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# Urban "Three States" Human Settlements High-Quality Coordinated Development

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**Abstract:** The high-quality interaction of urban reality human settlements (RHSs), pseudo-human settlements (PHSs) and image human settlements (IHSs) can better explain the constantly updated human settlements phenomena under the human–land-relationship regional system. At present, the basic connotation, empirical exploration and optimized path of high-quality and coordinated development of "three states" of human settlements are not clear. In this paper, we take 14 prefecture-level cities in Liaoning Province as case areas and empirically explore their spatial patterns, coupling and coordination spatial relationships, driving mechanisms and development paths by using a coupling and coordination model, the entropy weight method and the geographic detector method. The results indicate that: (1) The spatial pattern of high-quality development of "three states" of human settlements varies significantly in different regions, forming a "dual-core" and "hump" spatial structure. (2) RHSs, PHSs and IHSs are not completely coordinated, forming "high–high–high" and "low–low–low" types, represented by Shenyang and Fuxin. (3) The high-quality coordinated development of "three states" of human settlements is driven by economic conditions, population conditions, entertainment systems and other factors. The population system, the social communication system and the support system, respectively, lead the high-quality coordinated development of RHSs, PHSs and IHSs.

**Keywords:** "three states" of human settlements; high-quality coordinated development; "hump" type spatial structure; system differentiation; optimized path



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## 1. Introduction

High-quality development has gradually become the basic feature of China's economic development. The uniqueness of high-quality development applies to the change in the principal contradiction in Chinese society, which can better deal with the imbalance and problems of social development. This shows that people's needs for a better life can be gradually met through high-quality fundamental needs, high-quality supply guarantees, high-quality infrastructure and high-quality social resources, which is more conducive to promoting high-quality urban development. Human settlements constitute the main construction area of a city. Promoting high-quality development of urban human settlements is an important prerequisite for promoting the high-quality development of China's economy. High-quality development not only meets the basic requirements of the primary stage of socialism in China, but also becomes an inevitable requirement for building a new pattern of high-quality urban development.

In the stage of urbanization development, RHSs are an important choice for high-quality development. The advent of the information age made the construction of PHSs valued by the government. In the stage of citizenization development, "the city is the

people's city", and the image and evaluation of urban citizens are an important guide for the development of urban human settlements. However, the practice and theoretical exploration of the construction of urban human settlements is either approached at a single level or according to three separate levels, which is not in line with the development of the times, government guidance and residents' needs. Today, the high-quality development of urban human settlements is increasingly inseparable from the "three states" coordinated development of RHSs, PHSs and IHSs. The coordinated and unified development of the three states is an important choice for high-quality development. Therefore, it is necessary to shift the perspective from reality to the high-quality coordinated development of the "three states" of human settlements, so as to achieve the organic coordination of reality, pseudo and image so that residents can continuously enjoy a diversified, three-dimensional and high-quality human settlements.

"Three states" high-quality coordinated development of human settlements is not only the implication for the interdisciplinary and integrated development of human settlements but also the epochal topic of the high-quality development of the Chinese social economy in the period of "200 year historical convergence". Its theoretical connotation includes three stages: primary stage, intermediate stage and advanced stage, as shown in Figure 1.

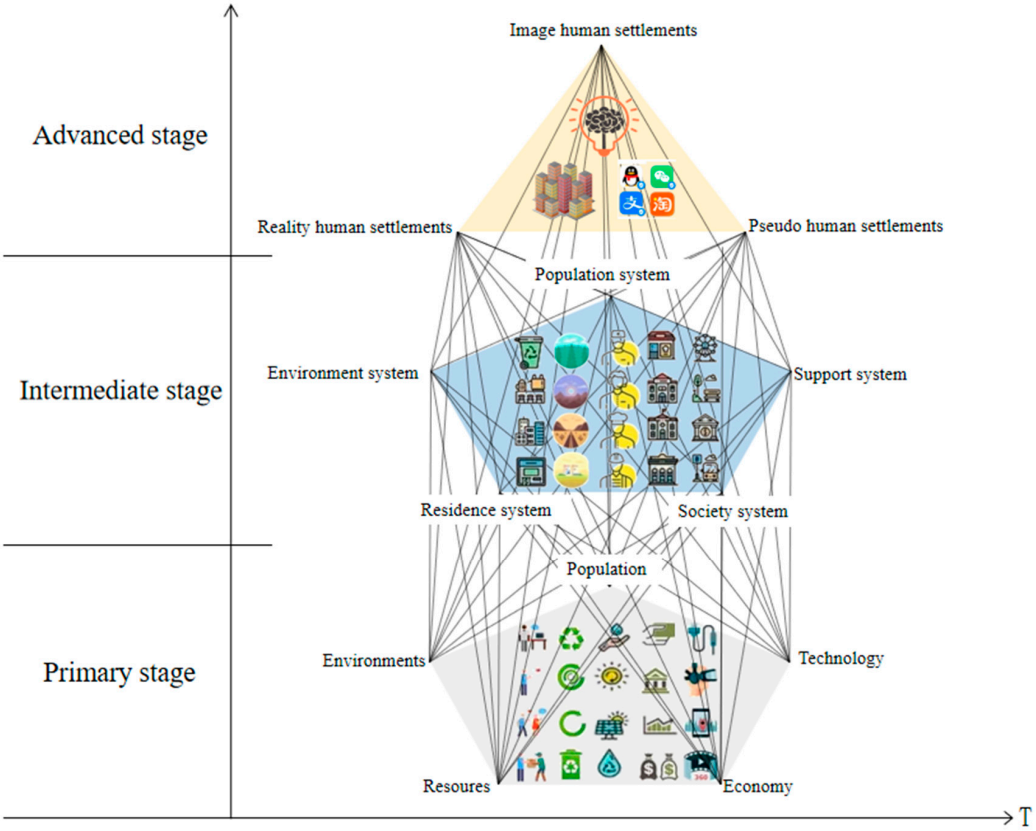



**Figure 1.** Frame diagram of theoretical connotation of "three states" coordinated development of high-quality human settlements.

The primary stage is high-quality coordinated development among various factors, including population, economy, environment, resources and other factors. For example, moderate population growth will reduce the pressure on the natural environment and the plunder of natural resources, while promoting high-quality economic development. People are the core of high-quality coordinated development of the "three states" of human settlements. To achieve harmony between human and nature, harmony with the ecological environment, and synchronization of economic development levels and the pace of population development can better promote the high-quality coordinated development

of the "three states" of human settlements. Basic units of systems and forms, as well as the high-quality coordinated development of human settlements factors, are the basic prerequisites for the high-quality coordinated development of "three states" of human settlements.

The intermediate stage is the high-quality coordinated development among systems, including the high-quality coordinated development among population, residence, society, support and environment. Taking RHSs as an example, the high-quality coordinated development of urban population, residence, society, support, environment and other systems can directly promote the high-quality coordinated development of RHSs. At the same time, the subsystem of human settlements is connected with factors and forms, and its position is very important. This is the key link for the high-quality coordinated development of "three states" of human settlements.

The advanced stage is the high-quality coordinated development among various forms, including the high-quality coordinated development of RHSs, PHSs and IHSs. RHSs are the places where human beings live together, produce and develop [1]. The construction quality of RHSs directly determines the level of PHSs and IHSs, serving as the bottom plate for both. PHSs are information and pseudo-human settlements based on media, which take RHSs as "raw material" [2]. IHSs are subjective human settlements in which people continuously describe cognition, judgment, view and appeal through their own mind in RHS and PHS activities.

RHSs are the foundation and base of PHSs and IHSs. PHSs are the informatization of RHSs, and IHSs are the subjectivity of RHSs. RHSs, PHSs and IHSs also have the relationship of mapping and being mapped to some extent. (1) In the development stage of urbanization, RHSs are an important choice for high-quality development. With the advent of the information age, the government attaches great importance to the construction of PHSs. IHSs are a new form based on the actual needs of residents in the era of citizenization. (2) RHSs have objective attributes. IHSs are affected by individual differences and have subjective evaluation attributes, while PHSs have subjective and objective compatible attributes. (3) RHSs are more specific, and IHSs are more abstract. From RHSs to IHSs, it is necessary to take PHSs as the medium. PHSs integrate all kinds of information and data of the RHSs and continuously transmits them to individuals, resulting in IHSs. All are important components of urban human settlements and important indicators for judging the quality of urban human settlements.

Taking provincial capital cities as an example, such cities with rapid development and mature support systems have developed human settlements in the three dimensions of reality, pseudo and image, and the three are closely linked and promote one another, indicating a situation of high-quality coordination. The above-mentioned situation is an ideal development mode. In addition, the development of urban RHSs, PHSs and IHSs is also out of sync. For example, although the edge city is "big" in the development quality of RHSs, it is the "short" in the development quality of PHSs and IHSs, failing to realize the high-quality coordinated development of the three. At the same time, some factors in the "three states" of human settlement indicators also result in "synergistic amplification" and "interference suppression" effects in high-quality development.

In summary, the high-quality coordinated development of urban "three states" of human settlements is an advanced stage of "three states" high-quality coordinated development after element coordination and system coordination, which provides a new direction for the theoretical research of interdisciplinary disciplines, such as human settlements. At the same time, under the new pattern of coordinated development of China's new round of northeast revitalization strategy and the background of the joint collaborative mechanism to promote northeastern revitalization, research is carried out on the "three states" of high-quality coordinated development of human settlements in 14 prefecture-level cities in Liaoning Province, which provides new ideas for local-government urban revitalization, high-quality coordination of human settlements and an optimized development path.

The proposal of high-quality development is mostly applicable to the main contradictions and changes in China's society, which are rarely studied in depth internationally. Domestic research mainly focuses on: (1) evaluation system under different administrative geographic scales, cities [3], urban agglomerations [4,5], towns, etc.; (2) correlation research concerning private economy [6], tourism industry [7], agriculture [8], economic growth [9], service industry [10], etc.; (3) evaluation system research concerning evaluation index [11], state evaluation, etc. [12]. Domestic research on high-quality development is not comprehensive and is mostly limited to academic aspects, such as theoretical mechanisms and interdisciplinary research methods. Coordination refers to the close degree of interconnection among subsystems, which affects overall development speed and quality. Promoting high-quality coordinated development promotes the improvement of urban competitiveness and the modernization of regional governance systems. Foreign scholars rarely carry out in-depth research on high-quality coordinated development, while the research of domestic scholars on high-quality coordinated development mainly focuses on: (1) research content: high-quality development coupling coordination [13] of spatial-temporal differentiation characteristics [14] and other fields; (2) research topics: human–land and spatial coordination [15], marine economic development [16], new urbanization and financial support [17], etc.

Much research has been conducted on domestic and foreign urban human settlements. International research topics mainly focus on: (1) a regional geography perspective, including studies on the sustainability of coastal human settlements in eastern Micronia [18], assessment of residents of informal settlements in Iran, applied research in quality of life [19], global patterns and potential drivers of human settlements within protected areas [20], impacts of arid zones on human settlements in the Wacissa River basin [21], etc.; (2) ecological perspectives, including the impact of green space on the human settlements of the elderly population [22], spatial typology of human settlements and their $CO_2$ emissions [23], urban heat islands [24,25], tsunamis [26], Mid-Late Holocene coastal environmental change [27], geomorphic processes [28], climate change [29]. etc.; (3) sociological perspectives, including the impact of human settlements on COVID-19 infections and recovered cases [30], the relationship between past environmental changes and human settlements [31], the analysis and evaluation of coastal human settlements [32], research on the relationship between human settlements and residential policies [33], changes if prehistoric human settlements over time [34],the changing trend of urban human settlements [35], urbanization [36],tourism [37], etc. Domestic research on human settlements mainly focuses on: (1) content research, including coupling coordination [2,38], satisfaction [39], livability, human settlement science, transformation of human settlements in traditional villages [40], etc.; (2) time-scale research, including the history of Chinese human settlements [1], change comparisons [41], evolution processes [42], etc.; (3) research methods, including grid data, CAS theory [43], analysis methods and entropy weight methods [44], emerging data mining [45], etc.; (4) correlation research, including coordinated economic development, housing prices [46], longevity phenomena, livable communities for the elderly [47], etc.

To sum up, at present, most scholars have conducted separate research on high-quality development and human settlements, but few of involve the exploration of high-quality coordinated development of urban human settlements. Human settlements are not only located in a two-dimensional space but a three-dimensional structure composed of reality, pseudo and image. There are few domestic and foreign studies on the high-quality coordinated development of "three states". Secondly, most of the theoretical research and empirical exploration on urban human settlements and high-quality development only focus on the reality level, such as space-time evolution, coordinated development, etc., all belong to the single reality level of urban human settlements. This does not reflect the whole picture. The development of the information age needs to introduce the high-quality development of urban PHSs. Thirdly, with the arrival of the era of citizenization, it is becoming more necessary to introduce the high-quality development of urban IHSs. Based

on the institutional and scientific development concept of "city is the city of the people", the image and cognition of urban residents and ordinary people have always been the guiding standard for high-quality development of human settlements. Therefore, based on the exploration of urban RHSs, PHSs and IHSs, the high-quality development of urban "three states" human settlement mode is constructed.

At present, scholars have proposed theoretical frameworks and case studies for the high-quality development of urban human settlements. However, there has been little researches on the high-quality coordinated development of "three states" human settlements, which determines the necessity and urgency of exploring the high-quality coordinated development of urban "three states" human settlements. Liaoning is an important representative of "imbalanced and inadequate" development in northeast China. In the national implementation of a new round of a northeast revitalization strategy, it of important scientific value and practical significance to conduct in-depth research on the problem of high-quality coordinated development of human settlements in Liaoning. Based on this, this paper explains the theoretical connotation of the high-quality development of "three states" human settlements, empirically studies the spatial pattern, coupling coordination, and spatial relationship of high-quality development of "three states" human settlements in 14 prefecture-level cities in Liaoning Province and studies the driving mechanism and optimized path of the spatial pattern in order to broaden the human settlements scientific research category. This work will contribute to the revitalization of northeast China and the high-quality development of Chinese cities.

## 2. Materials and Methods

### *2.1. Data Source*

1. The RHSs data originate from the statistical yearbooks of cities in Liaoning Province, the 2019 "Liaoning Province Statistical Yearbook", the Statistical Information Consulting Service Center of the Liaoning Provincial Bureau of Statistics, the 2018–2019 "Liaoning Province Environmental Quality Bulletin" and other statistical yearbooks. According to the systematicity and novelty of high-quality development of human settlements, as well as the uniqueness and operability of the index system, an RHS index system was constructed, considering population, residence, society, support, environment and 25 single indicators, as shown in Figure 2.

2. PHSs data mainly come from the Baidu Index. The comprehensive search penetration rate of the Baidu Index is number one among search engines, which symbolizes the representativeness of the Baidu Index in research, as well as its important universality and feasibility. A certain keyword represents a type of function and service. For example, Weibo represents social PHSs that meet the needs of residents. The degree of search and attention of the keyword on the Internet is not only a reliable basis for the importance of the factors and subsystems of PHSs fed back by keywords on the Internet and also an objective reflection of the potential needs of social residents at different levels. It is also an important embodiment of PHSs (place) built by bottom-up social forces (people) of network users to meet the needs of residents with functions and services, social interaction, shopping, travel, entertainment, etc. [48,49]. Based on previous research results, this paper selected 14 prefecture-level cities in Liaoning Province in 2019, including five comprehensive systems of social communication, learning and education, leisure and entertainment, transportation and online shopping and 25 single indicators, including WeChat, Learning Power, iQiyi, etc., as shown in Figure 2.

3. IHSs data are mainly based on online questionnaire surveys. Due to the impact of COVID-19, large-scale data acquisition cannot be carried out on-the-ground. The online questionnaire was conducted from September 6, 2020 to May 27, 2021. The target population of the questionnaire is people in most industries in Liaoning Province. The most effective questionnaires surveyed mainly young people (18–35 years old) and middle-aged people (35–60 years old), consisting mainly of civil servants, personnel of public institutions (teachers, etc.), workers, employees of private enterprises, students, etc. A total of 1869

questionnaires from 14 prefecture-level cities in Liaoning Province were collected, excluding 276 questionnaires that had data errors and were of no value, and the number of valid questionnaires was 1593. RHSs and PHSs fail to reflect the real wishes and ideas of the people. In order to more systematically represent the overall picture of the high-quality development of urban IHSs, a set of image-level index system was designed. The comprehensive indicator layer includes the five categories of population system, residence system, society system, support system and environment system, as well as 45 individual indicators, as shown in Figure 2. By comparing the satisfaction scores of citizens of different genders, ages and occupations and from different cities, the satisfaction degree of each city in terms of population, residence, society, support and environment system was obtained, directly reflecting the residents' general cognition and evaluation of the high-quality development trend of IHSs.

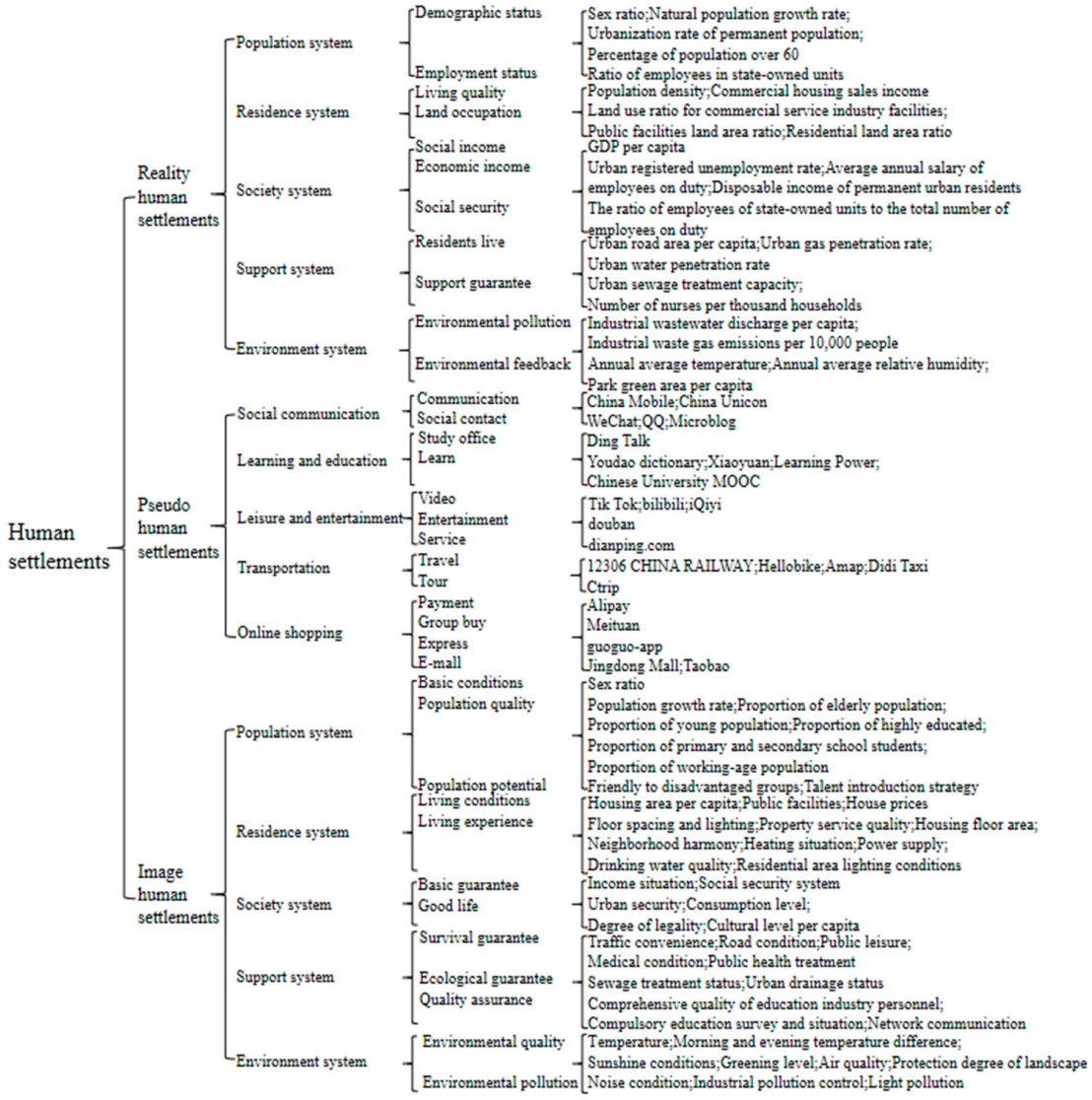



**Figure 2.** "Three states" human settlements index.

### *2.2. Research Method*

1. Coupling coordination degree. Many comprehensive evaluation methods can calculate the comprehensive score of the research object, but they cannot quantitatively express the degree of interaction between systems. The degree of coupling coordination describes the degree of interaction between two or more elements and systems. It has been widely used in geography, economics and sociology [50–52]. It was introduced in the

context of "three states" human settlement to quantitatively represent of the degree and state of correlation among reality, pseudo and image.

(1) Coupling degree of high-quality development of "three states" human settlements: Based on the source data of RHSs, PHSs and IHSs, a measurement model of degree of coupling of high-quality development of urban "three states" human settlements was constructed. The formula is as follows:

$$\mathrm{C_n}(HS_1, HS_2, HS_3 \cdots, HS_n) = n \times \left[ \frac{(HS_1 \times HS_2 \times HS_3 \cdots HS_n)}{(HS_1 + HS_2 + HS_3 \cdots HS_n)^n} \right]^{\frac{1}{n}} \quad (1)$$

where C represents the coupling degree of the high-quality development of "three states" human settlements, C ∈ [0, 1]. The closer the value of C is to 1, the stronger the coupling between dimensions of high-quality development of urban "three states" human settlements, as well as the inverse. $HS_1$, $HS_2$, $HS_3$ … $HS_\mathrm{n}$ represent the various subsystems of human settlements in reality, pseudo and image.

(2) Decree of coupling coordination of high-quality development of "three states" human settlements: To characterize the coupling coordination effect among the various dimensions of high-quality development of urban "three states" human settlements, a coupling coordination model of high-quality development of urban "three states" human settlements was developed. The formula is as follows:

$$D = \sqrt{C \times T}, T = \alpha R + \beta P + \gamma I \quad (2)$$

where $C$ is the degree of coupling of high-quality development of human settlements; $D$ is the degree of coupling coordination of high-quality development of human settlements; and $\alpha$, $\beta$ and $\gamma$ are the corresponding undetermined coefficients. The partition of coupling coordination types is as follows (Table 1).

**Table 1.** The partition of coupling coordinates.

| Coupling Coordination Degree | Coupling Coordination Types | Coupling Coordination Degree | Coupling Coordination Types |
|---|---|---|---|
| D ∈ [0.0000, 0.1000] | Extreme imbalance | D ∈ (0.5000, 0.6000] | Barely coordination |
| D ∈ (0.1000, 0.2000] | Serious imbalance | D ∈ (0.6000, 0.7000] | Primary coordination |
| D ∈ (0.2000, 0.3000] | Moderate imbalance | D ∈ (0.7000, 0.8000] | Intermediate coordinate |
| D ∈ (0.3000, 0.4000] | Mild imbalance | D ∈ (0.8000, 0.9000] | Advanced coordination |
| D ∈ (0.4000, 0.5000] | Basic coordination | D ∈ (0.9000, 1.0000] | Extreme coordination |

2. Entropy weight method. The advantage of the entropy weight method is objective weighting, which is mostly used in urban, environmental and other fields [53–55]. In the field of human settlements, the entropy method is used to measure the development level of reality, pseudo and image. According to the difference in attributes of the data index, the index attributes fall into positive and negative categories. The larger the positive attribute value, the better the quality of human settlements, with the opposite true for negative attribute. The formula is as follows:

Positive indicators:

$$\mathrm{Za} = \frac{Xa - Xa\mathrm{min}}{Xa\mathrm{max} - Xa\mathrm{min}} \times 100 \quad (3)$$

Negative indicators:

$$\mathrm{Zb} = \frac{Xb\mathrm{max} - Xb}{Xb\mathrm{max} - Xb\mathrm{min}} \times 100 \quad (4)$$

In the above formula, $X_a$ and $X_b$ are the original values; the standardized values are $Z_\mathrm{a}$ and $Z_\mathrm{b}$; and the maximum and minimum values of the matrix are $X_{a\mathrm{max}}$, $X_{b\mathrm{max}}$ and $X_{a\mathrm{min}}$, $X_{b\mathrm{min}}$.

Research method: Using the "entropy weight method", the specific steps are as follows:

(1) Original matrix: $X = \{xab\}m \times n(0 \le a \le m, 0 \le b \le n)$ is the index value of the $b$-th index of the $a$-th city.

(2) Calculate the weight of the $a$-th city of the $b$-th index: $pab = Xab \sum_{a=1}^{m} Xab$.

(3) The entropy value of the index: $eb = -k \sum_{a=i}^{m} (pab \ln pab), k = 1/\ln m, eb \in [0, 1]$.

(4) Difference coefficient: $ga = 1 - eb$.

(5) Calculate the weight of the $b$-th index: $wb = gb / \sum_{b=1}^{n} gb$.

(6) Calculate the result of human settlements: $R = \sum_{b=1}^{n} wb \times Xab$.

3. Geographic detector method. The geographic detector method was recently developed, but its application are becoming wider and wider [56,57]. One of its advantages is the ability to interpretate degree of quantitative measurement factors to the comprehensive index layer. The greater the $q$, the stronger the interpretation degree of a factor to reality, pseudo and image. The formula is as follows:

$$q = 1 - \frac{\sum_{h=1}^{L} N_h \delta_h^2}{N\delta^2} = 1 - \frac{SSW}{SST}, SSW = \sum_{h=1}^{L} N_h \delta_h^2, SST = N\delta^2 \quad (5)$$

where $q$ is the explanatory power of a single index factor to the comprehensive index layer; N and $\delta^2$ are the sample size and variance, respectively; $N_h$ and $\delta_h{}^2$ are the sample size and variance of the $h$ ($h$ = 1, 2, . . . , L) layer. For $q \in [0, 1]$, the larger the value, the stronger the explanatory power of the single index to the comprehensive index layer. A value of 0 indicates that the single indicator is completely irrelevant to the comprehensive index layer; a value of 1 indicates that the single indicator can fully explain the degree of development of the comprehensive index layer.

## 3. Results

### *3.1. Spatial Pattern of High-Quality Development of "Three states" Human Settlements*

#### 3.1.1. Overall Characteristics of the Spatial Pattern

(1) Spatial structure characteristics of regional differentiation

The high-quality development level of "three states" human settlements in 14 prefecture-level cities in Liaoning Province was measured. Among the 14 cities, Shenyang ranked at the top, with a score of 0.5057; Dalian followed closely behind, with a score of 0.4435; Panjin and Anshan ranked third and fourth, with scores of 0.3480 and 0.2884, respectively; the scores of cities such as Yingkou and Jinzhou were not significantly different, with scores in the range of 0.2440–0.2650, ranking 5th to 12th; Tieling and Fuxin had poor high-quality development of "three states" human settlements, with scores less than 0.2410, ranking 13th and 14th, respectively. As shown in Figure 3, on the whole, in terms of the high-quality development of human settlements in "three states" of Liaoning Province, cities in the south of Liaoning, including Dalian and Yingkou, and cities in the north of Liaoning, including Shenyang and Tieling, scored high, followed by cities in central Liaoning, including Panjin. Eastern Liaoning (Fushun, etc.) and western Liaoning (Huludao, etc.) scored low.

(2) "Hump" spatial-structure characteristics

The high-quality development of "three states" human settlements in Liaoning Province generally presents the characteristics of a "hump" spatial structure, decreasing from the central region to the surrounding areas. As shown in Figure 3, the average score of "three states" human settlements in Dalian and Yingkou in southern Liaoning is 0.3533, which is slightly higher than the scores of 0.3226 and 0.2859 in northern and central Liaoning Province. The average scores of Huludao and Chaoyang in western Liaoning Province is

0.2534, and the average score of Fushun, Benxi and Dandong in the east is 0.2492, which is the lowest score. The "hump" spatial pattern is remarkable.

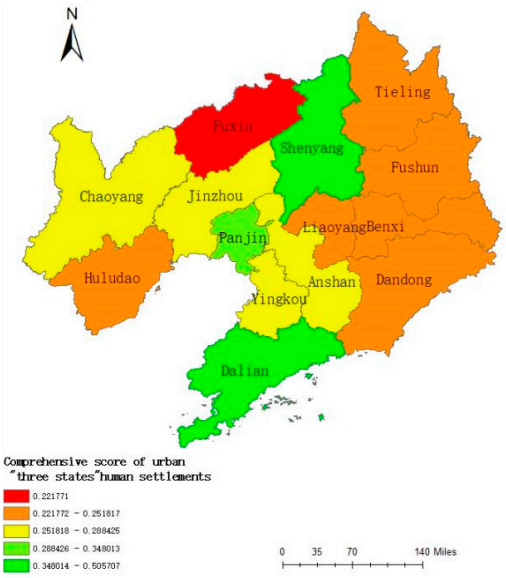



**Figure 3.** Comprehensive score of urban "three states" human settlements.

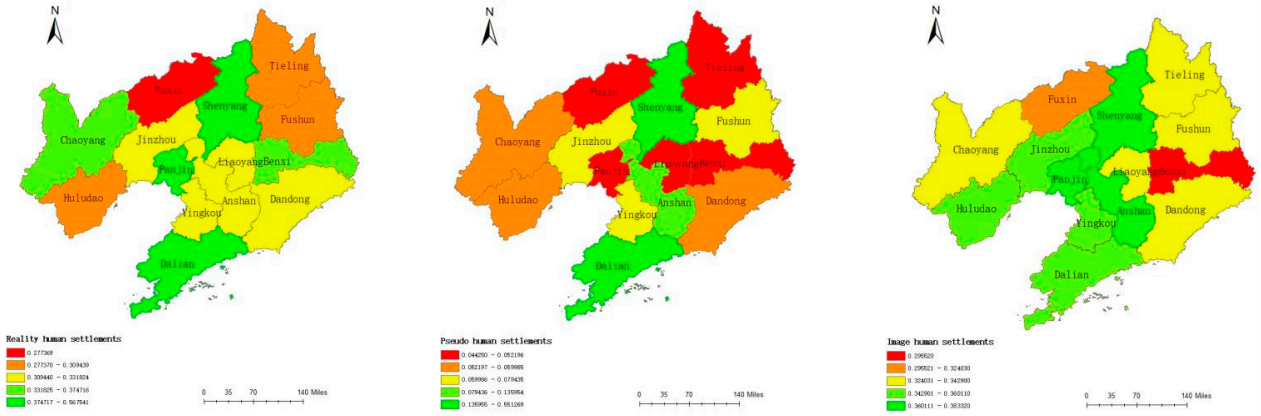
(3) "Dual-core" spatial-differentiation characteristics

Urban "three states" human settlements in Liaoning Province presents "dual-core" spatial characteristics, as shown in Figure 3. Shenyang and Dalian ranked first and second, with 0.5057 and 0.4435, respectively for the high-quality development of human settlements in "three states" human settlements. Panjin ranked third, with a score of 0.3480, which is nearly 0.2000 points less than that of the two pillars of Shenyang and Dalian. Fuxin ranked last, with a score of 0.2218 and a range of 0.2836. Therefore, urban "three states" human settlements scores in Liaoning Province are based on the two high-value areas of Shenyang and Dalian, which embody the characteristics of "dual-core" spatial differentiation characteristics.

### 3.1.2. Morphological Characteristics

1. Reality human settlements

Based on the high-quality development of urban RHSs, the 14 prefecture-level cities in Liaoning Province can be divided into three categories according to the score range, which is inseparable from the status and function of cities, as well as the development mode and degree of cities. The first category is the core areas of Liaoning Province, including Shenyang and Dalian, with scores of 0.5675 and 0.5389, respectively. They have significant advantages in economic income, residents' life and other realistic aspects, so their scores are far ahead of other cities. The second category is the transition zone formed by cities such as Benxi, Chaoyang and other cities, whose scores are between 0.3110 and 0.3750, which is significantly less than the first category of cities but with a cluster of internal scores. The development level of RHSs in these cities is similar, but there is a significant gap between them and the cities in the first category. The third category is the starting area composed of Tieling, Huludao and other cities, with a score of less than 0.3110. The development level of urban RHSs is relatively low, and high-quality development level and development ability need to be strengthened. On the whole, compared with inland areas, coastal areas have the advantages of convenient water and land transportation, sufficient information resources and advanced technology. Therefore, the high-quality development of RHSs presents a "high in the south and low in the north" trend, as shown in Figure 4.




(**a**) (**b**) (**c**)

**Figure 4.** (**a**) Scores of RHSs; (**b**) scores of PHSs; (**c**) scores of IHSs.

2. Pseudo-human settlements

The regional spatial differences in the high-quality development of urban PHSs is very significant, as shown in Figure 4. According to the score range, it can be divided into two categories. The first category is the high-speed development area composed of Shenyang and Dalian, which scored significantly higher than other cities, with values of 0.5513 and 0.4039, respectively. The "dual-core" spatial distribution is obvious. Except for Anshan, with a score of 0.1360, other cities all scored less than 0.0800, which is a slow-speed development area. The spatial difference between PHSs and RHSs is further expanded. As the two core areas for the development of Liaoning Province, Shenyang and Dalian gather high-tech industries and advanced technologies in various fields in RHSs, which makes the development of network elements more rapid and complete. At the same time, the strong urban competitiveness of Shenyang and Dalian have attracted a large number of young people, and the vitality of these cities has enabled them to develop more rapidly in pseudo-space and promoted the high-quality and vigorous development of urban PHSs.

3. Image human settlements

The high-quality development of urban IHSs presents a "hump" spatial structure, and the score gradually decreases from the middle to the east and west. Panjin and Anshan scored higher, as shown in Figure 4, both greater than 0.3800. Shenyang and Dalian are slightly behind, with scores of 0.3777 and 0.3557, ranking third and sixth, respectively, in Liaoning Province. Urban IHSs directly reflect residents' degree of satisfaction with human settlements and indirectly reflect the degree of benefit to the people of the city. Although Panjin and Anshan are located in the central part of Liaoning Province, the development of their five major systems is relatively complete, and residents have a relatively high degree of satisfaction with the city. Although Shenyang and Dalian are "dual-core" areas in Liaoning Province in terms of RHSs and PHSs, they do not score the highest in IHSs. Shenyang and Dalian, as areas with higher levels of development in Liaoning Province, are well developed in terms of social communication, learning, education, leisure and entertainment. However, due to their high population density, high consumption levels and expensive housing prices, the satisfaction with population systems and the residence system is low, which makes IHSs score slightly lower than the two cities of Panjin and Anshan.

4. "Three states" human settlements

Based on the high-quality development level of urban "three states" human settlements, this paper adopts the mapping of the position on the three-dimensional index structure of "three states" on the two-dimensional plane to express the balance relationship among the three forms of reality, pseudo and image in each area, as shown in Figure 5.

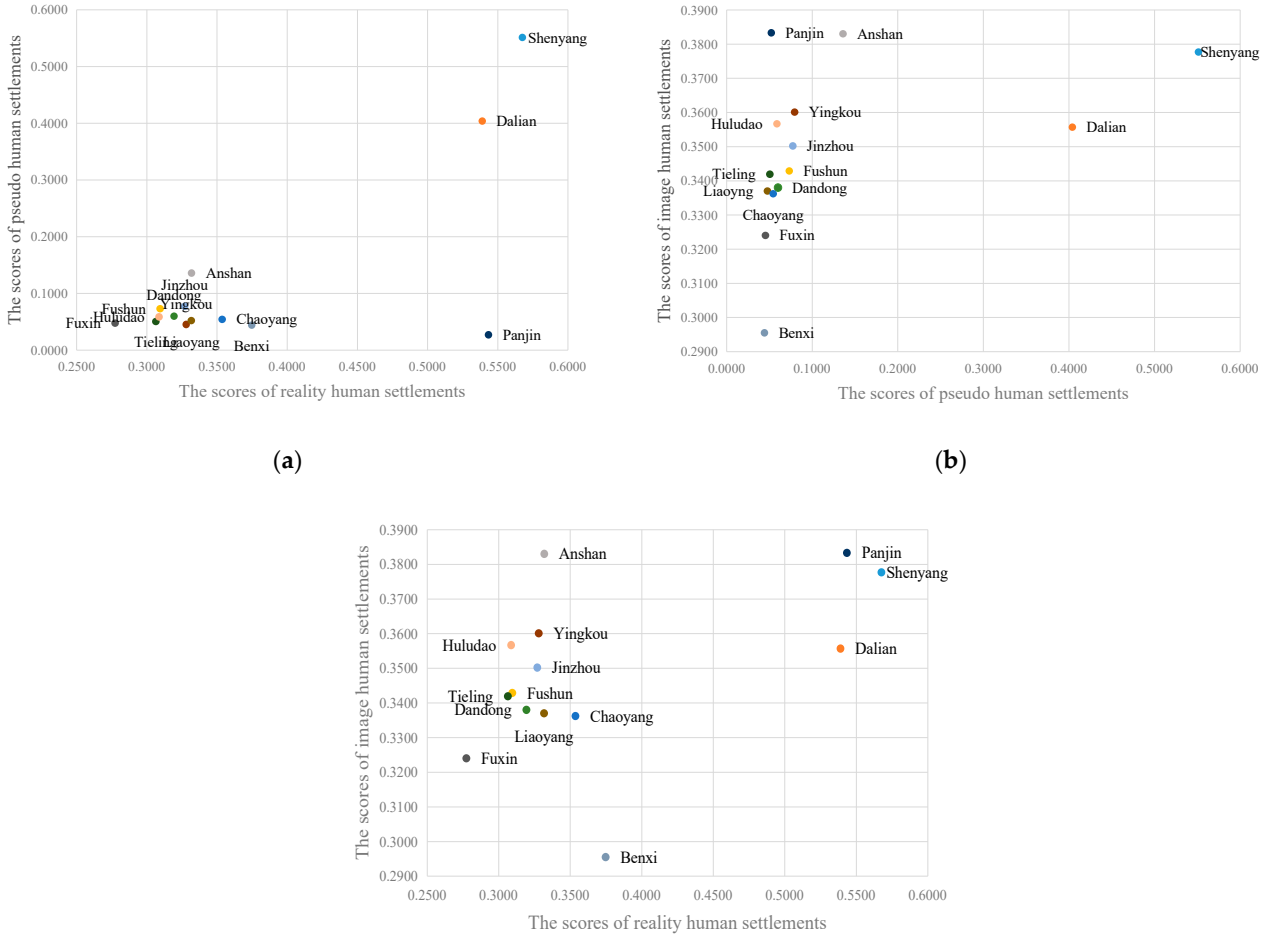



**Figure 5.** Two-dimensional planar mapping of three-dimensional index structure of reality-pseudo-image state: (**a**) reality-pseudo human settlements; (**b**) pseudo-image human settlements; (**c**) reality-image human settlement.

(1) From the perspective of the two-dimensional spatial equilibrium between RHSs and PHSs, the scores of RHSs in Shenyang and Dalian are 0.5675 and 0.5389, respectively, while the scores of PHSs are 0.5512 and 0.4039, respectively, which are in the double high level spatial equilibrium. Panjin's RHSs score is 0.5433, which is higher than that of PHSs (0.0271), which shows that the development quality level of PHSs is lower than the single high level of RHSs. The development of RHSs and PHSs in other cities in Liaoning Province is relatively lagging. Among them, Fuxin's RHSs score is 0.2773, and its PHSs score is 0.0476, both of which are relatively backward, and their development lags more prominently.

(2) From the perspective of the two-dimensional spatial equilibrium between PHSs and IHSs, Liaoning Province generally presents a situation of coexisting equilibrium and disequilibrium. The scores of PHSs in Dalian and Shenyang are 0.4039 and 0.5512, and the scores of IHSs are 0.3557 and 0.3777, respectively. The development of PHSs and IHSs in the two cities is more coordinated; Panjin's PHS score is as high as 0.3833, which is higher than most areas; Panjin's PHS score is only 0.0522, which is lower than most areas; and the development of PHSs and IHSs in Panjin presents a disequilibrium state. Dandong, Jinzhou, Yingkou and other cities also show a trend of development of IHSs than of PHSs.

(3) From the perspective of the two-dimensional spatial equilibrium between RHSs and IHSs, the scores of RHSs in Shenyang, Dalian and Panjin were 0.5675, 0.5389 and

0.5433, respectively, and the scores of IHSs in Shenyang, Dalian and Panjin were 0.3777, 0.3557 and 0.3833, respectively. All of them are at a relatively high level, belonging to a reality-image high-level spatial equilibrium state; Chaoyang's RHSs score is 0.3536, and it IHSs score is 0.3362. The quality of reality-image human settlements is doubly low, belonging to the low-level spatial equilibrium state between the development of RHSs and the development of IHSs. Urban areas such as Dandong, Yingkou and Huludao belong to the state of high IHS and low RHS development quality.

On the whole, Liaoning Province is in a state of coexisting equilibrium and disequilibrium in the mapping of three-dimensional space development and the two-dimensional plane. Shenyang, Dalian and Panjin showed a relative equilibrium in the two-dimensional system, while the development of the two-dimensional system in Fuxin, Dandong and other regions showed a disequilibrium situation.

#### 3.1.3. Subsystem Characteristics

1. Reality human settlements

The high-quality development of RHSs is composed of population, residence, society, support and environment. The level of its development directly reflects the comprehensive level of human settlements in each city. The comprehensive results show that the average RHS score is 0.3727. The results of the high-quality development scores of RHSs in different dimensions are represented by radar map. The results are shown in Figure 6a. It can be seen that among the five dimensions, Shenyang and Dalian score much higher in support system than other cities, and infrastructure construction of these two cities is relatively developed. In the three aspects of environmental systems, residential systems and social systems, the differences among regions are small, indicating that the development level of cities in Liaoning Province is not significantly different in the three aspects.

2. Pseudo human settlements

The high-quality development of urban PHSs reflects the comprehensive development level of social communication, learning and education, leisure and entertainment, transportation and online shopping in 14 prefecture-level cities in Liaoning Province. It represents the basic needs and services of urban residents in the information age and the Internet age and is a deepening exploration of human settlements. The comprehensive results show that the average score of PHSs is 0.1239, and the high-quality development score results of urban PHSs of different dimensions are represented by a radar map. The result is shown in Figure 6b. Shenyang ranks among the top scores in social communication, learning and education, leisure and entertainment, transportation and online shopping, which makes the development level of PHSs in Shenyang relatively high. Dalian ranked second, and Anshan ranked third. The development level of their PHSs is not as good as that of Shenyang; it is also higher than other cities and in the medium development level. However, Benxi, Fuxin and other cities have low scores and are at a low level of development. In the era of the rapid development of Internet and information technology, the development of PHSs should be paid full attention.

3. Image human settlements

Population systems, resident systems, social systems, support systems and environmental systems reflect the different aspects of the high-quality development of urban IHSs. Image is an important manifestation of urban residents' satisfaction with human settlements. Urban IHS development in Liaoning Province is relatively balanced. The result is shown in Figure 6c. It can be concluded from the comprehensive scores of various systems that social system and support system are in the top, showing the characteristics of "double engine", while population system and environmental system scores are relatively low. Population system especially need to be improve in terms of shortcomings in the development of IHSs by stages and targets in the aspects of birth rate, aging rate and number of talents.

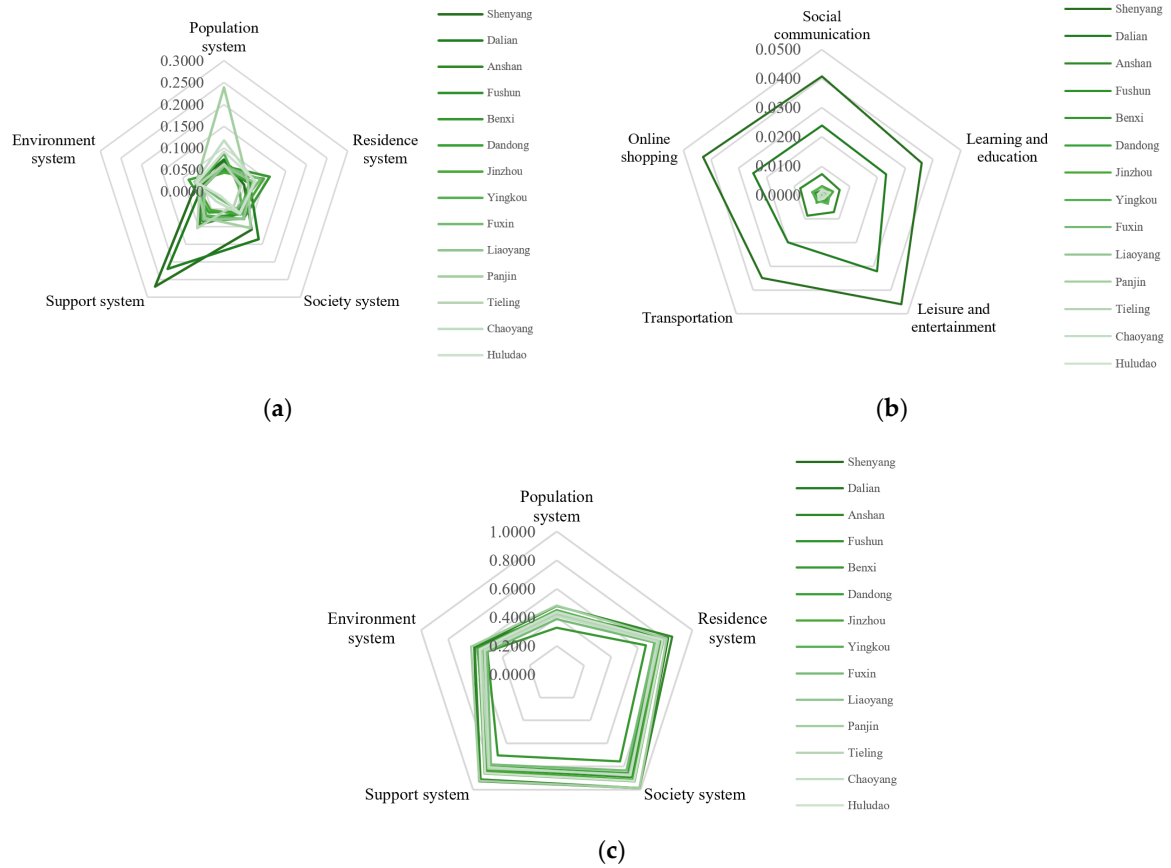



**Figure 6.** (**a**) RHSs system score radar map; (**b**) PHSs system score radar map; (**c**) IHSs system score radar map.

### *3.2. "Three States" Human Settlements High-Quality Development Coupling-Coordinating Spatial Relations*

#### 3.2.1. Corresponding Type

The high-quality development of human settlements is formed by the joint development of RHSs, PHSs and IHSs, but differences exist in development processes in the space, which forms the differentiation of the three corresponding relations on the basis of the grasp of the corresponding relationship between the three spaces to further explore coupling degree and coupling coordination spatial relationships. Based on previous research results [2] and the scores of RHSs, PHSs and IHSs, they are divided into three levels of high, medium and low. Nine corresponding relationships of RHSs, PHSs and IHSs are obtained, as shown in Table 2.

Urban RHSs, PHSs and IHSs do not completely present a coordinated relationship. The high-quality development of RHSs is a necessary condition for the high-quality development of urban human settlements. In terms of order, Shenyang, Dalian and Panjin are in the forefront of RHSs, and Shenyang and Dalian also ranked higher in PHSs, while Anshan, Panjin, Shenyang and other cities are in the lead in terms of IHSs. From the perspective of the corresponding relationship types, the proportion of the 14 prefecture-level cities of Liaoning Province that belong to complete correspondence relationship is relatively small, accounting for only 14.2857%, including two types of "high–high–high" and "low–low–low", covering Shenyang and Fuxin. Among them, the "medium–low–low" type appeared most frequently, including Benxi, Chaoyang, Liaoyang and Dandong. The "low–low–medium" type appeared three times, including Fushun, Huludao and Tieling, while other types, such as "medium–low–medium" and "high–low–high" appear only once. It comprehensively presents that the development level of urban RHSs, PHSs and IHSs does not reflect a fully coordinated correspondence relationship. The spatial level of the

three is relatively weak; among the nine types of correspondence relation, only two types of PHSs have a high level of development, accounting for 22.2222%. The specific types are "high–high–medium" and "high–high–high". When RHSs develop at a high level, the high-quality development of PHSs and IHSs is also at a relatively high level; when RHSs are at a low level of development, the development level of PHSs and IHSs is relatively low. This further proves that the high-level development of RHSs is a necessary condition for the high-quality and high-level development of urban human settlements. At the same time, it also shows that RHSs have an upper limit to support the high-quality development of urban human settlements, and the high-quality and high-level development of urban human settlements presents the fundamental demand for the development level of RHSs.

**Table 2.** Corresponding relationship, coupling degree and coupling coordination degree of "three states" coordinated development of high-quality human settlements.

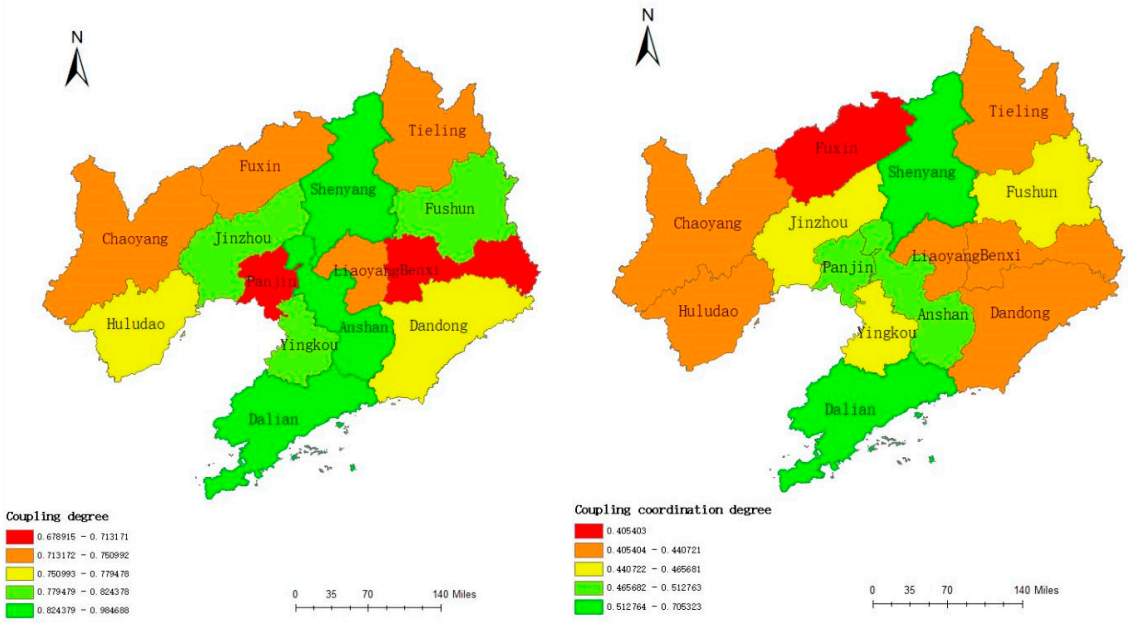
| Corresponding Relationship | Urban | Coupling Degree | Coupling Coordination Degree |
|---|---|---|---|
| high–high–high | Shenyang | 0.9837 | 0.7053 |
| high–high–medium | Dalian | 0.9847 | 0.6608 |
| high–low–high | Panjin | 0.6789 | 0.4861 |
| medium–medium–high | Anshan | 0.9116 | 0.5128 |
| medium–low–high | Yingkou | 0.8244 | 0.4657 |
| low–low–medium | Jinzhou | 0.8226 | 0.4616 |
| medium–low–low | Benxi | 0.7132 | 0.4238 |
| | Chaoyang | 0.7510 | 0.4407 |
| | Liaoyang | 0.7315 | 0.4260 |
| | Dandong | 0.7795 | 0.4389 |
| low–low–medium | Fushun | 0.8189 | 0.4512 |
| | Huludao | 0.7720 | 0.4376 |
| | Tieling | 0.7482 | 0.4240 |
| low–low–low | Fuxin | 0.7411 | 0.4054 |

Note: high, medium and low generation refer to the high-quality development level of RHSs, PHSs and IHSs; the corresponding relation types in the table are in the order of reality-pseudo-image human settlements.

#### 3.2.2. Coupling Coordination Characteristics

The high-value area of coupling degree of high-quality development of "three states" human settlements mainly includes Dalian, Shenyang and other rapidly developing cities, and their values are all greater than 0.9110. Low values of coupling degree are mainly concentrated in Benxi, Panjin and other cities, with values of less than 0.7320. On the whole, the coupling degree of the high-quality development of "three states" human settlements generally presents the characteristics of a "hump" spatial pattern, as shown in Figure 7, with the coupling degree of Shenyang, Anshan and Dalian in the center, and a decline to the east and west. The regional difference is significant.

From the perspective of space, basic coordination is the main type of coupling coordination, and its high-value area appears in Shenyang, Dalian and Anshan, which are of intermediate coordination, primary coordination and barely coordinated, with no extreme coordination. At the same time, Shenyang, Anshan and Dalian, as the pillars, gradually spread to the east and west, showing "hump" spatial distribution characteristics on the whole, as shown in Figure 7. From the regional perspective, the coupling coordination degree of human settlements in southern and northern Liaoning is higher than that in central Liaoning, eastern Liaoning and western Liaoning. The coupling coordination degree of Shenyang and Dalian is 0.7053 and 0.6608, respectively, as the two pillars lead the coupling coordinated development of urban "three states" human settlements in Liaoning Province. Shenyang is the development center of Liaoning Province, while Dalian is one of the first coastal open cities in China with coastal and port advantages and a high level of economic development. The superior geographical background and financial support of the two cities make them the two pillars for the high-quality coordinated development of human settlements in Liaoning Province.




(**a**) (**b**)

**Figure 7.** (**a**) Coupling degree of "three states" coordinated development of high-quality human settlements; (**b**) coupling coordination degree of "three states" coordinated development of high-quality human settlements.

There is a certain correlation between coupling degree and coupling coordination degree of the high-quality development of urban "three states" human settlements. Both high-value areas include cities such as Dalian and Shenyang. The development of these cities in reality, pseudo and image dimensions of human settlements is at a high level, and each dimension is closely linked with one another, presenting a high level of mutual promotion, thus promoting the high-quality development of urban "three states" human settlements. The low-value areas of coupling degree and coupling coordination degree include cities such as Benxi and Liaoyang. Such cities have low-level development in at least one of the three dimensions of the development of RHSs, PHSs and IHSs. The interaction between the dimensions is weak, which presents a low-level development trend, leading to a relatively backward high-quality development level of urban "three states" human settlements.

### *3.3. Driving Mechanism and Optimized Path of High-Quality Coordinated Development of "Three States" Human Settlements*

#### 3.3.1. Driving Mechanism

Under different spatial patterns, different dimensions of human settlements and their comprehensive index layer are definitely be influenced by different types of factors and driven by various factors. The quantitative analysis of geographic detectors is used to explore the influence of different individual index factors on the comprehensive index layer level and to explore the driving factors and driving mechanisms of the high-quality coordinated development of urban "three states" human settlements.

1. Factor analysis

Based on factor analysis, the following are shown in Table 3: (1) The core driving factors leading RHSs level are population status, living quality, economic income, residents' life and environmental feedback. (2) At the level of PHSs, social interaction, learning, video, travel and electronic mall are the leading core driving factors. (3) The core driving factors of IHSs are population quality, basic conditions, good life, survival guarantee and environmental quality. $RHS_1$~$RHS_{15}$ refer to the driving factors of RHSs, such as sex ratio

and population ratio over 60 years old. $PHS_1$~$PHS_{15}$ refer to the driving factors of PHSs, such as WeChat and QQ. $IHS_1$~$IHS_{15}$ refer to driving factors of IHSs, such as population growth rate and elderly population proportion.

**Table 3.** The detection q value of different comprehensive index-layer drivers developed in the high-quality development of "three states" human settlements.

| RHSs | 2018 | PHSs | 2019 | IHSs | 2020 |
|---|---|---|---|---|---|
| $RHS_1$ | 0.9253 | $PHS_1$ | 0.6028 | $IHS_1$ | 0.5406 |
| $RHS_2$ | 0.9232 | $PHS_2$ | 0.6037 | $IHS_2$ | 0.4374 |
| $RHS_3$ | 0.8828 | $PHS_3$ | 0.2321 | $IHS_3$ | 0.3836 |
| $RHS_4$ | 0.9742 | $PHS_4$ | 0.5930 | $IHS_4$ | 0.6147 |
| $RHS_5$ | 0.8832 | $PHS_5$ | 0.5279 | $IHS_5$ | 0.6070 |
| $RHS_6$ | 0.9328 | $PHS_6$ | 0.9113 | $IHS_6$ | 0.5611 |
| $RHS_7$ | 0.9298 | $PHS_7$ | 0.7121 | $IHS_7$ | 0.1547 |
| $RHS_8$ | 0.8832 | $PHS_8$ | 0.3436 | $IHS_8$ | 0.5781 |
| $RHS_9$ | 0.9228 | $PHS_9$ | 0.4502 | $IHS_9$ | 0.4445 |
| $RHS_{10}$ | 0.8766 | $PHS_{10}$ | 0.5873 | $IHS_{10}$ | 0.3313 |
| $RHS_{11}$ | 0.8549 | $PHS_{11}$ | 0.1854 | $IHS_{11}$ | 0.5011 |
| $RHS_{12}$ | 0.8867 | $PHS_{12}$ | 0.4690 | $IHS_{12}$ | 0.2241 |
| $RHS_{13}$ | 0.8820 | $PHS_{13}$ | 0.9018 | $IHS_{13}$ | 0.4853 |
| $RHS_{14}$ | 0.8597 | $PHS_{14}$ | 0.2423 | $IHS_{14}$ | 0.4351 |
| $RHS_{15}$ | 0.9303 | $PHS_{15}$ | 0.6630 | $IHS_{15}$ | 0.3344 |

Note: The *q* value of the marked line represents the core driver in the front rank of comprehensive rankings.

2. System analysis

Based on the system analysis, the values of the comprehensive index layer were obtained and are shown in Table 4. According to the influence on the comprehensive index layer, from strong to weak, the values are as follows:

**Table 4.** Detection results of difference factors at different levels of the high-quality coordinated development of "three states" human settlements.

| RHSs | 2018 | PHSs | 2019 | IHSs | 2020 |
|---|---|---|---|---|---|
| Population system | 0.7619 | Social communication | 0.9955 | Population system | 0.4661 |
| Residence system | 0.6351 | Learning and education | 0.9919 | Residence system | 0.4800 |
| Society system | 0.7128 | Leisure and entertainment | 0.9904 | Society system | 0.3943 |
| Support system | 0.6977 | Transportation | 0.9911 | Support system | 0.4947 |
| Environment system | 0.6550 | Online shopping | 0.9939 | Environment system | 0.4499 |

(1) RHSs: population > society > support > environment > residence; (2) PHSs: social communication > online shopping > learning and education > transportation > leisure and entertainment; (3) IHSs: support > residence > population > environment > society.

Population systems, social communication and support systems are the core driving systems for the high-quality coordinated development of urban human settlements. The core driving system of RHSs is the population system, followed by the social system. The main driving factors are the urbanization rate of the permanent population and the annual average salary of employees. In RHSs, the development of a region is based on "people" and serves people. For people, it is particularly important to meet basic daily needs. The core driving system of PHSs is social communication, followed by online shopping. QQ and Taobao are the main driving factors. With the advent of the information age, the basic life needs in RHSs have gradually been transformed into multidirectional and high-level development needs in PHSs. Social communication is related to the intensity of interpersonal communication. Online shopping represents people's desire and ability to buy, is the external manifestation of economic strength and conforms to the requirements

and laws of high-quality development. The support system is the core driving system of IHSs, and the core driving factor is medical condition; as people's demand for a better life increases, the pay more attention to the social protection of health issues.

3.3.2. Optimized Path

1. Shenyang and Dalian "dual cores" lead "three states" human settlements to develop in high-quality

Shenyang and Dalian have a relatively high level of RHSs, so they should continue to play a leading role in the high-quality development of RHSs in other prefecture-level cities in Liaoning Province. Other cities should improve and strengthen the development of support systems, population systems and environmental systems to follow the example of Shenyang, Dalian and Panjin, which are better developed. Protecting the "priceless treasures" of green waters and mountains, reforming forest rights and turning green into gold, Benxi's forest coverage rate is as high as 75% and can promote the gradual transformation of "ecology" into "business", from tourism, vacation, internships and training to natural movement and visiting animals. As the leading enterprise in Liaoning Province, "Anshan Iron and Steel Group Corporation" made outstanding contributions to the development of the three northeastern provinces and even the whole country in the early days of the founding of the People's Republic of China. In the important period of the new round of the northeast revitalization strategy, the role of the development of Anshan Iron and Steel Group Corporation and other manufacturing industries in driving the high-quality development of Liaoning province cannot be underestimated.

2. The "three states" of reality, pseudo and image have an equal emphasis on high-quality coordination of human settlements

With the rapid development of information technology, in addition to considering the construction of RHSs, it is also necessary to promote the development of PHSs. In areas where talents gather and network information is dense and safe, such as Shenyang and Dalian, the development of PHSs is relatively rapid. The development of other cities in Liaoning province should also strengthen the construction of the network level to protect network security and actively introduce high-quality talents to make the high-quality development of urban PHSs more effective. The propaganda power of various apps at the pseudo level, as well as WeChat official accounts, should not be underestimated. Almost every city in Liaoning Province has its own characteristic tourist attractions, such as Shenyang Imperial Palace, Dalian Xinghai Square, Benxi Water Caves, Yingkou Wanger Mountain, etc. These types of scenic spots are famous in Liaoning Province and even the whole country. Local governments and tourism departments can strengthen the publicity of their hometown by creating official accounts or APPs, so as to promote reality by pseudo and promote the efficient and coordinated development of the two. The development of urban IHSs is dominated by human consciousness. The scores of IHSs directly reflect the people's aspiration. The low score in population systems and environment systems in IHSs of Liaoning Province is directly related to the poor development of Liaoning Province in recent years.

3. Attach importance to the high-quality development of the subject "people" in "three states" human settlements

According to the Bulletin of the Seventh National Census of Liaoning Province, problems such as the serious outflow of population, the serious aging of the population and the declining birth rate in most cities of Liaoning province directly feedback the obstacles to the development of IHSs. Therefore, local governments should strengthen the capacity of infrastructure construction and talent attraction and, at the same time, listen to the opinions of the people, formulate and improve relevant laws and regulations and truly achieve development that depends on the people and development for the people so that the high-quality development of urban human settlements can be recognized by the people and truly achieve "a city for the people".

## 4. Discussion

RHSs, PHSs and IHSs jointly determine the high-quality development of urban "three states" human settlements, which promote and restrict one another. RHSs are the foundation of all high-quality development. Doing a good job in the construction of RHSs can is a reliable prerequisite for the high-quality development of Liaoning. PHSs are an extension of RHSs in the Internet field and are an important embodiment of urban high-quality development. IHSs are the most intuitive reflection of residents, and the level of recognition and evaluation by ordinary people can best reflect whether the development of urban human settlements is of high quality. It is particularly important that the high-quality development of single forms of human settlements is not the end point of the construction of urban human settlements. The integration and coordinated and comprehensive development of "three states" human settlements is an important guide for the high-quality development of the city.

This paper constructs a theoretical framework for the high-quality coordinated development of "three states" human settlements and makes an empirical study with 14 prefecture-level cities in Liaoning Province. Compared with previous relevant studies: (1) The "double core" spatial characteristics and the spatial differentiation of the core area, transition area and starting area of human settlements have been well verified in previous studies, which has its objective reality [58,59]. (2) The spatiotemporal differentiation law of PHSs and the coupling coordination between PHSs and RHSs have been thoroughly studied and confirmed by peers [2,60]. (3) The theoretical framework, spatial relationship and new driving factors of the coupling and coordination of "three states" human settlements are some thoughts and explorations that keep pace with the times based on the development of human settlement practice and theory. Research have evolved from the investigation of single state and the correlation of two states to the research of high-quality coupling and coordination of "three states" human settlements. Admittedly, there are some deficiencies in these explorations, but at the same time, further research is being developed in the sciences of human settlements under the background of informatization and citizenization.

Exploring the high-quality coordinated development of "three states" human settlements in Liaoning Province has certain theoretical and practical significance for the integration and development of human settlements and other interdisciplinary subjects, as well as the implementation of the new national strategy for the revitalization of northeast China.

At the same time, there are some shortcomings that need to be further optimized: (1) Dynamics: adding time as an important geographical factor to the static study of "three states" human settlements, so as to carry out the dynamic study of long time series and further study the spatiotemporal characteristics of human settlements. (2) Refinement: exploring the elements, dominant systems and key forms that strongly interact with one another in "three states" human settlement elements, systems and forms, so as to carry out refinement research on human settlements under the complex relationship between humans and land. (3) Specification: the geographical scale of provinces and cities is tied to the scale of districts and streets of a typical city (Dalian), so as to conduct concrete and targeted research on the high-quality coordinated development of "three states" human settlements on a microscopic scale. (4) Specialization: different group characteristics lead to certain differences in the "three states" space where they are located. For example, in the pseudo space, teenagers pay more attention to learning, education, leisure and entertainment, while middle-aged people pay more attention to transportation, financial management, social communication, etc. The difference in pseudo space affects PHSs, as well as the development of "three states" human settlements. In the future, the research subjects will be divided according to certain attributes to carry out special research on different groups. (5) Three-dimensional urban human settlements are formed by the common development of RHSs, PHSs and IHSs, reducing the "interference suppression" effect among the three and improving the "synergistic amplification" effect among the three, so as to promote the comprehensive and three-dimensional development of human settlements to meet the

diversified practical needs of the development of the times, government decision making and residents' needs.

## 5. Conclusions

Taking reality, pseudo and image of human settlements as the point of penetration, this paper explains the connotation of the high-quality coordinated development of urban "three states" human settlements and used 14 prefecture-level cities in Liaoning Province as case areas to explore their spatial patterns, the coupling coordinating spatial relationships, driving mechanisms and optimized paths. This paper provides new ideas for the research direction of urban human settlements and other cross-discipline approaches and provides new inspiration for the high-quality coordinated development and optimization of human settlements by the local government of Liaoning Province. The theoretical connotation of the high-quality coordinated development of "three states" human settlements includes primary stage, intermediate stage and advanced stage. The high-quality coordinated development of each stage is a necessary condition for the high-quality coordinated development of urban "three states" human settlements.

1. Spatial pattern of high-quality development of "three states" human settlements. (1) The 14 prefecture-level cities in Liaoning Province show obvious regionally differentiated spatial-structure characteristics, forming a "hump" spatial structure centered on southern Liaoning, northern Liaoning and central Liaoning and forming "dual-core" spatial differentiation characteristics, with Shenyang and Dalian as the pillars. (2) According to the morphological characteristics of high-quality development of human settlements, RHSs in Liaoning Province can be divided into core area, transition zone and starting zone; PHSs can be divided into the high-speed development area composed of Shenyang and Dalian and the slow-speed development area composed of other cities. The dual-core spatial distribution characteristics are remarkable. In IHSs, Shenyang and Dalian score lower and failed to lead the high-quality coordinated development of IHSs. Whether it is two-dimensional development of reality-pseudo, pseudo-image or reality-image human settlements, Liaoning Province as a whole is in a state of coexisting equilibrium and disequilibrium. (3) Among the subsystems of RHSs, Shenyang and Dalian score much higher than other cities in terms of support systems and social systems. In PHSs, Shenyang and Dalian rank in the forefront of scores in all dimensions, and the overall development level of PHSs is relatively high. It is not Shenyang and Dalian that score higher in terms of systems of IHSs but Panjin, which scores higher in both social systems support systems.
2. The coupling coordination spatial relationship of high-quality development of "three states" human settlements. (1) RHSs, PHSs and IHSs do not completely present a coordinated corresponding relationship, forming the "high–high–high" and "low–low–low" types represented by Shenyang and Fuxin, respectively. The high-level development of RHSs is a necessary condition for the high-quality and high-level development of urban "three states" human settlements. (2) There is a certain correlation between the high-quality development coupling degree and coupling coordination degree of "three states" human settlements. The high-value areas of the two correspond to one another, showing a "dual-core" spatial distribution dominated by Dalian and Shenyang. Low-value areas include cities such as Benxi and Liaoyang. From a spatial perspective, the types of coupling coordination are basic coupling and basic coordination.
3. The driving mechanism and optimized path of the high-quality coordinated development of "three states" human settlements. (1) Through the calculation of the geographic detector, it is possible to quantitatively analyze the degree of influence of different individual index factors on the comprehensive index layer. The core driving factors of RHSs are population status, living quality, etc., and the population system is the main driving system. The core driving factors of PHSs are social interaction, learning, etc., and social communication is the main driving system. The population

quality and basic conditions in IHSs are the core driving factors, and the support system is the core driving system, among which medical conditions dominate. (2) By exploring the spatial pattern of the high-quality coordinated development of "three states" human settlements in Liaoning Province, this paper proposes the following optimized paths: a. taking Shenyang and Dalian as the "dual cores" to guide the high-quality development of "three states" human settlements; b. Equal emphasis on the high-quality coordination of reality, pseudo and image "three states" human settlements; c. emphasis on the high-quality development of the subject "human" in "three states" human settlements.

**Author Contributions:** Conceptualization, S.T. and X.L.; methodology, A.Q. and Z.L.; software, X.P. and Y.L.; validation, S.T. and A.Q.; formal analysis, A.Q. and Z.L.; investigation, X.P. and Y.L.; resources, S.T.; data curation, S.T. and A.Q.; writing—original draft preparation, A.Q.; writing—review and editing, S.T. and A.Q.; visualization, A.Q. and Z.L.; supervision, S.T. and X.L.; project administration, S.T. and X.L.; funding acquisition, S.T. and X.L. All authors have read and agreed to the published version of the manuscript.

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