environment. Based on the understanding of the real world, people process, select and edit the informa-

tion of the real environment through media such as network media, and then construct a mimetic living environment that reflects real things. The pseudo human settlements environment is an information system with functions of social interaction, entertainment, life, study, work and other functions created by people under the background of the internet and big data with the help of computers, television, newspapers and other media. The categories of time and space in geographic attributes have become dynamic and diversified, and people use various applications to live in virtual environments that reflect the real world [13]. Microblogs can reflect the characteristics of online social space, high-quality shops affect the quality of the living environment [14]. There is always a deviation between pseudo and reality human settlements. When the deviation between the two is small, the media credibility is high, and the mimetic information can reflect the real human settlement; when the deviation is large, the ability of the mimetic information to reflect the real human settlement is weak. Although the pseudo human settlement environment cannot fully reflect the real human settlement environment at present, the development of networking and technology can narrow the deviation between them and realize the coordinated development of pseudo and real human settlement environments. The Baidu index can reflect the mimetic living environment [15]. Based on the Baidu Index, Tian et al. studied the relationship between the pseudo human settlements and the reality human settlements [16].

It is generally believed that natural elements affect human habitation from the early stages. Peter studied the impact of climate change on human settlements from the perspective of globalization [17]. Jenerette used the method of multiple linear regression to verify that green coverage affects urban climate and thus has a positive impact on human settlements [18]. Mortensen analyzed the correlation between temperature, soil, vegetation and human settlements [19]. As research progresses, it is generally believed that socioeconomic factors likewise play a more important role. Tritsch and Le Tourneau used remote sensing technology to obtain data on Amazon population density and deforestation, and analyzed the guiding role of public policies on the development of human settlements [20]. Li et al. show that internet development, economic development and housing are the main driving forces for the coupling and coordination of the human settlement environment system in Liaoning Province [21]. Resource abundance and government support affect the quality of the living environment, and financial support is conducive to promoting urban renewal and creating a high-quality living environment [22,23]. Differences in industrial structure have a negative impact on the spatial correlation strength of human settlements, while population, fiscal expenditure and level of opening to the outside world can have a positive impact [24]. At the same time, education level is the dominant factor affecting the resilience of urban living environments [25]. In addition, scientific and technological investment and government management capabilities have a positive effect on the coupled and coordinated development of human settlements [26].

The exploration of human settlements by scholars has matured, and a corresponding research system and research paradigm have been formed, but there are still some deficiencies. First, the coverage of related research on human settlements is narrow, mainly concentrated in a certain city. The analysis of human settlements in resource-based cities needs to be expanded urgently. Second, the existing research ignores the existence of pseudo human settlements, and the research on the level of coupling and coordination between city pseudo and real human settlements is still at the stage of theoretical analysis and qualitative analysis. Third, current research lacks thinking on the improvement path of human settlements. The introduction of the qualitative comparative analysis method is helpful to identify various ways of improving the coupling and coordination degree of human settlements in resource-based cities. In view of this, this paper takes 114 resource-based cities in China as the research objects, constructs the pseudo and real human settlements index systems, and uses fsQCA to explore the specific improvement path while studying the coupling coordination characteristics of the pseudo and real human settlements. At

the same time, it provides reference and inspiration for the coordination and sustainable development of human settlements in China's resource-based cities.

3. Data and Methods

3.1. Construction of Index System

3.1.1. Construction of Real Human Settlement Environment Index System

The real human settlement environment (RHS) is the surface space where human beings live and live together, and it is the main space for production and life. Based on the relevant literature on the existing human settlement environment research [4,5], the index system for the evaluation of the reality human settlement environment in resource-based cities is constructed from the perspective of five systems: natural system, human system, living system, social system and support system (Table 1).The natural system represents the ecological environment in which human beings live, which includes both the natural environment such as sunshine and precipitation, and the artificial environment such as park greenery and waste disposal. The core of the human system is people, so the human system includes the natural population growth rate, population size, population density and urbanization rate. The living system is divided into the soft living environment and the hard living environment, which provide the places and various functions needed for human production and life. The social system contains 6 indicators such as per capita GDP and unemployment rate. The support system includes various elements that support human development such as transportation, infrastructure and communication. Among them, industrial sulfur dioxide emissions, industrial wastewater discharge, PM2.5, population growth rate, population size, population density, and unemployment rate are not conducive to the improvement of real human settlement environment, so the indicator attributes are negative. The rest of the indicator attributes are positive.

Table 1. The RHS index system in resource-based cities.

Target Layer	Criteria Layer	Indicator Layer	Weight	Attribute
Reality Human Settlements Environment	Natural system (0.1125)	Industrial wastewater discharge (ten thousand tons)	0.0047	-
		Industrial sulfur dioxide emissions (ten thousand tons)	0.0041	-
		Per capita park green space (m^2)	0.0201	+
		Green coverage rate of built-up area (%)	0.0039	+
		Harmless treatment rate of garbage (%)	0.0039	+
		Average annual precipitation (mm)	0.0477	+
		Annual average sunshine hours (hours)	0.0211	+
		PM2.5 (mg/m^3)	0.0071	-
	Human system (0.0538)	Population growth rate (‰)	0.0061	-
		Population size (ten thousand people)	0.0114	-
		population density (people/km^2)	0.0106	-
		Urbanization rate (%)	0.0257	+
	Living systems (0.3071)	Residential land area (km^2)	0.0519	+
		Built-up area (km^2)	0.0582	+
		Proportion of built-up area (%)	0.0515	+
		The amount of investment in real estate development (ten thousand yuan)	0.0813	+
		Water penetration rate (%)	0.0032	+
		Gas penetration rate (%)	0.0053	+
		Drainage pipeline density (km/km^2)	0.0558	+
	Social system (0.2435)	Per capita GDP (yuan)	0.0378	+
		Per capita retail sales of consumer goods (ten thousand yuan)	0.0172	+
		Average salary of employees (yuan)	0.0697	+
		Savings of urban and rural areas (ten thousand yuan)	0.0004	+
		Unemployment rate (%)	0.0516	-
		Innovation and Entrepreneurship Index	0.0668	+
	Support systems	Collection of books in public libraries (thousands)	0.0280	+

Table 1. *Cont.*

Target Layer	Criteria Layer	Indicator Layer	Weight	Attribute
Reality Human Settlements Environment	(0.2831)	Per capita road area (m^2)	0.0250	+
		Hospital beds per ten thousand people (person)	0.0344	+
		Doctors per ten thousand population (person)	0.0424	+
		Number of Internet users per ten thousand people	0.0633	+
		Number of road lighting lamps (lamps)	0.0560	+
		Proportion of post and telecommunication service (%)	0.0339	+

3.1.2. Construction of Pseudo Human Settlement Environment Index System

With the development of the Internet, the traditional habitat environment cannot explain the comprehensiveness of the habitat environment system. The scope of settlements environment has been expanded to include imaginary space and perceptual space. Information, networks, big data, and media have penetrated into the environment in which human beings live, and the inclusion of the concept of pseudo environment helps to explore the whole picture of human settlements environment. Pseudo human settlements environment (PHS) is formed under the background of the vigorous development of Internet and big data, and has rich connotations and certain complexity. We may refer to Tian's practice of constructing a pseudo habitat system index system, and constructing the PHS system with the help of Baidu search index [2]. Baidu is the most used search engine in China, and most Chinese Internet users tend to use Baidu to search. Baidu Search Index is based on the search volume of netizens in Baidu, and uses keywords as statistical objects, reflecting the demand trend of users. Baidu index can make up for the shortcomings of the real living environment and characterize the development trend of the mimic human settlement environment. This paper uses Python to crawl the daily data of Baidu search index of 21 elements such as MicroBlog and WeChat in 114 resource-based cities from 1 January 2011 to 31 December 2019, and obtains the annual average data after collating and summarizing the data. The annual average search index was used to construct the pseudo human settlement environment system from four aspects: social system, entertainment system, tool system and services system. The specific indicators are shown in Table 2. The higher the search amount of a particular element, the better the adaptation of the proposed environment to which the element responds, so the attributes of each element in the PHS index system are positive.

Table 2. The PHS index system in resource-based cities.

Target Layer	Criteria Layer	Indicator Layer	Weight	Attribute
Pseudo Human Settlements Environment	Social system (0.2105)	QQ	0.0419	+
		MicroBlog	0.0448	+
		WeChat	0.0580	+
		Quora	0.0659	+
	Entertainment system (0.2276)	QQ Music	0.0381	+
		iQIYI	0.0649	+
		bilibili	0.0587	+
		WeTV	0.0464	+
	Tools system (0.1735)	Meitu	0.0196	+
		QQmail	0.0422	+
		WPS	0.0203	+
		Amap	0.0523	+
		Tencentnews	0.0277	+
		Youdao	0.0161	+
		ICBC	0.0150	+
	Services system (0.3883)	JD	0.0476	+
		Lianjia.com	0.1023	+
		Meituan	0.0598	+
		Where to travel	0.0979	+
		Taobao	0.0442	+
		Alipay	0.0364	+

3.1.3. Index System Measurement Method

In order to manage the influence of different indicators with different magnitudes and orders of magnitude on the evaluation results, the data are standardized using the polarization method before the comprehensive evaluation. The standardization process needs to distinguish the indicator symbols. If a single indicator is favorable to the development of the settlement environment, the positive indicator calculation method is used; if a single indicator is unfavorable to the development of settlement environment, the negative indicator calculation method is used. In Formulas (1) and (2), X'_{ij} is the standardized value of the j-th index of the i-th city, $X_{\min}$ is the minimum value of the j-th index, $X_{\max}$ is the maximum value of the j-th index.

$$\text{Positive indicator}: \ X'_{ij} = \frac{X_{ij} - X_{\min}}{X_{\max} - X_{\min}} (i = 1,\ 2, \ldots, m; j = 1,\ 2, \ldots,\ n) \tag{1}$$

$$\text{negative indicator}: \ X'_{ij} = \frac{X_{\max} - X_{ij}}{X_{\max} - X_{\min}} (i = 1,\ 2, \ldots,\ m; j = 1,\ 2, \ldots,\ n) \tag{2}$$

Since the entropy method is an objective weighting method, it can effectively overcome the deviation caused by human factors and the problem of index information superposition [27]. Therefore, this paper uses the entropy method to determine the weight, and then comprehensively measures the evaluation index of pseudo human settlement environment and real human settlements environment, respectively.

First, the weight of the indicator value of city i under the j-th indicator is calculated and expressed as P_{ij}.

$$P_{ij} = \frac{X'_{ij}}{\sum_{i=1}^{m} X'_{ij}} \ \left(0 \le P_{ij} \le 1\right) \tag{3}$$

Second, information entropy and redundancy are calculated. The information entropy is denoted by e_j and the redundancy is denoted by d_i.

$$e_j = -\frac{1}{\ln m} \sum_{i=1}^{m} P_{ij} \ln P_{ij} \tag{4}$$

$$d_{ij} = 1 - e_j \tag{5}$$

Third, the weight w_j of each indicator is calculated based on the redundancy.

$$w_j = \frac{d_j}{\sum_{i=1}^{m} d_j} \tag{6}$$

The weights of each indicator of the RHS system are shown in Table 1. Among them, the weight of investment in real estate development is the largest, which is 0.0813, indicating that the real estate development has the strongest influence on the real habitat environment system. The smallest weight is the sulfur dioxide emission, which indicates that industrial sulfur dioxide emission has less influence on the real human settlements environment. The weights of each indicator of the PHS system are shown in Table 2. For the pseudo habitat environment, the living system has the largest weight and the tool system has the smallest weight. Specifically, Lianjia has the greatest influence on the pseudo settlements environment system and ICBC has the least influence.

Finally, the comprehensive scores S_i of real human settlements and pseudo human settlements were calculated separately.

$$S_i = \sum_{j=1}^{n} w_j X'_{ij} \tag{7}$$

3.2. Coupling Coordination Model

The concept of coupling first originated in the field of physics, reflecting the interaction of several objects, affecting each other to produce a certain dependency. The degree of coupling reflects the mutual influence between two or more systems, and can reflect the degree of interdependence between the systems. However, the coupling degree can only reflect the magnitude of the interaction between systems, but cannot indicate the level of coordinated development between systems, so the coupling coordination degree is introduced; the coupling coordination degree can more intuitively indicate the degree of coordinated development of each system, reflecting whether the systems promote each other or constrain each other.

This paper refers to the existing research to establish a coupling coordination model to analyze the degree of coupling and coordination between pseudo human settlement environment system and the real human settlement environment system in resource-based cities [28]. First of all, a coupling model needs to be constructed, and based on this, a coupling coordination model of mimic and real human settlements is constructed.

$$C = \sqrt{\frac{U_1 \times U_2}{[(U_1 + U_2)/2]^2}} \tag{8}$$

In the Formula (8), C represents the coupling degree, and U_1 and U_2 represent the real human settlement index and the pseudo human settlement index respectively. The value range of the coupling degree C is 0 to 1. The closer the coupling degree C is to 1, the higher the correlation between the real human settlement system and the pseudo human settlement system, and the more orderly the development between the systems. The closer to 0, the lower the correlation between the two systems.

Resource-based city pseudo and the real human settlement environment system are complex and diverse systems, and the coupling degree model is not enough to reflect the coordination and unity between the two. Therefore, it is necessary to build the coupling coordination degree model. The model settings are as follows:

$$D = C \times T, T = \alpha U_1 + \beta U_2 \tag{9}$$

In the Formula (9), D represents the coupling coordination degree between the mimic and the real human settlement system, C is the coupling degree calculated by the above formula, and α and β are the undetermined coefficients. In this paper, it is considered that the two systems of the pseudo and the real human settlement have the same degree of importance, so take $\alpha = \beta = 1$. The range of the coupling coordination degree D is [0, 1]. The closer D is to 1, the higher the degree of coupling and coordination of the pseudo human settlement system and the real human settlement system, and the lower the degree of coordination that is closer to 0.

3.3. Qualitative Comparative Analysis

Qualitative comparative analysis (QCA) is a method that combines qualitative and quantitative analysis. QCA is an analytical method based on Boolean algebra, which explores the relationship between sufficient and necessary subsets of condition variables and outcome variables, and can solve the problem of how multiple antecedent conditions affect the outcome. Compared with traditional regression analysis, QCA admits the existence of asymmetric relationships and relaxes the assumptions of traditional regression. It pays attention to the necessary and sufficient conditions for the production of a certain outcome variable, and can analyze the effect of the combination of condition variables on the outcome.

Qualitative comparative analysis can be divided into three categories according to the different types of variables: clear set qualitative comparative analysis (csQCA), multi-valued set qualitative comparative analysis (mvQCA) and fuzzy set qualitative comparative

analysis (fsQCA). csQCA can only be used to process samples where both the outcome variable and the condition variable are binary variables. mvQCA is an extension of csQCA, allowing the condition variable and the outcome variable to be multi-category variables. Qualitative comparative analysis of multi-valued sets increases the information contained in variables. It divides the value of variables on the basis of binary variables, and improves the accuracy of Boolean assignment. fsQCA has the dual attributes of qualitative analysis and quantitative analysis, and can deal with continuous condition variables and outcome variables. Since the condition variables and outcome variables involved in this paper are continuous variables, fsQCA is used to explore the improvement path of coupling and coordination of human settlement environment in resource-based cities in China.

3.3.1. Variables Setting

A variety of factors jointly affect the level of coupling and coordination of human settlements in resource-based cities. The measured coupling coordination of resource-based cities pseudo and reality human settlements is taken as the outcome variable. Education level, resource dependence, opening up, financial support, government intervention and specialization of industry structure are taken as condition variables. Table 3 shows the condition variables description.

Table 3. Description of the influencing condition variables.

Variable	Variable Meaning	Variable Description
Edu	Education levels	Number of ordinary colleges and universities
Rely	Resource dependence	Total employed population in extractive industries/Total employed population (%)
Open	Opening	Take the natural logarithm of actual amount of foreign capital used
Fin	Finance support	Take the natural logarithm of loan balance of financial institutions
Fixl	Specialization of industry structure	Industrial structure specialization index
Gov	Government intervention	Take the natural logarithm of per capita fiscal expenditure

Education levels: Human capital is one of the key incentives for the improvement of urban living environment. The improvement of education level is conducive to the cultivation of high-quality talents, and the realization of high-quality urban development in the process of driving urban technological progress and technological innovation. Expanding the scale of colleges and encouraging multi-level and wide-area exchanges among colleges will help resource-based cities to cultivate innovative talents. This paper selects the number of ordinary colleges and universities to measure the education level of a region.

Resource dependence: Resource dependence is defined as the degree of dependence of the economy on resources, which can promote the innovation of high-tech and improve the quality of living. However, areas rich in natural resources are prone to over-reliance on resources during the development process, resulting in a series of problems, which are not conducive to the coordinated development of the human settlements in resource-based cities. Referring to the existing research [29], it is measured by the ratio of the number of people employed in the extractive industry to the total number of employed people.

Opening: An open economy is conducive to the free flow of goods, factors and services, improving economic efficiency and optimizing resource allocation. Implementing a positive foreign policy is an inevitable choice for the development of the urban market economy [30]. This paper draws on Zhu and Sun to use the amount of actual foreign capital used to measure the level of openness [31].

Finance support: The improvement of the living environment of a region cannot be separated from the promotion of the financial system. On the one hand, the financial system promotes the financial transformation of urban savings and investment, accelerates the speed of currency circulation, and increases the city's funds for comprehensive management

of human settlements and the construction of urban supporting facilities. On the other hand, the financing scale of financial appropriation is limited, and the role of capital expansion is limited, which cannot meet the needs of urban construction. This paper selects the loan balance of financial institutions as a measure of financial support [32].

Specialization of industry structure: Industrial structure can be divided into industrial structure specialization and industrial structure diversification. The specialization of industrial structure plays a huge role in promoting the development of resource-based cities in the early stage, but when the city encounters a strong industrial crisis or the economy is in a downward state, the specialization of industrial structure may no longer be suitable for the development of resource-based cities [33]. This paper uses the proportion of the employed population in the industry with the largest employed population to the total employed population to measure the industrial structure specialization index.

Government intervention: Financial appropriation is the main source of funding for resource-based urban renewal. The government can control the process of urban development and improve the living conditions. However, the government's excessive intervention in the operation of the city will make the main body of the city's characteristics reflect policy dependence, which is not conducive to the coordinated development of the living environment [34]. The article uses the per capita fiscal expenditure to measure the degree of government intervention.

3.3.2. Data Calibration

Condition variables and outcome variables need to be calibrated before univariate analysis and configuration analysis. The dimensions of each continuous variable are different, and there are certain differences in its unit and value. Uncalibrated data cannot reflect the relative positions between cases, so it is necessary to convert them to values to between 0 and 1 to form a set [35]. In this paper, the direct calibration method is used to set three anchor points, and the 95% quantile, 50% quantile, and 5% quantile of the condition variable are used as the thresholds for fully affiliated, cross point and not affiliated. The specific calibration parameters are shown in Table 4. After calibration, the membership degree of each variable is between 0 and 1, 0 means no membership at all, 1 means complete membership.

Table 4. Data calibration.

	Variable	Fully Affiliated (0.95)	Cross Point (0.50)	Not Affiliated (0.05)
Outcome variable	Coupling coordination degree (Y_D)	0.6033	0.4461	0.3567
Conditional variables	Education levels (Edu)	8.4833	2.6667	1.0000
	Resource dependence (Rely)	0.3271	0.0562	0.0074
	Opening up (Open)	13.5695	11.4566	9.0613
	Finance support (Fin)	17.0142	15.8288	14.9561
	Government intervention (Gov)	9.1240	8.5101	8.0186
	Specialization of industry structure (Fixl)	14.4329	3.0376	1.6670

3.4. Data Sources

The "National Sustainable Development Plan of Resource-Based Cities (2013–2020)" delineates the scope of China's resource-based cities, including 116 prefecture-level cities, 8 autonomous prefectures, and 2 prefectures. Among them, the data of Bijie, autonomous prefectures and prefectures are seriously incomplete, and Laiwu was withdrawn in 2019. Therefore, 114 prefecture-level cities in Figure 1 were selected as research objects. Due to the insufficient data for 2020 for variables such as the natural population growth rate, the number of employees, population density, and industrial wastewater discharge, this paper uses the panel data of 114 prefecture-level cities from 2005 to 2019 to comprehensively measure the evaluation index of real human settlements and pseudo human settlements in resource-based cities, and build a coupling coordination model between them.

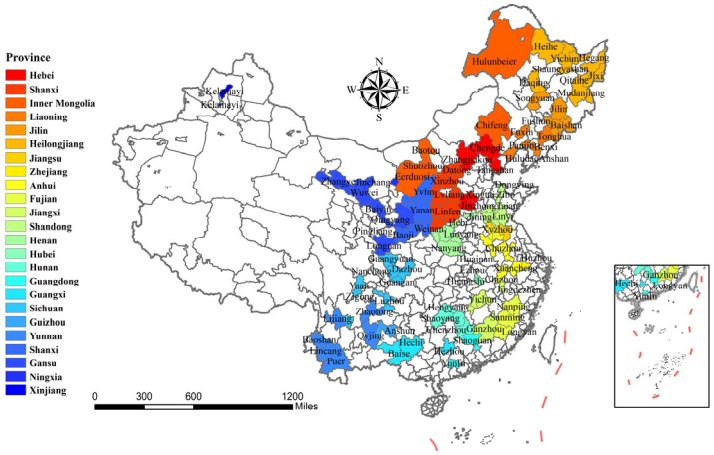

Figure 1. Study area.

The data of pseudo human settlements environment comes from Baidu Index (https://index.baidu.com/v2/index.html#/, accessed on 10 January 2022). The real human settlement system and condition variable data are mainly from the "China City Statistical Yearbook", "China Regional Economic Statistical Yearbook", "China Urban-Rural Construction Statistical Yearbook" and the official website of the National Bureau of Statistics (http://www.stats.gov.cn, accessed on 10 December 2021). The precipitation and sunshine hours are from the National Meteorological Information Center (http://www.nmic.cn/, accessed on 19 January 2022), and the missing values are filled by interpolation. In order to eliminate the factors of price fluctuations, the per capita GDP, real estate development investment and per capita total retail sales were all converted using 2011 as the base period.

4. Results and Discussion

4.1. The Characteristics of Pseudo and Reality Human Settlements Environment

Figure 2 shows the change trend of the annual average value of the real human settlement environment (RHS) and the pseudo human settlement environment (PHS). The RHS index in resource-based cities increased from 0.2818 in 2011 to 0.3577 in 2019. The continuous growth of the development level of the real human settlement environment benefits from digitalization and urban modernization. The support system mainly composed of networks, communication and infrastructure drives the improvement of the quality of the real living environment. The evaluation index of PHS showed a trend of first increase and then decrease. From 2011 to 2015, with the rise of the Internet, the evaluation index of mimetic human settlements grew rapidly during this period. From 2015 to 2017, the growth rate of imitation human settlements decreased. After 2017, the evaluation index of imitation human settlements has been decreasing year by year, showing a negative growth trend.

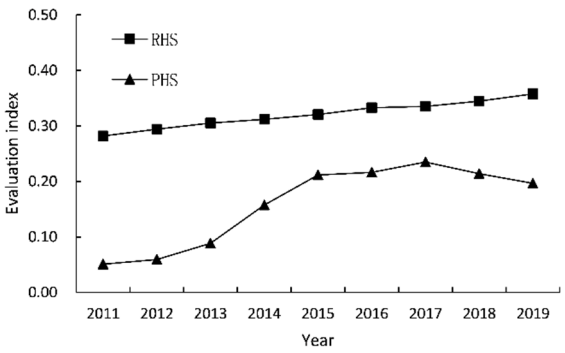

Figure 2. The trend of resource-based cities' RHS and PHS index.

Figure 3 shows that the development quality of RHS in resource-based cities in various provinces is better than PHS, but the average annual growth rate of PHS is much higher than RHS. From the perspective of different regions, the annual average value of the evaluation index of pseudo and real human settlements in the eastern provinces is higher than that in the central and western provinces. The real human settlements environment development quality of resource-based cities in Zhejiang is the highest, and the pseudo settlements environment development quality of resource-based cities in Jiangsu is the highest. Affected by the "One Belt One Road" and "Western Development", the average growth rate of resource-based cities in the western provinces is significantly higher than the central and eastern provinces. The average growth rate of the real human settlements environment is the highest in Guizhou. Gansu Province has the highest average growth rate of pseudo human settlements environment.

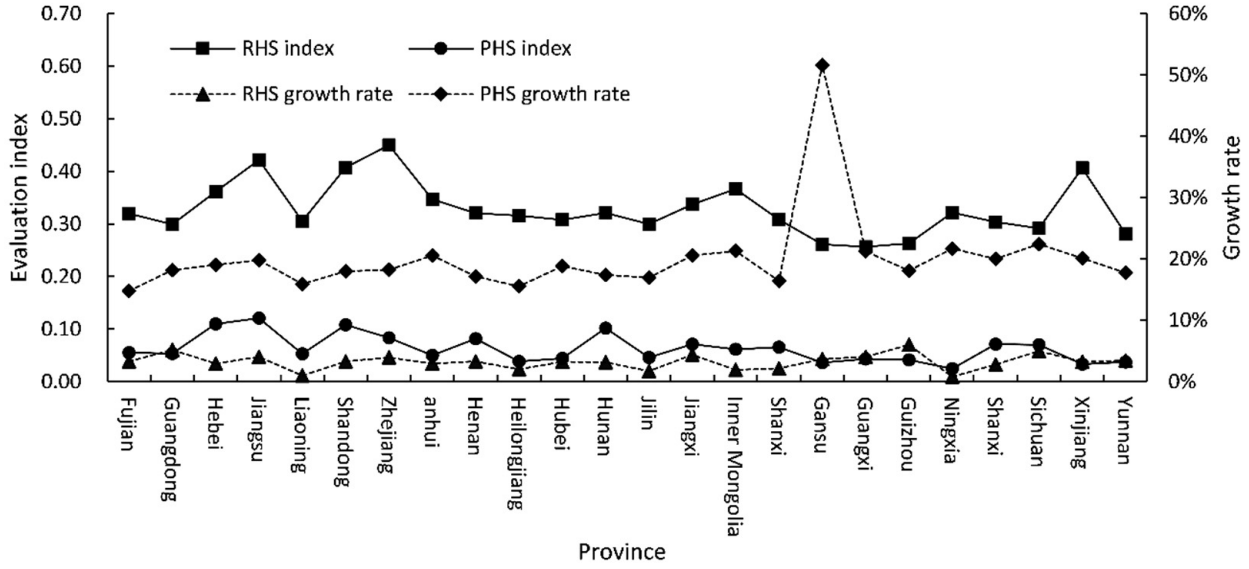

Figure 3. The average growth rate and mean value of RHS and PHS.

4.2. Evolution of Coupling Coordination between Pseudo and Real Human Settlements Environment

The coupling coordination between pseudo and real human settlement environment is calculated according to the coupling coordination model, and the overall evolution trend is shown in Figure 4. The coordination degree of human settlements in resource-based cities shows an inverted U-shaped change trend. In 2017, the level of coupling coordination reached the highest point of 0.5175, and then began to slowly decrease. From the perspective of growth rate, it can be divided into three stages. From 2011 to 2014, the growth rate was rising. The coupling coordination degree increased by 0.1237 at this stage, with an average growth rate of 11.05%. The growth rate was stable from 2014 to 2017. At this stage, the growth rate of the coupling coordination between pseudo and the real human settlement environment slowed down, with an average growth rate of 2.04%. The coordination level of human settlements began to gradually decrease after 2017, which is the declining stage.

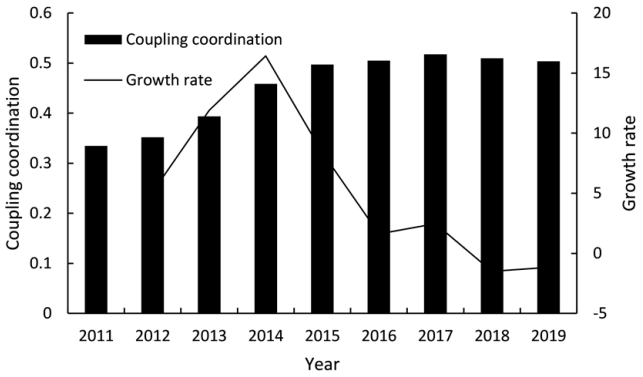

Figure 4. The trend of coupling coordination.

The kernel density can reflect the regional evolution characteristics of coupling coordination level between pseudo and real human settlements. The estimated results are shown in Figure 5. The kernel density curve first moves to the right, then moves to the left, and the moving distance gradually decreases, indicating that the level of coupling and coordination between the resource-based city pseudo and real human settlement environment first increases and then decreases, and the range of change decreases slowly. In terms of shape, the kernel density curve showed a bimodal distribution and clustered towards a higher coordination level. From the perspective of kurtosis, the height of the main peak of the coupling coordination degree between pseudo and real human settlements is decreased, and the width becomes wider. The regional differences in the coupling coordination degree of resource-based cities in China have shown an expanding trend, but this trend has gradually weakened in the later stage, and the regional inconsistency has eased.

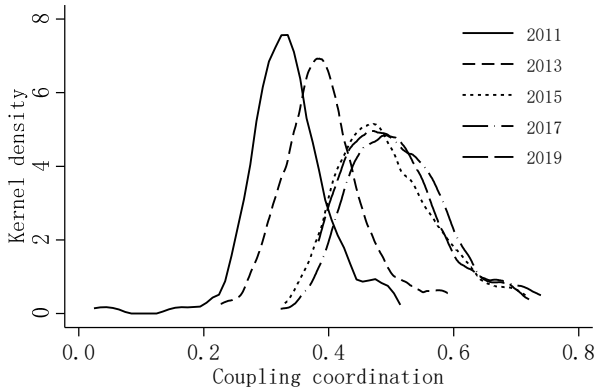

Figure 5. The kernel density of coupling coordination.

Figure 6 shows the spatial evolution characteristics of the coupling coordination of resource-based city pseudo and real human settlements. Figure 7 shows the changing trend of the coupling coordination degree in each province. The spatial differentiation characteristics of the coupling coordination degree of human settlements in resource-based cities are significant, presenting a three-level ladder-like distribution pattern of east, middle and west. In 2011, the overall coupling coordination degree of resource-based cities was low and in a state of imbalance. Two severely dysfunctional cities, Jinchang and Baiyin, are located in the western region. In 2015, there were two intermediate-level coordination cities in the east, namely Tangshan and Xuzhou, and the coordination level of the cities in the central and western regions improved significantly. In 2017, the coupling coordination degree of all resource-based cities was above 0.3. Cities with mild imbalance were located in the central and western regions. There were 4 cities with intermediate coordination in the east and 2 in the central region. In 2019, the overall level of coupling coordination decreased. Cities with intermediate coordination were all located in the eastern region. The

top 20 cities in terms of coupling coordination of human settlements comprised 10 in the east, 7 in the middle, and 3 in the west. The bottom 20 cities are mainly concentrated in Heilongjiang, Yunnan and Gansu.

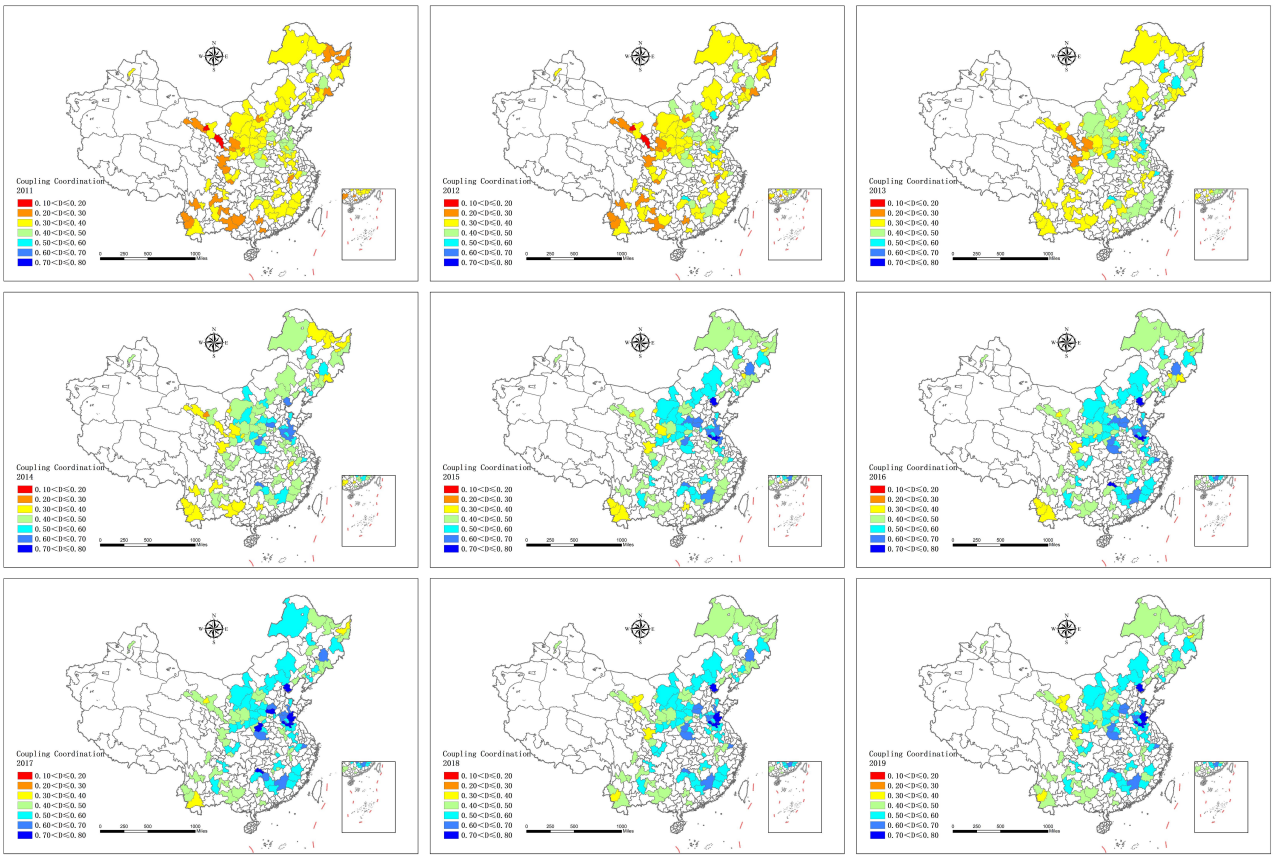

Figure 6. Spatial evolution of coupling coordination degree between RHS and PHS.

4.3. Improvement Path of Coupling Coordination between Pseudo and Real Human Settlements Environment

4.3.1. Necessity Analysis of Single Condition

The necessity of single condition variables needs to be analyzed before configuration analysis. Necessity analysis can determine which factor is the necessary condition for the coupling coordination of human settlements in resource-based cities. The necessary condition is a condition that always exists when the result occurs, and the test standard is the consistency. Table 5 shows the analysis of necessary conditions for high level of coordination and non-high level of coordination of human settlements environment in resource-based cities. From Table 5, it can be seen that the consistency level of financial support is 0.9107 and the consistency level of other condition variables is less than 0.9, which indicates that there are no other necessary conditions affecting the high and non-high level coordination of human settlements environment system except for financial support which is necessary for the coordination of human settlements environment in resource-based cities.

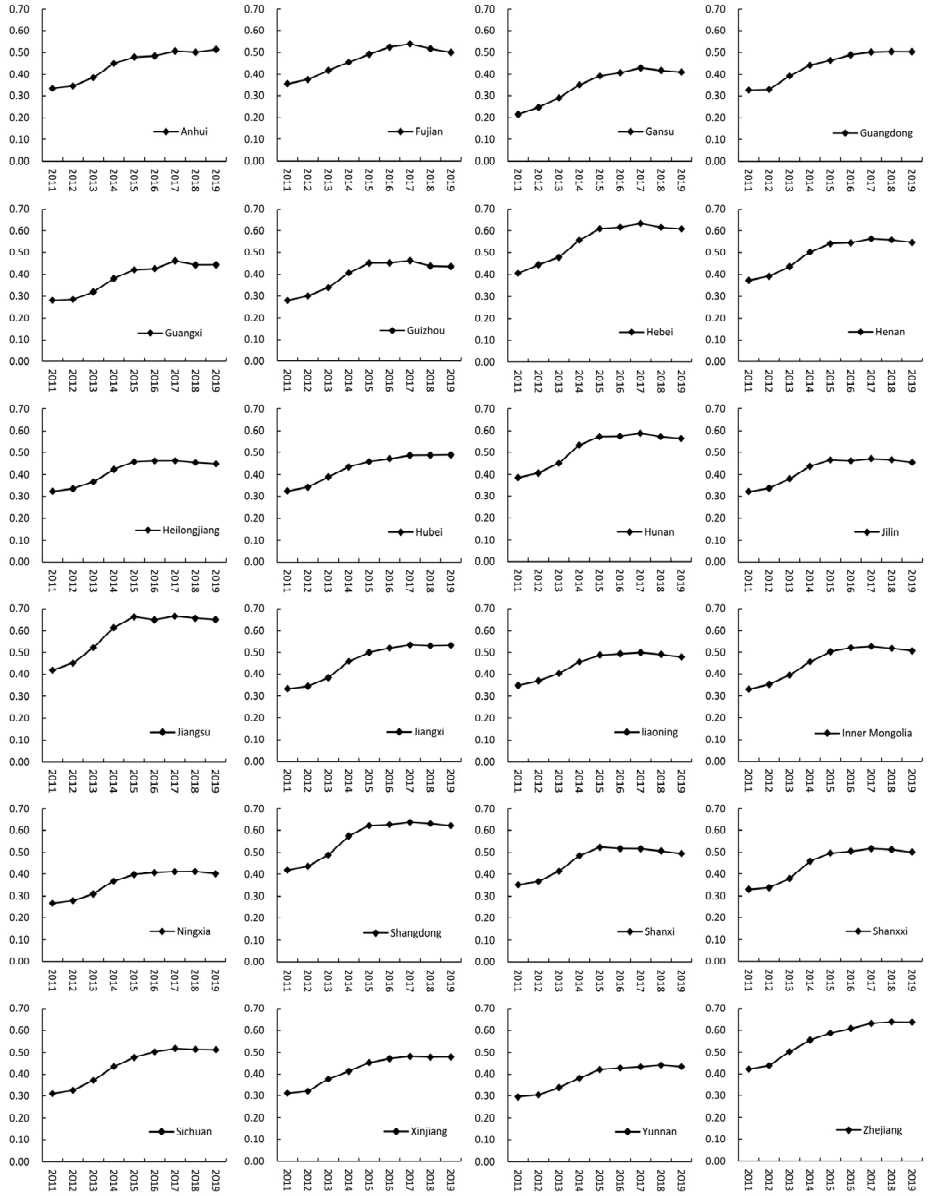

Figure 7. Time trend of coordination degree between RHS and PHS.

Table 5. Analyses of substitutable necessary conditions.

Conditions	High Level of Coordination		Non-High Level of Coordination	
	Consistency	Coverage	Consistency	Coverage
Edu	0.7971	0.8229	0.4493	0.5392
~Edu	0.5536	0.4638	0.8525	0.8300
Rely	0.6075	0.5958	0.6151	0.7011
~Rely	0.6952	0.6084	0.6454	0.6565
Open	0.7976	0.7482	0.5302	0.5781
~Open	0.5502	0.5019	0.7691	0.8154
Fin	0.9107	0.8766	0.4656	0.5209
~Fin	0.5023	0.4471	0.8897	0.9205
Gov	0.5827	0.5588	0.6965	0.7764
~Gov	0.7669	0.6849	0.6043	0.6273
Fixl	0.5266	0.5409	0.6343	0.7574
~Fixl	0.7638	0.6425	0.6155	0.6018

Note: "~" means "not" in logical operations.

4.3.2. Adequacy Analysis of Conditional Configuration

Table 6 shows the configuration analysis results of the factors influencing the coupling coordination degree of the human settlement environment system in resource-based cities. This paper focuses on reporting the intermediate solutions and parsimonious solutions of the fsQCA configuration analysis. If a factor only appears in the intermediate solution, the factor is defined as a "peripheral condition". If a factor may or may not be present, the factor is denoted by a blank. The overall solution consistency of the five groupings was 0.9380, and the consistency was 0.9617, 0.9724, 0.9444, 0.9622, and 0.9332, respectively, all of which were greater than the minimum acceptable consistency level of 0.75; thus, these five groupings were a sufficient combination of conditions for a high level of coordination. Combined with the results of the intermediate solution and the parsimonious solution, the five configurations of the coupling coordination degree of resource-based city human settlements are classified into three types: open + finance, open + education + finance, and education + finance.

Table 6. Configuration analysis of coupling coordination degree of human settlements.

Conditions	Solution1	Solution2	Solution3	Solution4	Solution5
Edu		●	●	●	●
Rely			●	⊗	●
Open	●	●	●		
Fin	●	●	●	●	●
Gov	⊗			⊗	⊗
Fixl	⊗	⊗		⊗	●
Consistency	0.9617	0.9724	0.9444	0.9622	0.9332
Raw coverage	0.4862	0.5209	0.4124	0.4685	0.3127
Unique coverage	0.0512	0.0628	0.0381	0.04178	0.0138
Overall solution consistency			0.9380		
Overall solution coverage			0.7584		

Note: The existence of the condition is represented by ●, and the absence of the condition is represented by ⊗, which has an auxiliary role in the interpretation of the final result. If a factor appears in both the intermediate solution and the parsimonious solution, the factor is defined as the "core condition"; the existence of the core condition is indicated by ●, and the absence of the core condition is indicated by ⊗.

Path 1: Open + financial driven model.

Solution 1 is Open* Fin* ~Gov* ~Fixl, which emphasizes that opening and financial support exist as core conditions, and the degree of government intervention and industrial structure specialization conditions are missing. It is clear that if resource-based cities have a sound financial development system and an inclusive level of opening, the government will appropriately reduce interventions and not stick to a single industry, which will help improve the level of coupling and coordination of the human settlements environment system. Typical cities in solution 1 are Nanyang, Suqian, Yichun, Handan, Xuzhou, Huangshi, Ganzhou, Hengyang, Linyi, Jiaozuo, Shaoyang, Luoyang, Xingtai, Chuzhou, Chenzhou, and Bozhou. Among them, Henan Province accounts for the largest proportion of cities. In order to build a beautiful and livable modern city, Henan Province focuses on the construction of beautiful Henan, carries out green and low-carbon transformation, and creates a smart and harmonious living environment.

Path 2: Open + education + finance driven model.

Solution 2 and solution 3 also emphasize the existence of opening, education and financial support as the core conditions, indicating that without considering other factors, the improvement of the coordination degree of human settlements in resource-based cities

can be achieved by continuously expanding the level of opening to the outside world and improving education level and financial support achieved.

Specifically, solution 2 not only emphasizes the existence of education, opening and finance, but also emphasizes the lack of specialization in the industrial structure, indicating that in the process of diversifying the industrial structure of resource-based cities, if the local educational resources are improved, then continuous expanding opening and promoting financial market reforms can reduce the impact of industrial structural reforms, and improve the overall level of human environment coordination. Resource dependence exists as an auxiliary condition in solution 3, indicating that resource-based cities in path 2 can rely on local natural resources and promote the regional living environment if they have a strong education level, a perfect opening system, and strong financial demand.

Path 3: Education + finance driven model.

Education and financial support are emphasized as core conditions in solutions 4 and 5. This result shows that the strong education level and strong financial support have become the primary factors in the process of improving the coupling coordination of the human settlement environment system in resource-based cities. Solution 4 is Edu* ~Rely* Fin* ~Gov* ~Fixl. Education and financial development exist as the core conditions, while resource dependence, government intervention and industrial structure specialization are missing. This indicates that reducing the degree of resource dependence, reducing government intervention, and reducing resource input to a leading industry in resource-based cities will help improve the coordination degree of the human settlement environment system. Solution 5 emphasizes the positive role of education and financial development, the auxiliary role of resource dependence and industrial structure specialization, and the inhibitory role of government intervention. Resource-based cities can moderately rely on resources and build specialized cities when government intervention is weak and education and financial levels are high. This development path can also improve the coupling coordination degree of human settlements in resource-based cities to a certain extent.

4.3.3. Path Analysis in Different Regions

Due to the difference in economic development level and geographical location, the living environment of resource-based cities in different regions has obvious heterogeneity. In addition, there are differences in the system and environment of different resource-based cities, which lead to factors such as education, openness, and industrial structure, having different effects on the coupling coordination of the pseudo and real human settlements. Therefore, this paper classifies the whole sample data according to the eastern and central and western cities, and explores the differential influence of each condition variable on the coupling coordination level of pseudo and real human settlements in different regions. The results are shown in Table 7.

There are five solutions for the coupling coordination degree between the pseudo and real human settlements of the eastern resource-based city. The consistency and overall consistency of each solution are greater than 0.75, indicating that these five solutions are a combination of sufficient conditions for high-level coupling coordination of the human settlement system in the eastern region. Based on the configuration of resource-based conditions in the east, it is found that financial support is the core condition in each solution, indicating that the key to improving the coordination of the human settlement environment system in resource-based cities in the east is to improve financial support. Specifically, opening as an auxiliary condition in solution 1, and the educational level, resource dependence, and industrial structure specialization are missing. This shows that under the circumstance of limited education level, resource dependence and industrial structure specialization, the eastern resource-based cities with higher financial support and level of opening to the outside world can obtain a higher level of coupling coordination of the human settlement environment system. In solution 2, opening and government intervention exist as marginal conditions, and resource dependence and industrial structure specialization are missing. This shows that under the condition of insufficient resources and

single industrial structure, if the eastern resource-based city has a perfect financial market and an open environment, it can realize the coupling coordination of human settlements. Solution 3 shows that the coordinated development of the human settlement environment system can be achieved by paying attention to finance, education and opening at the same time. In solution 4, financial development exists as a core condition; government intervention is optional in this model, and other conditions exist as auxiliary marginal conditions. Solution 5 shows that resource-based cities with outstanding educational and financial advantages, complemented by certain government intervention and specialized industrial structures, can still achieve a high degree of coordination of human settlements environment systems even when their advantageous resources are scarce and their opening-up dynamics are insufficient.

Table 7. Configuration analysis of different regions.

Conditions	Eastern Region					Central and Western Regions		
	Solution1	**Solution2**	**Solution3**	**Solution4**	**Solution5**	**Solution1**	**Solution2**	**Solution3**
Edu	⊗		●	●	●	⬤	⬤	⬤
Rely	⊗	⊗	●	●	⊗		●	⊗
Open	●	●	●	●	⊗	⬤	⬤	
Fin	⬤	⬤	⬤	⬤	⬤	⬤	⬤	●
Gov		●	⊗		●			⊗
Fixl	⊗	⊗		●	●	⊗		⊗
Consistency	0.9545	0.9445	0.9936	0.9892	0.8847	0.9599	0.9289	0.9607
Raw coverage	0.4133	0.4096	0.4606	0.4672	0.1902	0.4875	0.3554	0.4853
Unique coverage	0.0437	0.0357	0.0255	0.0700	0.0022	0.0661	0.0986	0.1015
Overall solution consistency			0.94469				0.9388	
Overall solution coverage			0.7668				0.6875	

Note: The existence of the condition is represented by ●, and the absence of the condition is represented by ⊗, which has an auxiliary role in the interpretation of the final result. If a factor appears in both the intermediate solution and the parsimonious solution, the factor is defined as the "core condition"; the existence of the core condition is indicated by ⬤, and the absence of the core condition is indicated by ⊗.

The high level of coupling coordination of the human settlements environment system of resource-based cities in central and western areas formed three solutions with consistency of 0.9599, 0.9289, and 0.9607, respectively, and overall consistency of 0.9388, which is greater than the minimum standard of 0.75. From the perspective of core conditions, resource-based cities in the central and western regions have formed two improvement paths: education + finance, education + finance + opening. Solution 3 emphasizes the existence of education and finance as core conditions and the lack of resources, government intervention, and specialization of industrial structure. It shows that some resource-based cities in the central and western regions can improve the coordination level of human settlement environment by improving the level of education, establishing a complete financial development system and diversifying the industrial structure under the condition of insufficient resource advantages and weak government intervention. Solutions 1 and solution 2 also emphasize the existence of opening on this basis, indicating that while some resource-based cities in the central and western regions focus on the joint development of education, finance, and openness, regions with abundant resources can rely on resources to improve human settlements. Resource-poor regions can assist in improving coordination through the transformation of industrial structure diversification. In general, compared with the eastern region, resource-based cities in the central and western regions cannot rely

solely on finance to drive the level of coupling and coordination of human settlements, but also require strong education and support for opening.

5. Conclusions

Developed countries paid early attention to environmental sustainable development. In order to respond to the deterioration of living conditions caused by environmental damage, many countries actively use clean energy and promote industrial transformation. This series of measures has greatly improved the happiness index of residents, creating a clean and suitable living environment. Compared with western countries, the density of Chinese population is large, the rise of the Internet is recent, and the research on human settlements started late. As the largest developing country, China faces a greater dilemma in improving its habitat, and there are still many shortcomings in achieving the integration of Internet life and real life. Based on China's national conditions, this paper takes China's resource-based cities as the research object, constructs the evaluation system of pseudo and real human settlements, respectively, and calculates the coupling coordination level of pseudo and real human settlements in 114 resource-based cities. The key conclusions can be summarized as follows:

First, the evaluation index of real human settlements in resource-based cities continued to grow, and the evaluation index of pseudo human settlements showed a trend of first increasing and then decreasing. The average annual index value for resource-based cities in the eastern provinces is higher than that of the central and western regions, and the average growth rate in the western regions is higher than that in the central and eastern provinces.

Second, from the perspective of time evolution, the coordination degree of human settlements in China's resource-based cities shows an inverted U-shaped change trend, and the regional absolute differences in coupling coordination show an expanding trend, but this expanding trend gradually weakened in the later period. From the perspective of the spatial distribution pattern, the overall level of coupling coordination of human settlements presents a three-level ladder-like distribution pattern of east-middle-west.

Third, the single factor approach is weak in explaining the degree of coupling coordination of human settlements, and the combined influencing factors can effectively explain the level of coupling coordination of human settlements. The coupling coordination degree of pseudo and real human settlement environments has formed three improvement paths: open + finance driven model, open + education + finance driven model, education + finance driven model. From the perspective of different regions, financial support is the core condition for the improvement of the coupling coordination of human settlements in the east. In addition to financial support, the resource-based cities in the central and western regions also need to improve the level of regional coupling coordination with the help of education and opening.

Studies show that the low population growth rate and high population density of resource-based cities in eastern China are not conducive to the improvement of the city living environment. Although the western cities are less densely populated, they are unable to keep pace in the new era because of the low income levels and backward construction of culture and technology. Therefore, in order to achieve long-term development under the current situation of low population growth rate, resource-based cities in the east need to improve the quality of talents and cultivate innovative talents. The government should make reasonable interventions, ensure the fairness of the allocation of public resources, avoid homogeneous competition, and overcome the siphon effect of developed cities on less developed cities. For the central and western regions, cities need to diversify and upgrade their industrial structure, ensure the upgrading of low-end heavy industries to high-end emerging industries, undertake industrial transfer in the eastern coastal areas, and formulate reasonable industrial development policies based on their own characteristics. It is necessary to apply modern information technologies such as big data and cloud computing to strengthen the construction of the mimicry environment and promote the cities' operation efficiency.

Overall, the coordination between pseudo and realistic human settlements environment in resource-based cities has made great progress, but the level of coordination has slowly declined since 2017. Therefore, corresponding policy recommendations should be proposed based on the above research conclusions to optimize and adjust the coupling coordination of human settlements environment in resource-based cities. First of all, it is necessary to improve the infrastructure construction of resource-based cities and implement the reform of infrastructure investment and financing. Financial support has increasingly become the core element for the improvement of the human settlement environment in resource-based cities. The government should encourage financial institutions to provide special loans for the improvement of human settlements, continuously expand financing channels on the basis of the support of national policy banks, attract financing from enterprises and non-financial institutions, and improve urban infrastructure construction. Secondly, authorities should take the digital economy as an opportunity to stimulate the potential of new human resources, give priority to the development of science and technology and education, build smart cities, and realize the development of digital intelligence and informatization in cities. Resource-based cities have a low conversion rate of educational and scientific and technological achievements and serious brain drain, which is not conducive to the optimization of the urban living environment. Resource-based cities should effectively integrate resources, vigorously develop education, and explore new driving forces and new technologies to improve the local living environment. Finally, it is important to build a new mechanism for regional coordinated development, and improve the coupling coordination of the human settlements environment based on the principle of mutual benefit and reciprocity. There are obvious differences in the development of human settlements in different regions of China. Therefore, resource-based cities should strengthen regional cooperation, break the restrictions of administrative divisions, realize the complementarity and efficient use of production factors between cities, and achieve coordinated and sustainable development of human settlements.

Author Contributions: Conceptualization, G.L. and M.L.; Methodology, G.L. and M.L.; Software, G.L. and M.L.; Formal Analysis, G.L. and M.L.; Data Curation, G.L. and M.L.; Writing—Original Draft Preparation, G.L. and M.L.; Writing—Review and Editing, G.L.; Funding Acquisition, G.L. and M.L. are the co-first authors, M.L. is the corresponding author, and all authors contributed equally to this work. All authors have read and agreed to the published version of the manuscript.

Funding: This paper was supported by the National Social Science Foundation of China, grant number (18BJY081).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: China City Statistical Yearbook (https://navi.cnki.net/knavi/yearbooks/YZGCA/detail, accessed on 23 December 2021), China Regional Economy Statistical Yearbook (https://navi.cnki.net/knavi/yearbooks/YZXDR/detail, accessed on 19 January 2022), China Urban-Rural Construction Statistical Yearbook (https://navi.cnki.net/knavi/yearbooks/YCXTJ/detail, accessed on 8 February 2022).

Acknowledgments: Thanks to the editors and reviewers for their comments; our article has been greatly improved. Moreover, we would like to thank Hebei GEO University (KJCXTD-2022-02) for providing us with the necessary financial support.

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

References

1. Yu, J.; Li, J.; Zhang, W. Identification and classification of resource-based cities in China. *J. Geogr. Sci.* **2018**, *73*, 677–687. [CrossRef]
2. Tian, S.; Li, S.; Wang, Y.; Li, H.; Li, X. Mimicry and real living environment in coastal cities study on spatiotemporal law of coupling coordination: Cases of 53 cities in China. *J. Liaoning Norm. Univ. (Nat. Sci. Ed.)* **2021**, *44*, 540–548.
3. Howard, E. *Garden Cities of Tomorrow*; Faber and Faber: London, UK, 1946.
4. Doxiadis, C.A. Ekistics. the Science of Human Settlements. *Science* **1970**, *170*, 3956. [CrossRef] [PubMed]

5. Li, H.; Li, X.; Tian, S.; Li, S.; Zhao, P. Temporal and spatial variation characteristics and mechanism of urban human settlements: Case study of Liaoning province. *Geogr. Res.* **2017**, *36*, 1323–1338.
6. Chen, C.; Zhang, W.; Zhang, D.; Li, X. Quantitative evaluation of human settlement environment and influencing factors in the Bohai Rim area. *Prog. Geogr.* **2017**, *36*, 1323–1338.
7. Yao, S. Research on the Coupling Coordination Degree between Industrial Economic Development and Human Settlement Environment—Take Harbin as an Example. *Land Nat. Resour. Stud.* **2020**, *06*, 61–65.
8. Dong, S.; Zhang, P.; Li, F. Comprehensive evaluation of living environment in Shandong Peninsula agglomeration. *China Popul. Resour. Environ.* **2017**, *27*, 155–162.
9. Shang, G.; Ge, W. Coupling correlation analysis between economic development and living environment quality in Northeast China. *Contemp. Econ. Res.* **2019**, *04*, 70–78.
10. Gu, Y.; Yang, J.; Feng, X.L.; Li, C.; Li, X.M. Spatial differentiation of human settlement environment suitability in Chinese typical tourist cities. *Sci. Geogr. Sin.* **2015**, *35*, 410–418.
11. Sun, X.; Zhang, D. Analysis on the spatial-temporal variation about urban human settlements in shanxi province on AHP-GIS. *J. Shanxi Norm. Univ.* **2015**, *29*, 81–89.
12. Li, M.; Li, X. Application research on quality evaluation of urban human Ssettlements based on the BP neural network improved by GA. *Econ. Geogr.* **2007**, *27*, 99–103.
13. Tian, S. The Preliminary Study on the Temporal and Spatial Evolution of Urban Reality and Pseudo Human Settlements: Taking 36 Prefecture Level Cities of Three Northeastern Provinces in China as Cases. Doctoral Thesis, Liaoning Normal University, Dalian, China, 2018.
14. Zhang, F.; Wang, B.; Chen, Y. city network characteristics based on social network space: An empirical analysis of sina micro-blog. *Acta Geogr. Sin.* **2012**, *67*, 1031–1043.
15. Xue, Q.; Yang, X.; Wu, F. A two-stage system analysis of real and pseudo urban human settlements in China. *J. Clean. Prod.* **2021**, *293*, 126272. [CrossRef]
16. Tian, S.; Li, X.; Yang, J.; Zhang, W.; Guo, J. Spatio-temporal coupling coordination and driving mechanism of urban pseudo and reality human settlements in the three provinces of Northeast China. *Acta Geogr. Sin.* **2021**, *76*, 781–798.
17. Peter, E. Political strategies for more livable cities: Lessons from six cases of development and political transition. *City Rev.* **2001**, *2*, 222–247.
18. Jenerette, G.D.; Harlan, S.L.; Brazel, A.; Jones, N.; Larsen, L.; Stefanov, W.L. Regional relationships between surface temperature, vegetation, and human settlement in a rapidly urbanizing ecosystem. *Landsc. Ecol.* **2007**, *22*, 353–365. [CrossRef]
19. Morten, F.M.; Peter, S.H.; Ole, B. Living on the good soil: Relationships between soils, vegetation and human settlement during the late Allerod period in Denmark. *Veget. Hist. Archaeobot.* **2014**, *23*, 195–205. [CrossRef]
20. Tritsch, I.; Le Tourneau, F.-M. Population densities and deforestation in the Brazilian Amazon: New insights on the current human settlement patterns. *Appl. Geogr.* **2016**, *76*, 163–172. [CrossRef]
21. Li, X.; Guo, Y.; Tian, S.; Bai, Z.Z.; Liu, H. The Spatio-temporal pattern evolution and driving force of the coupling Coordination degree of urban human settlements system in Liaoning province. *Sci. Geogr. Sin.* **2019**, *39*, 1208–1218.
22. Tang, J.; Liu, Y. The evolutionary process and driving mechanism of human settlement environment in typical tourism cities based on living-production-ecological system: A case study of Zhangjiajie city. *Geogr. Res.* **2021**, *40*, 1803–1822.
23. Qiao, J.; Xu, L. The realization path of financial support for urban renewal in Hebei Province: A case study of Shijiazhuang. *Hebei Financ.* **2022**, *6*, 52–55.
24. Shao, H.; Wang, Z. Spatial network structure of human settlement environment and Its driving factors of urban agglomerations in middle reaches of Yangtze River. *Resour. Environ. Yangtze Basin* **2022**, *31*, 983–994.
25. Li, X.; Liu, K.; Tian, S.; Guan, Y.; Liu, H. Evaluation of urban human settlements resilience based on DPSIR model: A case study of the Yangtze river delta urban systems. *Hum. Geogr.* **2022**, *37*, 54–62.
26. Gong, Y.; Li, X.; Liu, H.; Huang, L. Research on coupling and coordination relationship between urban human settlements and vegetation net primary productivity in Liaoning province. *Ecol. Econ.* **2022**, *38*, 193–201.
27. Shannon, C.E. A Mathematical Theory of Communication. *Bell Syst. Tech. J.* **1948**, *27*, 379–423. [CrossRef]
28. Wang, S.; Kong, W.; Ren, L.; Zhi, D.D.; Dai, B.T. Research on misuses and modification of coupling coordination degree model in China. *J. Nat. Resour.* **2021**, *36*, 793–810. [CrossRef]
29. Cockx, L.; Francken, N. Natural resources: A curse on education spending. *Energy Policy* **2016**, *92*, 394–408. [CrossRef]
30. Chen, Y.; Wang, S.J.; Mei, L. The comparison study of industrial structure transformation between non-resource-based and resource-based cities in Northeast China. *Geogr. Res.* **2021**, *40*, 808–820.
31. Zhu, J.H.; Sun, H.X. Research on spatial-temporal evolution and influencing factors of urban resilience of China's three metropolitan a gglomerations. *Soft Sci.* **2020**, *34*, 72–79.
32. Li, P.; Dang, X. Natural resource dependence and regional financial development. *Rev. Ind. Econ.* **2020**, *19*, 73–96.
33. Zhang, Z.; Dang, X. Research on spatial spillover effect of industrial structure and regional economic resilience in northeast China. *Sci. Technol. Prog. Policy* **2020**, *37*, 37–46.

34. Wang, J.; Cui, N. Research on "resource curse" effect and transmission mechanism in resource-based cities: A case of 36 cities in central China. *Acta Sci. Nat. Univ. Pekin.* **2018**, *54*, 1259–1266.
35. Fiss, P.C. Building Better Casual Theories: A Fuzzy Set Approach to Typologies in Organizational Research. *Acad. Manag. J.* **2011**, *54*, 393–420. [CrossRef]