

Article

The Key Factors Driving the Development of New Towns by Mother Cities and Regions: Evidence from China

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Abstract: As an important carrier of expanded urban spatial growth, new towns have been a “policy tool” for spatial production in the new era and have received long-term and constant attention from circles such as geography, planning, and economics. National new districts constitute a new regional space for China to implement the national strategy and promote the transformation of urban development mode. They are mutually reinforcing with their mother cities and hinterland provinces. Based on the geodetector method, this paper reveals the key factors driving the development of national new districts by mother cities and hinterland provinces and their interaction effects, which provides a basis for municipal and provincial governments to accurately formulate policies to promote the development of new towns by classification. The study shows that, firstly, there are five types of driving factors, that is, all-round driving factors, scale-increasing factors, expansion and quality-improving factors, expertise driving factors, and non-driving factors. The strength and dimension of the driving factors are characterized by prominent heterogeneity; R&D personnel, export and import trade are the key factors to expand the increment, optimize the inventory, and improve the quality; the overall development driving forces are in the order of innovation > opening > industry > investment > population. Secondly, the pairwise interaction between different factors exhibits two-factor enhancement, and the population shows a nonlinear increase in the driving force of investment, openness, and innovation on a provincial scale. Thirdly, according to the driving force of the factors and the interaction between them, suggestions are put forward based on the development stage and key demands for city and provincial governments to make policies for the development of national new districts, to support the establishment of scientific competition and cooperation between new towns and mother cities or regions, and to build a long-term collaborative development mechanism.

Keywords: new town; national new district; driving mechanism; geodetector; China



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1. Introduction

1.1. Background

New town construction and old city renewal are two trends of urban spatial development, especially for countries in the rapid development stage of urbanization and industrialization, where it is a common spatial phenomenon to develop and construct new towns on the edge or periphery of the old city. In 1945, the British central government directly funded and ordered the establishment of a new town development company, marking the beginning of the institutionalized new town campaign in the UK, followed by promulgation of New Town Act and building of 32 new towns. In the specific economic, social, and political context after World War II, the planning and construction of new towns originated from Britain became popular in western countries, which affected the development of cities in many countries including France, the United States, and Japan. With the change in macro-conditions of development, the planning and construction of

new towns entered a period of stasis when new towns in western developed countries were gradually brought into the regular management under the jurisdiction of local government in the mid-late 1980s [1]. On the contrary, as the economic globalization picks up the speed, the new town campaign is rising in developing countries.

With the transfer and division of labor in the international industry to promote the rapid development of urbanization, there is an increasing demand for urban space expansion in developing countries. Based on the concept of sustainable composite development of new towns, and the practical experience in planning and construction of developed countries such as Britain and the United States, building new towns on the edge or periphery of the old city has gradually become a strategic choice for urban development in many countries or regions. New town construction in China, originated from the development of special economic zones and development zones, has played an important role in China's urban and regional development since the introduction to the reform and opening-up, and has become a major phenomenon and concept in China. It is obvious that new towns have been an important carrier of urban spatial expansion and economic development in China, driving the rapid change of urban visions and spatial structure, and greatly promoting the development of national economy. Therefore, it is of great significance to study them for catching on the urban and economic development in China.

1.2. Literature Review

As various types of industrial cities, science cities, economic cities, university cities, satellite cities, comprehensive development zones, special economic zones, and other new urban spaces continue to spring up, the planning and construction of new towns has attracted extensive and continuous attention from the circles of geography, planning, economics and sociology, and there have been a large number of high-quality research results, mainly in three categories, as follows:

The first category is about the case analysis and comparative analysis of the history and experience of new town campaign in the world, including case analysis of the United Kingdom [2–4], Israel [5], Europe [6], Oman [7], Egypt [8], India [9,10], South Korea [11], the Netherlands [12], and Canada [13]. It systematically summarizes new experience and knowledge [14], new approaches and methods [15], and new technologies and theories [16–18] concerning the development of new towns. In Asia, especially in China, the scale of new towns is much larger than in Europe. Therefore, the research on China's new towns has aroused many scholars' discussions. Important papers are as follows: Review and prospects of the development and planning of new towns in China's Shanghai and Taiwan [19,20], the logic of green development mechanism and space production in China's new towns [21–23], China's national new district identification standards [24], and comparative study of South Korea and China, India, and China on the development and planning modes of new towns [25,26]. The second category is about the research on the sustainable development indicators and paths of the new town, including prediction of the potential impacts and risks of the development of new towns by SEA (Environmental Strategic Assessment) and ESIA (Environmental and Social Impact Assessment) [27], scenario prediction for the future development of new towns in Kuwait [28], new town planning methods for sustainable development of public space [29], role of participatory landscape in the sustainable development of new towns [30], forecast of carbon emissions for new town planning by system dynamics [31], measurement of diversity of new towns [32], evaluation of new town development sustainability [33], and new town development and sustainable transition under urban entrepreneurialism in China [34].

The third category is the study on the relationship between the new town and its mother city, for example, Surya pointed out that the spatial transformation works as a determinant of changes in the social formation of local communities in the new city area of Metro Tanjung Bunga, and the effect of spatial use, changes in social formation, and work differentiation on the socio-economic sustainability of local communities [35]. By quantitatively comparing the spatial characteristics and evolution processes between

mother city and new towns using a multinomial logit-based cellular automata (CA) land-use change model, Zhao shows that CA model can capture the real regulations of spatial growth for both mother city and new towns [36]. Lawton believed that there was uneven development of new towns in Ireland, and further analyzed the sustainable relationship between the new town and its mother city in the context of economic prosperity and depression [37]. Through a new analytic framework based on the integration of geographic information systems (GIS) and an extended shift-share analysis, Sui models the Spatial Economic-Impacts of New Town Development in Hong-Kong [38]. Campagna and Steinitz creatively proposed Geodesign [39–41], and conducted an in-depth discussion on its application in the field of strategic planning and green infrastructure [42,43]. Tiboni and Rossetti further expanded the comprehensive application analysis method based on GIS and introduced it into the framework of public transportation planning and analysis, such as bus station planning [44,45]. The relationship between development-planning and local economic-growth of Bracknell New Town [46].

In conclusion, as a new carrier of urban space production, new town construction responds to the specific needs of cities in different countries at different stages of development, and it has become an important step to optimize the urban spatial structure. In the early stage, the primary mission of new town construction was to dredge the old city function with the social demands as orientation, and the study focused on the function, form, employment-residence relationship and socio-spatial isolation of new towns. Later, the primary mission of new town construction was to balance the functions of metropolitan areas with the economic demands as orientation, and the study focused on industrial agglomeration, new economy cultivation, city-industry integration in new towns, and the relationship of economic development between new towns and mother cities. Now the primary mission of the new town construction is to implement the national strategies and government policies with the ecological demands and innovation demands as orientation, and the study focuses on the ecological economy, innovation-based economy, low-carbon economy, foreign investment agglomeration and foreign trade development, spatial governance, and innovation in government institutions and mechanisms.

However, there are some shortcomings in the existing study as follows. Firstly, in view of the fact that new towns are mutually reinforcing with their mother cities and hinterlands, it is the original intention of the government to drive and lead the sound and rapid development of the mother cities and hinterlands, while relying on the resources of the mother cities and hinterlands to drive the sustainable development of the new towns is a practical problem that must be addressed first. There are many studies on the former (at the fourth point of Literature Review), but the study on the latter is still insufficient. Secondly, in the era of big data, there has been growing attention to improving the quantification and accuracy of spatial planning as well as public policy formulation and implementation, but the quantitative analysis of existing study results is unsatisfactory, featured by low degree of quantification, disconnection of quantitative analysis with policy design and planning, thus leading to the lack of guidance of research conclusions for new town planning and policy design. Thirdly, the sample size has an effect on the breadth of the study and the accuracy of the conclusions. The sample size for the analysis of study results is generally small at present, for example, most papers conduct in-depth description and explanatory analysis on a single case, while few conduct comparative analyses on 3–5 new town cases. There are rare studies on numbers of samples or full samples of new towns depending on more cases.

1.3. Aim and Question

The new town is a strategic space for different levels of government to achieve multi-dimensional resource integration and function cultivation. Its sound and rapid development cannot be divorced from the strong support of the hinterland city government, provincial government and even the central government. What policies need to be introduced by the hinterland city (mother city) and the hinterland province (province or state

where the new town lies) governments to promote the rapid and sound development of the new town? Will the multiple policies implemented at the same time are symbiotic with enhanced effects, antagonistic with nullified effects, or produce negative effects? In other words, as policies are the core driving force for the development of national new districts, what factors must the mother city and the hinterland province governments attach importance to and what is the interaction between these factors? These questions are of great practical value for governments at different levels to make policies for the development of new towns, and of certain academic value for recognizing the development law of new towns. However, the existing studies are more about the result of new town establishment and its driving effect on surrounding cities and regions, while there are rare studies on how the mother cities and regions influence the development of new districts through policies, especially the acting point and force of policy driving mechanism, and the superposition effect of policies. Only Jing Rui has made an exploratory study so far on the development heterogeneity and driving mechanism of Pudong New Area and Jiangbei New Area by comparative analysis of economic development, population agglomeration, and land expansion indicators [47].

The practical and theoretical research on the development and planning of national new districts has been highly concerned by the political and academic circles and has become a major research topic in geography, planning, economics, and other disciplines. Therefore, based on the “quasi” full sample data of 18 national new districts (excluding Xiong’an New Area), this paper quantitatively depicts the heterogeneity of the development of national new districts and the effectiveness of their hinterland driving forces by the geodetector method, and measures the interaction effect of different policies in the case of multiple measures, with an attempt to reveal the mechanism of hinterland provinces driving the development of national new districts, so as to provide reference for the central, provincial and city governments to design policies related to the development and planning of new towns. The analysis framework provided in this paper is conducive to more rational planning and policy making, and also helps to better integrate quantitative analysis into policy design and implementation. It not only provides guidance for the development and planning of new towns at provincial and municipal levels in China, but also offers a certain reference value for city and state governments in developing countries in the stage of rapid urbanization such as India, Belarus, and Egypt.

2. Research Design

2.1. Study Area

The new town is the most important and prominent spatial phenomenon appearing in the course of urbanization and industrialization in China. With the rapid development of urbanization and industrialization, all types of new towns in China are developing rapidly and widely in recent years, and the number of new cities has grown explosively. For example, the average annual number of new towns established in China from 1984 to 2018 reached 97, with the height in 2010–2014 when up to 300 new towns were set up every year on average. According to incomplete statistics, there are 3846 new towns in China, with an approved area of 7.5 km², a planned area of 148,000 km², a planned construction land area of 73,000 km², a constructed land area of 2.9 km², a planned population of 430 million, and a contribution to the GDP accounting for more than 55% of the total in China [48].

National new districts, as the highest-level and highest-standard new towns in China, hold an extremely important position in China’s new town system. The national new district is established with the approval of the State Council of China, serving as a comprehensive functional area that undertakes China’s major strategic tasks of development, reform and opening up. The National Development and Reform Commission issued the “Guidelines on Promoting Sound Development of National New Districts”, requiring the national new district to play a leading and exemplary role in the construction of new towns and the urbanization of hinterland provinces and cities.

Since the establishment of the Pudong New Area in 1992, China has so far set up 19 national new districts. Since 2014, the central government of China has strengthened the plan for construction of national new districts, and has established 13 national new districts successively, accounting for about 70%, indicating that national new districts are once again at the forefront of a new round of reform and opening up and the transformation of urban development model. Although there are a small number of national new districts, accounting for less than 5% of all new towns in China, they are large-scale, with an average approved area of 1133 km² and an average planned population of 2.97 million, more than 30 times the average of new towns in China, quite typical in the construction of new towns in China.

Due to the short history of establishment and hard access to data, Xiong'an New Area is not included in the study. In this paper, 18 national new districts are selected as samples for the study, accounting for 95% (see Figure 1). The 18 national new districts correspond to 23 hinterland cities (Guian, Xixian, Tianfu, and Ganjiang new districts are distributed in 2 cities in space) and 18 hinterland provinces. In 2018, the GDP contributed by national new districts accounted for 16.46% and 8.28% of the average of hinterland cities and provinces, respectively; the GDP the national new district per area was 1.24 and 4.57 times the average of the hinterland cities and provinces. Most of the national new districts have become major growth poles of hinterland provinces and cities. Out of the 18 national new districts, 12 are in the initial stage of construction with a history of less than 5 years; Lanzhou New District, established more than 10 years ago, is still in the initial construction stage; Liangjiang, Nansha, and Zhoushan Islands have entered a period of steady development; Pudong and Binhai are already in the mature development period.

Due to the different time of establishment and development stage, the national new districts show significant heterogeneity in their planning and development levels (see Table 1). For example, Jinpu New District with the largest planned area is 4.94 times that of Ganjiang New District with the smallest, Pudong New Area with the largest planned urban construction land area is 6.17 times that of Zhoushan Islands New District with the smallest, and Binhai New District with the largest planned population is 6 times that of Lanzhou New District with the smallest. In 2018, Pudong New Area with the largest GDP and the largest GDP per area is 75.81 times and 55.26 times of Xixian New District with the smallest. In 2016–2018, Pudong New Area with the largest GDP increment was 137.31 times of Harbin New District with the smallest. All indicators have a coefficient of variation greater than 36%, and the Gini coefficient is greater than 0.5, indicating that they are all highly heterogeneous [49].

Table 1. Analysis of Planning and Development Heterogeneity of National New Districts.

	Max	Min	Max–Min	Max/Min	CV	Gini
Planning area (km ²)	2299	465	1834	4.94	54.74	0.68
Planning land area for urban construction (km ²)	810	131.3	678.7	6.17	46.60	0.67
Planning population (Thousand)	600	100	500	6.00	48.15	0.68
GDP (100 million)	10,462	138	10,324	75.81	107.78	0.78
GDP increment (100 million)	1730	12.6	1717.4	137.30	91.29	0.74
GDP per area (100 million/km ²)	8.65	0.16	8.49	54.06	89.85	0.81

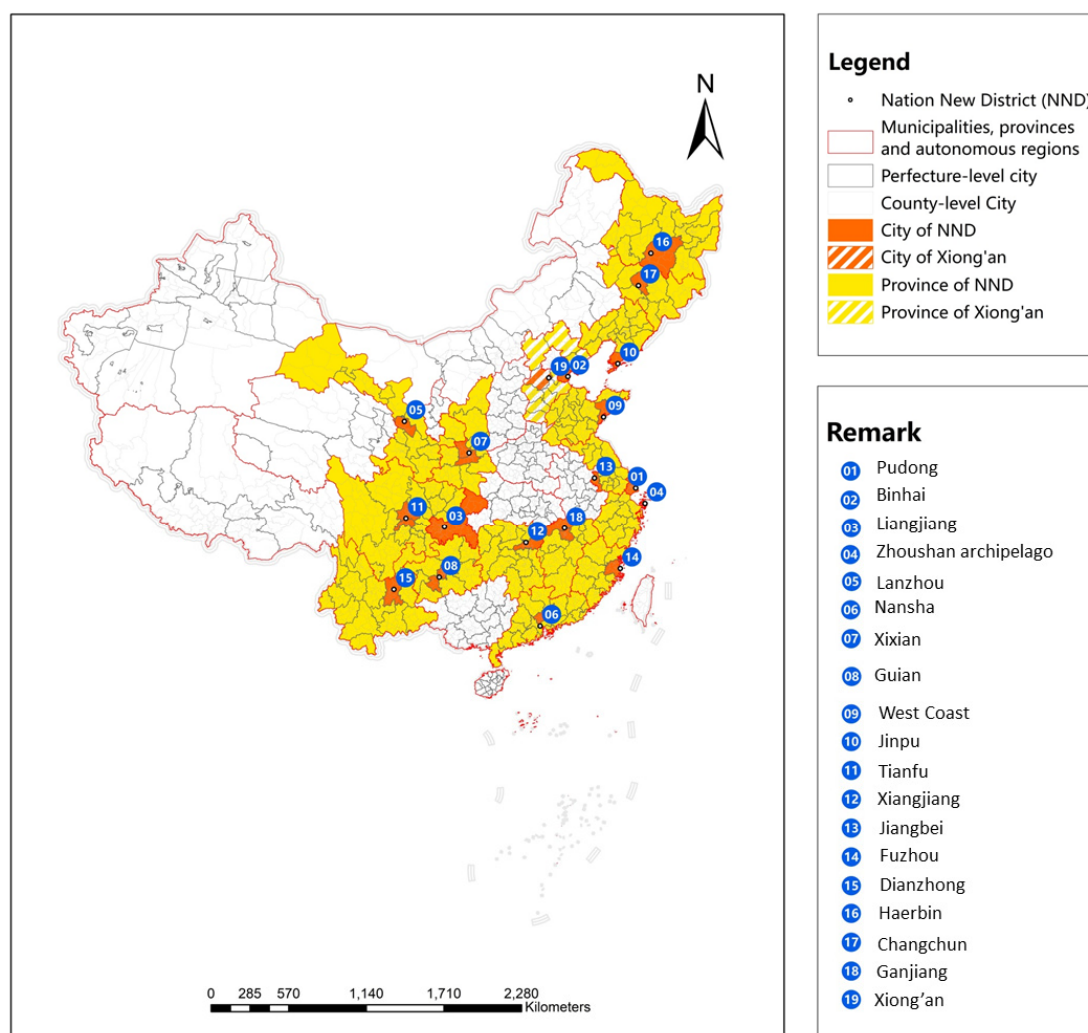


Figure 1. Study Area.

2.2. Research Methods

Geodetector, put forward by Wang Jinfeng [50,51], is a statistical method to detect spatial heterogeneity and reveal its driving force, and it has been widely used in medicine [52–56], geography [57–62], sociology [63,64], economics [65–67], ecology [68,69], environmental science [70–72], landscape architecture [73,74], urban and rural planning [75–80], and other fields. In the working principle of geodetector, it is assumed that if a certain independent variable has an important influence on the dependent variable, the independent variable and the dependent variable should have the similar heterogeneity of spatial differentiation or stratification [81,82]. Geodetector involves differentiation and factor detection, interaction detection, risk area detection, and ecological detection, which can be achieved by means of Geodetector (<http://www.geodetector.cn>, accessed date 1 November 2020). This paper studies the heterogeneity of national new districts and the explanatory power of their hinterland driving factors and the interaction effects of different driving factors based on the geodetector functions of differentiation and factor detection, and interaction detection.

Let the independent variable be X_i and the dependent variable be Y_i , the q value acquired from the differentiation and factor detection can be used to measure the heterogeneity of Y_i and to what extent X_i explains the heterogeneity of Y_i . The q value is in a range of $[0, 1]$, under the condition of passing the significance test, a larger value indicates that Y_i has a more obvious heterogeneity and X_i has a stronger power to explain it. Generally speaking, 0.01 is taken as the standard for the significance test under strict conditions, 0.05 under general conditions, and 0.1

under easing conditions. Interaction detection helps identify the interaction between different driving factors X_i ; that is, whether the driving factors X_1 and X_2 will increase or decrease the explanatory power of the dependent variable Y_i when they are in the interaction, or whether the influence of these factors on Y_i is independent of each other. According to the relationship between q_{12} , q_1 , and q_2 under the interaction of the two driving factors, the evaluation results include nonlinear weakening ($q_{12} < \text{Min}(q_1, q_2)$), single-factor non-linear weakening ($\text{Min}(q_1, q_2) < q_{12} < \text{Max}(q_1, q_2)$), dual-factor linear enhancement ($q_{12} > \text{Max}(q_1, q_2)$), independence ($q_{12} = q_1 + q_2$), and non-linear enhancement ($q_{12} > (q_1 + q_2)$) [51].

2.3. Index Selection

Inventory, increment, and quality are the keys to evaluating the development level of national new districts. In this paper, three indicators of GDP, GDP increment, and GDP per area are used as dependent variables. To implement the policy requirements regarding the functional positioning of the “growth pole” of the national new district in the “Guidelines on Promoting Sound Development of National New Districts”, the GDP and its increment are the key indicators to evaluate whether the national new district can effectively play the role of “demonstration” or “leading”, and they have been the core concern of the cultivated national new districts and their hinterland provinces and cities. And in the context of high-quality development, GDP per area has become a key indicator to evaluate whether the national new district can “lead” the sound development of local cities and regions.

National new districts are an important starting point for their hinterland provinces and cities to implement national strategies and optimize spatial patterns, serving as an important carrier in gathering population and industries, undertaking investment in major projects, promoting opening up and technological innovation, as well as an important engine and space guarantee for new local urbanization and urban space expansion. Therefore, in this paper, 12 indicators are used as independent variables; that is, urban population, GDP, industrial land, public financial expenditure, fixed asset investment in urban municipal public facilities, completed investment in real estate development, goods imports, goods exports, actual use of foreign capital, science and technology expenditure, and R&D personnel and their expenditure (see Table 2).

It should be noted that the effects of development stage and industrial structure should be included in the analysis framework, but they were abandoned because they could not pass the significance test. The hinterland cities and provinces are generally in the developed stage (the tertiary industry is more important than the secondary), and only the hinterland cities of Changchun and Ganjiang, and hinterland provinces of Jiangxi, Fujian, Shanxi are in the industrialization stage (see Figure 2). The difference between the development stages of cities and provinces is very small, it is not suitable to use GeoDetector method. We chose “proportions of secondary industries” and “proportions of tertiary industries” for testing, but the results were not satisfactory. Only “proportions of tertiary industries” can pass the significance test in the hinterland province of the inventory dimension (see Table 3).

Table 2. Development Heterogeneity of National New Districts and the Indicator System for Measuring Their Hinterland Driving Factors.

Variable	Index	Code	Type	Data Sources
Dependent variable $Y_i(\text{new town})$	GDP	Y_1	Inventory	National New District Development Report
	GDP increment	Y_2	Increment	
	GDP per area	Y_3	Quality	
Independent variable $X_i(\text{city, Provincial})$	Population	X_1	Population driving force	China City Statistical Yearbook, China Statistical Yearbook
	GDP	X_2	Industry driving force	China Urban Construction Statistical Yearbook
	Industrial land	X_3		
	Public expenditure	X_4	Investment driving force	China City Statistical Yearbook
	Fixed asset investment in urban municipal public facilities	X_5		China Urban Construction Statistical Yearbook
	Real estate investment	X_6		China City Statistical Yearbook
	Import	X_7	Open driving force	China City Statistical Yearbook, Provincial and city statistical yearbooks or statistical bulletins
	Export	X_8		
	FDI (Foreign Direct Investment)	X_9		
	Science and technology expenditure	X_{10}	Innovation driving force	
	R&D staff	X_{11}		
	R&D expenditure	X_{12}		

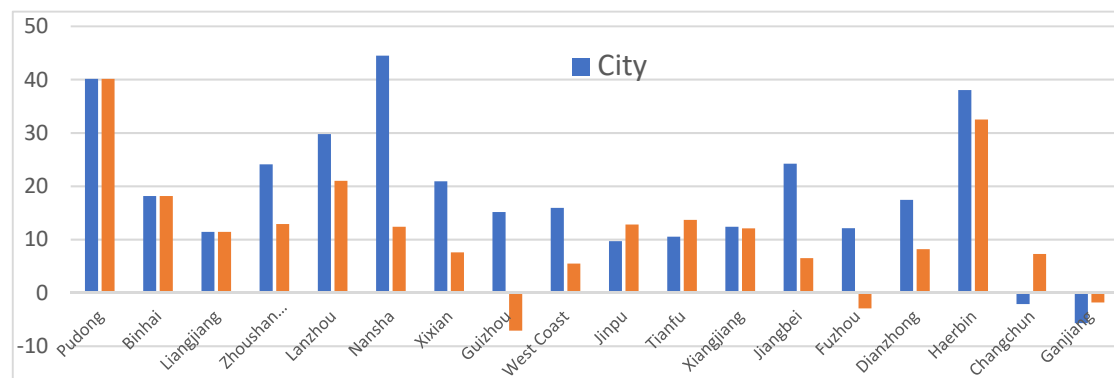
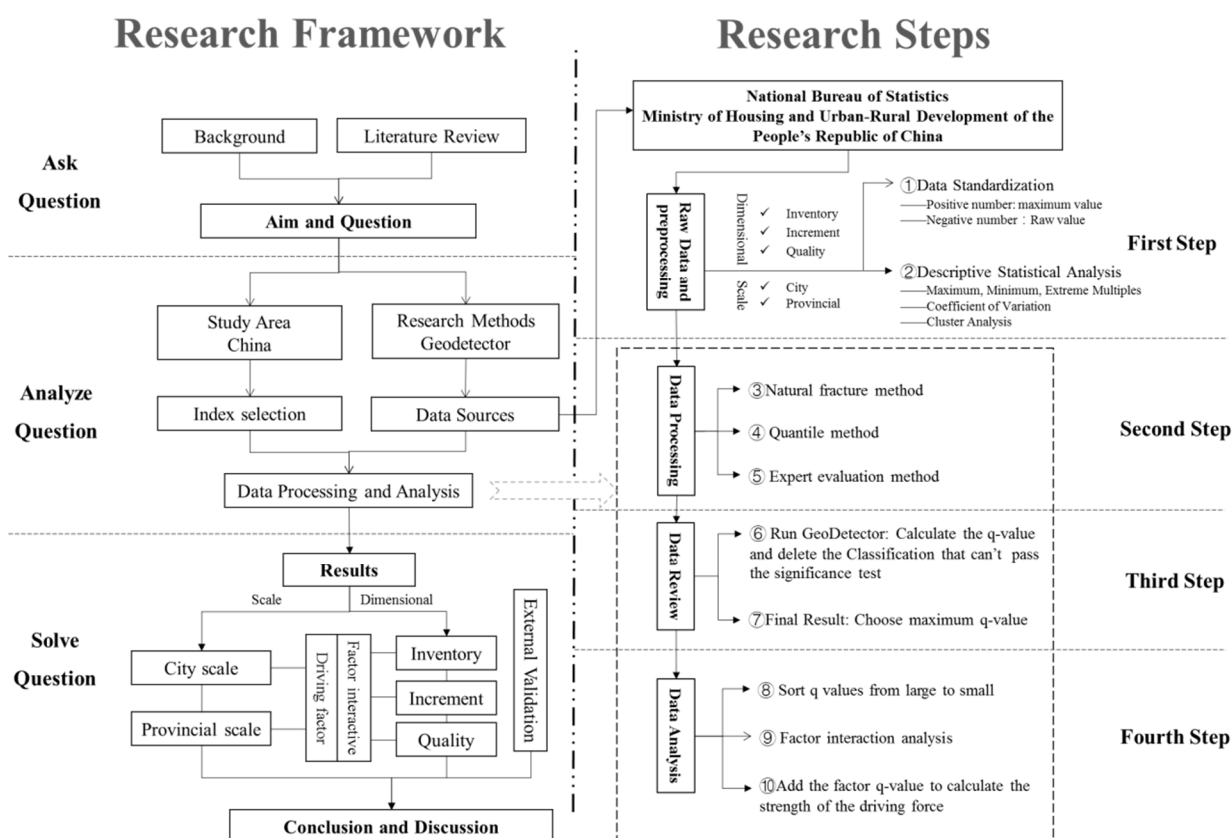
**Figure 2.** The proportion of the tertiary industry is higher than the secondary.

Table 3. Test based on the proportion of the tertiary industry.

Proportions	Test Parameters	City Scale			Provincial Scale		
		Inventory	Increment	Quality	Inventory	Increment	Quality
secondary industries	q statistic	0.338711	0.22538	0.330801	0.204148	0.099033	0.293889
	p value	0.489453	0.720348	0.530066	0.417666	0.543412	0.353524
tertiary industries	q statistic	0.152779	0.160736	0.124653	0.87874	0.433035	0.579629
	p value	0.212785	0.203035	0.26575	0.000	0.326005	0.108477

2.4. Research Steps

Figure 3 shows the research framework and steps in this paper the former contains three levels of “asking questions”, “analyzing problems” and “solving problems”, while the latter provides four main research steps. First, the research purpose and existing problems are put forward according to the background and literature analysis. Second, the data of China’s national new districts and their hinterland cities and provinces are collected, processed and analyzed by the research tool of Geodetector, based on the national new districts in China as the study area. Third, we have conducted a multi-dimensional and multi-scale analysis of the data in the indicator system, and finally reached some conclusions with the help of external validations and discussions.

**Figure 3.** Research Framework and Steps.

There are mainly four steps involved:

The first step is to preprocess the data: ① transform the data containing no negative numbers other than the GDP increment into a set of (0, 1) based on the maximum standardization method, ② and calculate the maximum, minimum, range, range multiple, coefficient of variation and other general statistical indicators. As the geodetector can directly process

negative numbers and continuous values can be used directly as dependent variables, the GDP increment with negative numbers is not processed but to use the source data directly.

The second step is to discretize the independent variables: according to the geodetector principle, the independent variables must be type indicators. The independent variables used in this paper are all continuous numbers, which are discretized successively by the ③ natural fracture method; ④ quantile method and expert evaluation method [83]. Geodetector requires at least two samples for each class, so the discretization scheme that has only 1 sample or no sample for a certain class is removed from the classification result.

The third step is to carry out trial calculations and select the final scheme: ⑥ import multiple discretization schemes of independent variables and dependent variables in the second step into Geodetector, to observe and compare q values. ⑦ Due to the influence of the discrete granularity of independent variables on the results of the model, many trial calculations are required generally. The discretization scheme with the maximum q value is selected for data measurement in the end, and the maximum q value passing the significance test is selected as the final scheme. The number of national new districts studied in this paper is 18, less than 30, small in sample size, so each dependent variable is subject to more than 10 trial calculations so as to improve the accuracy of the results.

The fourth step is to analyze the results and discuss the policy implications: ⑧ identify the heterogeneity of the development of national new districts and the main driving factors of the hinterland provinces and cities according to the q value measured; ⑨ determine the interaction effect of the factors; ⑩ calculate the intensity of different driving forces by summing the q value passing the significance test, and compare the differences between the two scales of province and city and the three dimensions of inventory, increment and quality, to further reveal the driving mechanism and policy implications of the development of national new districts in hinterland provinces and cities.

2.5. Data Sources and Processing

Inventory and quality are based on the data of 2018, and the increment is based on the data of 2016–2018. The data mainly come from “China City Statistical Yearbook 2017 and 2019”, “China Urban Construction Statistical Yearbook 2016 and 2018”, China Statistical Yearbook 2017 and 2019”, and the statistical yearbooks of provinces and cities. Some missing data come from the statistical bulletins and government work reports of provinces and cities in 2016 and 2018. The source data are directly used as the dependent variables. The independent variables are successively discretized into type variables by natural fracture method, quantile method, and expert method. Based on more than 10 trial calculations, the scheme with the largest q value under the conditions of meeting the significance test conditions is selected as the final, with reference to its calculation results by geodetector.

3. Results

3.1. City Scale Analysis

3.1.1. Driving Factor Detection

The differentiation and factor detection results are shown in Figures 4 and 5, analyzed as follows:

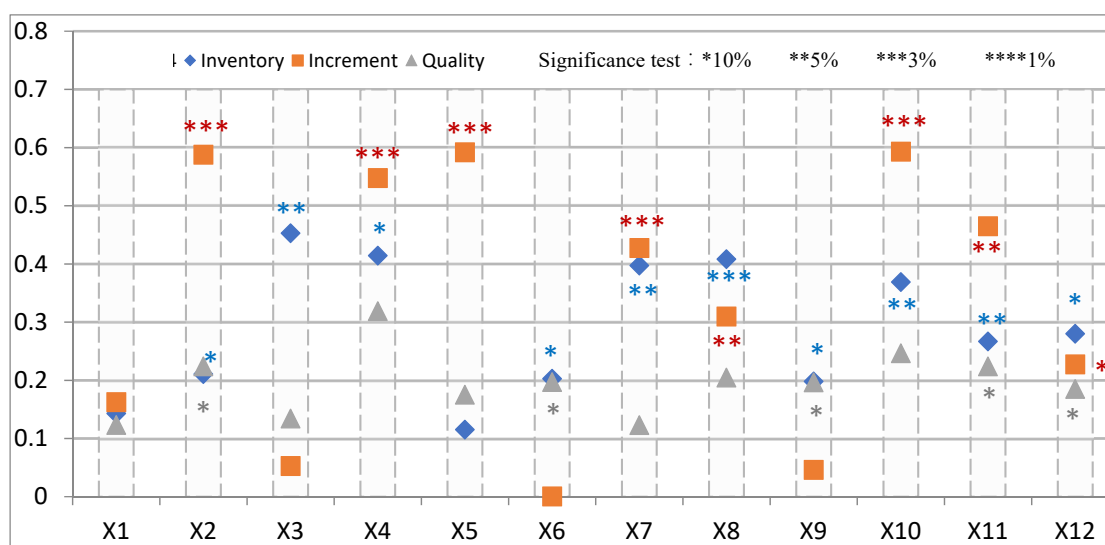


Figure 4. Detection and Analysis of Driving Factors of Hinterland Cities in the Development of National New Districts.

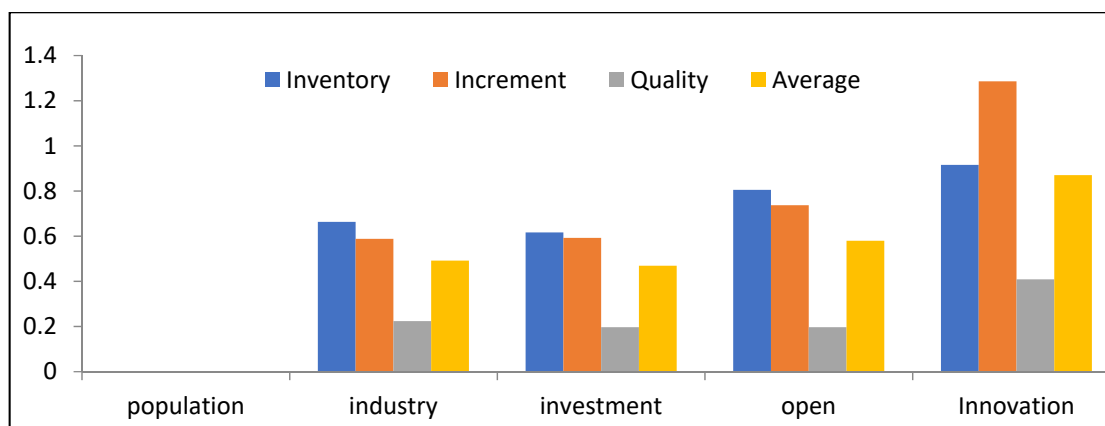


Figure 5. Comparison and Analysis of Driving Forces of Hinterland Cities in the Development of National New Districts.

From the perspective of the inventory, X_1 , X_5 , and X_9 cannot pass the significance test, while the other factors can successfully pass the 10% and more stringent significance tests. Under the condition of 10% significance, the driving factors are ranked in the following order by intensity: $X_3 > X_4 > X_8 > X_7 > X_{10} > X_{12} > X_{11} > X_2 > X_6$. X_3 , X_8 , X_7 , X_{10} , and X_{11} have passed the 5% significance test, and only X_8 can pass the 3% significance test; no factor can pass the most stringent 1% significance test. The rank of innovation driving force > opening driving force > industry driving force > investment driving force in broad terms reflects that the foreign trade, technology, industrial development, and government investment in hinterland cities play a significant role in driving the national new districts to increase their total GDP, and they have been key factors to affect the capacity level of the national new districts.

From the perspective of the increment, X_1 , X_3 , X_6 , and X_9 cannot pass the significance test, while the other factors can successfully pass the 10% and more stringent significance tests. Under the condition of 10% significance, the driving factors are ranked in the following order by intensity: $X_{10} > X_5 > X_2 > X_4 > X_{11} > X_7 > X_8 > X_{12}$. X_{10} , X_5 , X_2 , X_4 , X_{11} , X_7 , and X_8 have passed the 5% significance test, and X_{10} , X_5 , X_2 , X_4 , and X_7 can pass the 3% significance test; no factor can pass the most stringent 1% significance test. The rank of innovation driving force > opening driving force > investment driving force > industry driving force in broad terms reflects that the technology and financial investment, investment in urban public facilities, economic growth in hinterland cities play a significant role in driving the

national new districts to increase their GDP increment, and they have been key factors to affect the rapid growth of the national new districts.

From the perspective of the quality, $X_1, X_3, X_4, X_5, X_7, X_8$, and X_{10} cannot pass the significance test, while the other factors can successfully pass the 10% significance test. Under the condition of 10% significance, the driving factors are ranked in the following order by intensity: $X_2 = X_{11} > X_6 > X_9 > X_{12}$. No factor can pass the 5%, 3%, and 1% significance tests. The rank of innovation driving force > industry driving force > investment driving force > opening driving force in broad terms reflects that the innovation investment, comprehensive development, actual use of foreign capital in hinterland cities play a significant role in driving the national new districts to increase their GDP per area, and they have been key factors to affect the high-quality development of the national new districts.

3.1.2. Factor Interactive Detection

The interaction detection results are shown in Figure 6, analyzed as follows:

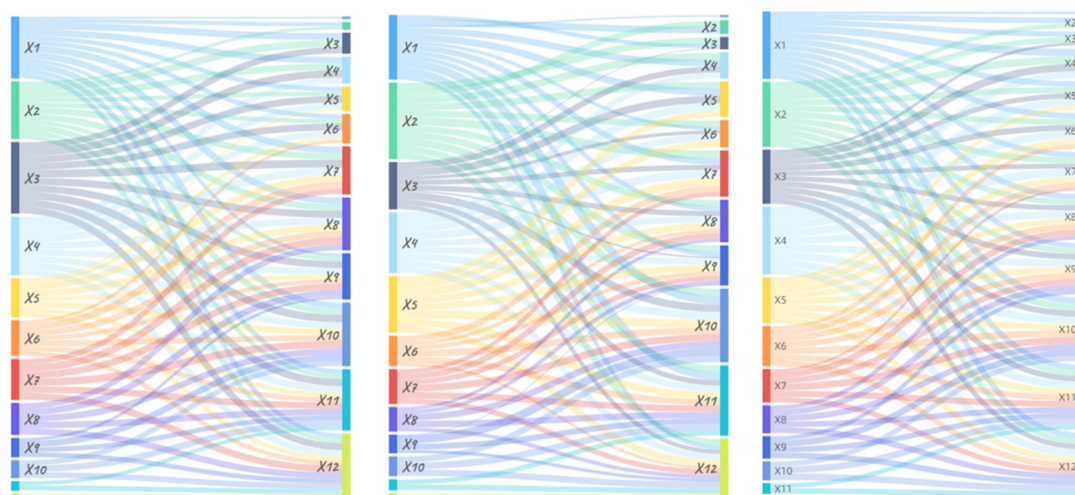


Figure 6. Detection and Analysis of Interaction of Driving Factors of Hinterland Cities in the Development of National New Districts.

Under the condition of 10% significance, the pairwise interaction between factors plays a dual-factor enhancement role for the GDP inventory, increment, and quality of the national new districts, without nonlinear enhancement, independence, or weakening, which reflects the driving factors of national new districts in economic capacity level, growth rate, and development quality are complex. From the perspective of the inventory, the average factor pair q is 0.46, and the factor pairs greater than the average account for more than 55%. The TOP3 factor pairs include $X_3 \cap X_7$, $X_{10} \cap X_7$ and $X_3 \cap X_{10}$, indicating that the industrial development is in close connection with innovation drive and open economy. From the perspective of the increment, the average factor pair q is 0.63, and the factor pairs greater than the average account for more than 50%. The TOP3 factor pairs include $X_5 \cap X_7$, $X_2 \cap X_7$, and $X_5 \cap X_{10}$, indicating that the investment drive relies on open economy accumulation and further stimulates the rise of the driving force of innovation. From the perspective of the quality, the average factor pair q is 0.27, and the factor pairs greater than the average only account for about 70%. The TOP3 factor pairs include $X_6 \cap X_9$, $X_2 \cap X_6$, and $X_6 \cap X_{11}$, indicating that the scale of development is highly coupled with innovation drive, open economy, and investment in real estate.

3.2. Provincial Scale Analysis

3.2.1. Driving Factor Detection

The differentiation and factor detection results are shown in Figures 7 and 8. There are only three factors in the quality dimension passing the most easing 10% significance test. The reliability of the detection results still needs to be further tested. The analysis of the detection results in the dimensions of inventory and increment is as follows:

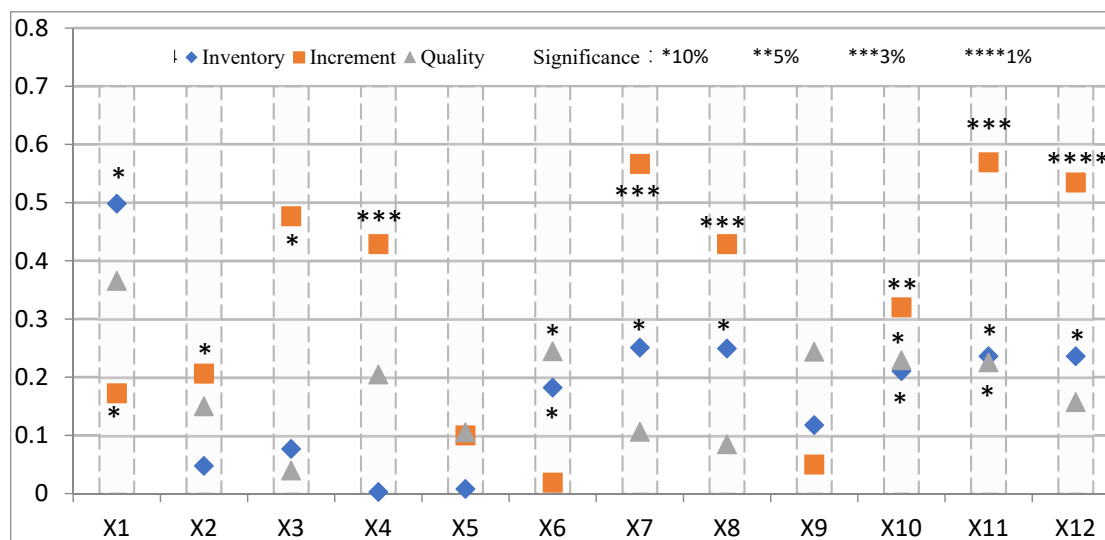


Figure 7. Detection and Analysis of Driving Factors of Hinterland Provinces in the Development of National New Districts.

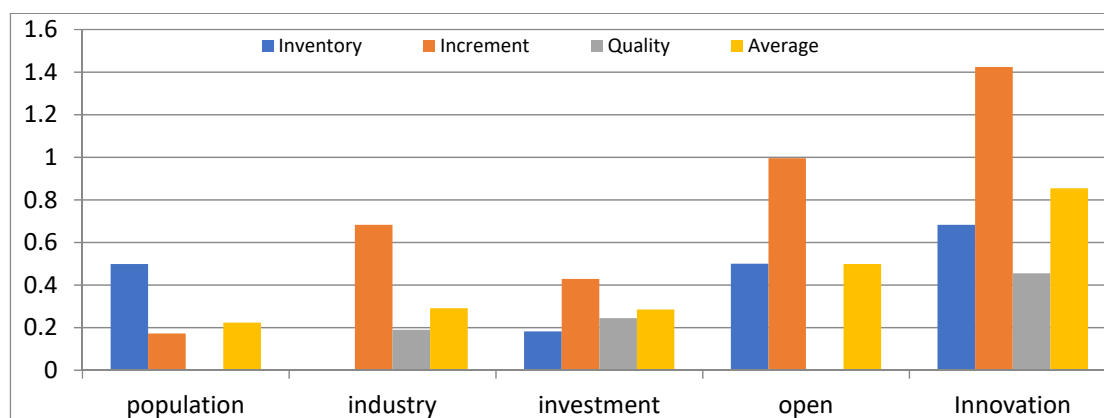


Figure 8. Comparison and Analysis of Driving Forces of Hinterland Provinces in the Development of National New Districts.

From the perspective of the inventory, X_2 , X_3 , X_4 , X_5 , and X_9 cannot pass the significance test, and no factor can pass a significance test more stringent than 10%. Under the condition of 10% significance, the driving factors are ranked in the following order by intensity: $X_1 > X_7 > X_{11} > X_{12} > X_{10} > X_6$. The rank of innovation driving force > opening driving force > population driving force > investment driving force in broad terms reflects that the population size, technology, and foreign trade in hinterland provinces play a significant role in driving the national new districts to increase their total GDP, and they have been key factors to affect the capacity level of the national new districts.

From the perspective of the increment, X_6 , X_5 , and X_9 cannot pass the significance test, while the other factors can successfully pass the 10% and more stringent significance tests. Under the condition of 10% significance, the driving factors are ranked in the following order by intensity: $X_{11} > X_7 > X_{12} > X_3 > X_4 > X_8 > X_{10} > X_2 > X_1$. X_{11} , X_7 , X_{12} , X_4 and X_8 have passed the 3% significance test, and only X_{11} and X_{12} can pass the most stringent 1% significance test. The rank of innovation driving force > opening driving force

> industry driving force > investment driving force > population driving force in broad terms reflects that the technological innovation, foreign trade, government investment growth in hinterland provinces play a significant role in driving the national new districts to increase their GDP increment, and they have been key factors to affect the rapid growth of the national new districts.

3.2.2. Factor Interactive Detection

The interaction detection results are shown in Figure 9. There are only three factor pairs in the quality dimension, and their accuracy needs to be verified. In the inventory and increment dimension, the results are analyzed as follows: under the condition of 10% significance, the pairwise interaction between factors plays a dual-factor enhancement role for the GDP inventory, increment, and quality of the national new districts; $X_1 \cap > X_6$, $X_1 \cap > X_7$, $X_1 \cap > X_8$, $X_1 \cap > X_{10}$, $X_1 \cap > X_{11}$, and $X_1 \cap > X_{12}$ present non-linear enhancement in the inventory dimension, without independence or weakening. From the perspective of the inventory, the average factor pair q is 0.49, and the factor pairs greater than the average are all of non-linear enhancement, accounting for about 30%. The TOP3 factor pairs include $X_1 \cap > X_6$, $X_1 \cap > X_7$, $X_1 \cap > X_8$, and $X_1 \cap > X_{10}$ (the last two pairs have the equal q value), indicating that population is in close connection with open economy and innovation drive. From the perspective of the increment, the average factor pair q is 0.65, and the factor pairs greater than the average account for more than 60%. The TOP3 factor pairs include $X_3 \cap > X_{12}$, $X_{11} \cap > X_7$, $X_3 \cap > X_4$, and $X_3 \cap > X_8$ (the last two pairs have the equal q value), indicating that open economy, industrial development, technological innovation, and government investment are highly coupled.

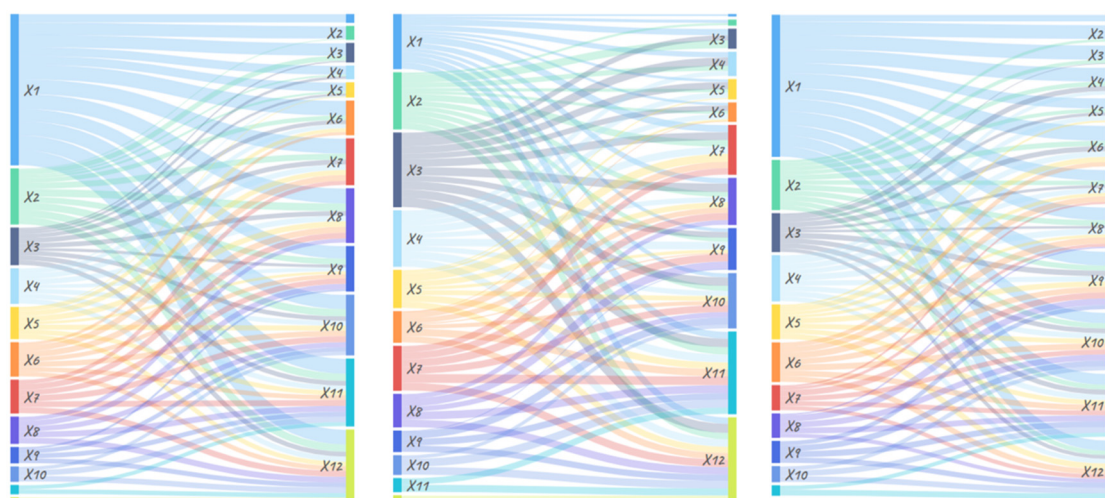


Figure 9. Detection and Analysis of Interaction of Driving Factors of Hinterland Provinces in the Development of National New Districts.

3.3. Overall Descriptive Analysis

The study shows that the detection effect of driving factors at the city scale is better than that at the provincial scale, and the driving factors show prominent heterogeneity in the acting force. The 12 factors can be classified into five categories; that is, all-round driving factors, scale-increasing factors, expansion and quality-improving factors, expertise driving factors, and non-driving factors. It is worth noting that R&D personnel is an all-round driving factor on both scales of city and province, which can promote the synchronous development of the development inventory, increment and quality of the national new districts. It gives reasons for the increasingly fierce “war for talent” between cities and provinces in China under the concept of innovation drive, and also indicates that phenomenon will become even more prominent in the context of seeking high-quality

development. The import and export trade volume are a scale-increasing factor on both scales of city and province, and it is the key to expand the economy. However, the actual use of foreign capital is not satisfactory, indicating that an open real economy is of great value for local governments to improve the development capacity level. The lack of intersection between the driving factors for improving quality at the city and provincial levels requires that the two should adopt differentiated strategies in the context of high-quality development. The interaction effects of different factors present a dual-factor enhancement relationship, or even a non-linear enhanced relationship, indicating that new towns are in a complex development relationship with their mother cities and hinterland areas. Moreover, the comprehensive development driving forces on the two scales are ranked in the same order as innovation > opening > industry > investment > population, except difference in the driving force and the dominant dimension.

From the international experience and study results, the new town has essentially become “a spatial development driven by policy so as to achieve certain policy objectives”. Policies, as the core driving force for the development of new towns, may accelerate sound development of new towns if established accurately, which has been the top concern of the municipal, and provincial or state government of the mother city and even the national central government. As a systematic project, it has been put forward by the government with clear planning and construction goals, with formulation and implementation of specific policies or laws, and establishment of dedicated special administrative agencies, or space governance mechanisms. The establishment and development of national new districts, always bound up with China’s national macro strategies in different periods, has become an important starting point for local governments to implement national strategies and innovate development models [84,85]. The above conclusions suggest that the city and provincial governments should formulate and implement the policies adapted to local conditions based on the development stage and key demands of the new town, according to the driving force of factors and the interaction effect between them. It brings light to the government facing the dilemma in designing policies for new town development.

4. Discussion

4.1. Driving Factors: The Dominant Driving Factors Are Different at Different Scales and Dimensions, and the Factors Produce an Enhancement Effect When in Interaction

The detection effect of driving factors at the city scale is better than that at the provincial scale, and the driving factors show prominent heterogeneity in the acting force (Table 4). The 12 factors can be classified into five categories, that is, all-round driving factors, scale-increasing factors, expansion and quality-improving factors, expertise driving factors, and non-driving factors. At the city scale, R&D personnel and their expenditure, and GDP are all-round driving factors, promoting the synchronous development of inventory, increment and quality in national new districts, where GDP plays a greater role. Real estate development is an expansion and quality-improving factor, helping expand the scale and improve the quality at the same time, with a small acting force. Public financial expenditure, science and technology expenditure, and import and export trade volume are scale-increasing factors, and the first two have a stronger effect on expanding the economy. Industrial land drives the growth of the inventory, the investment in municipal public facilities helps increase the increment, and the actual use of foreign capital is more to serve the improvement of quality. The three are all expertise driving factors. Population is a non-driving factor. At the provincial scale, science and technology expenditure and R&D personnel are all-round driving factors; R&D spending, import and export trade volume and population are scale-increasing factors; real estate development is an expansion and quality-improving factor; industrial land and fiscal spending are expertise driving factors; actual use of foreign capital and investment in municipal utilities are non-driving factors. The driving forces at the two scales of city and province are in the same order of comprehensive development, that is, innovation > opening > industry > investment > population.

Table 4. Comparison and Analysis of Driving Factors of Hinterland in the Development of National New Districts.

	City Scale			Provincial Scale		
	Y ₁	Y ₂	Y ₃	Y ₁	Y ₂	Y ₃
X ₁	—	—	—	★	☆	—
X ₂	☆	★	★	—	☆	—
X ₃	★	—	—	—	★	—
X ₄	★	★	—	—	★	—
X ₅	—	★	—	—	—	—
X ₆	☆	—	☆	☆	—	★
X ₇	★	☆	—	☆	★	—
X ₈	★	☆	—	☆	★	—
X ₉	—	—	☆	—	—	—
X ₁₀	★	★	—	☆	☆	☆
X ₁₁	☆	☆	★	☆	★	☆
X ₁₂	☆	☆	☆	☆	★	—

Note: —represents the non-driving factors passing the significance test, ★ represents the high-intensity driving factors (*q* is higher than the average), and ☆ represents the low-intensity driving factors (*q* is lower than the average).

Some conclusions reached in this paper are the same as those of some scholars, but there are some differences. The development of China's new towns shows significant heterogeneity, on which Xie [24] and Jing [47] hold the same view. Lawton [37] also found that there was uneven development of new towns in Ireland. The degree of heterogeneity is in connection with many factors such as the establishment history of the new town, location, resource endowments, functional positioning, planning quality, hinterland development level and support, strategic orientation, and policy orientation. The government at different levels dominates the spatial production of the new town, and there are significant scale and grade differences in the spatial and temporal evolution of the new town. The essence behind it is the interweaving process of power reconstruction and spatial reorganization, which will eventually lead to new development imbalance and geographical imbalance. The regional economic growth is uneven in essence. The government should uphold the values and development concept that focus on promoting the convergence of regional living standards in designing new town development policies, instead of pursuing balanced economic growth. In particular, it needs to gather high-end talents based on financial transfer payments and investment in technology and R&D to compensate for the imbalance in the development of the new town, and to accumulate new experience in space governance.

For the city government, expanding the scale of GDP and increasing R&D investment can promote the rapid and good development of the new town, which agrees with the conclusions reached by Li in the case analysis of Songjiang New Town in Shanghai [86]. As Alghais said, to solve housing shortages and traffic congestion is the original intention of most new town planning and construction, with no exception to national new districts in China. Although most city governments have invested a lot in real estate and municipal public facilities in national new districts, there is no significant driving effect on the development of national new districts, which is different from the case in Gulf countries [28]. Chen, based on the case analysis of Changzhou municipal-level new town, believes that real estate investment has produced significant negative effects. This paper finds that real estate has a positive, but small in intensity, effect on both the city and province scales, quite different from Chen's conclusion [31].

The factors that have passed the significance test on the city and provincial scales all show dual-factor enhancement and even non-linear enhancement effects, as a result, the factors with a weak driving force produce greater energy and influence when coupled with other factors. It is heterogeneous to the conclusion reached by Shin in the case study of the South Korean new towns [87]. For example, the population factor on the provincial scale has a weak driving force, but it has a non-linear enhancement effect when interacting with the factors of completed investment in real estate development, goods import, goods

export, science and technology expenditure, R&D personnel, R&D expenditure in the inventory dimension. It is an important factor that the provincial government must pay attention to when making policies for national new districts. It also reflects that the central government referred to the thinking of Ricks in the logic of the new town site selection [16].

It is worth noting that a major original discovery in this paper is the key role that innovation plays in the construction of new towns. It holds a very prominent position for both municipal and provincial governments. On both the municipal and provincial scales, science and technology investment, R&D human capital, and capital investment in public finance are all comprehensive driving factors that play a leading role, and when interacting with other factors such as industrial land, import, and investment in urban municipal public facilities, the innovation factor shows a dual-factor enhancement effect. Innovation drive has become a key policy measure that governments at all levels should give priority to. Although the value of “innovation” has been found in some papers and the element of “innovation” is emphasized in empirical analysis and policy design, it has not been put in such a prominent position, and there is no sufficient quantitative data to support the statement.

4.2. Policy Implications: Municipal and Provincial Governments Implement Policies by Classification According to Different Development Stages and Demands of New Towns

As there is a certain deviation in the understanding of the concept of “new town” in different countries and even between governments in a country at different levels; besides, the planning and construction of new towns is a long-term and complex comprehensive development project, the central, provincial, and city governments of the countries must sort out and accurately position new towns, and design targeted policies according to the areas where they play an effective role to give hierarchical and classified guidance [88]. According to the force size of the driving factors and their interaction effects, as well as different development stages of the life cycle of the national new districts and their key demands, this paper puts forward the suggestions that should be properly considered when the hinterland provinces and cities of the national new districts and even the central government make policies (see Table 5), so as to better play the role of government or politics in the sustainable development of the new town [89].

Table 5. Suggestions on development policies of national new districts.

Stage	Demand	Policy Suggestion	
		City Government	Provincial Government
Startup	Expand increment	Expand the economy (GDP), increase government investment (financial expenditure), give priority to expenditure on technological innovation and fixed asset investment in urban municipal public facilities	Further expand foreign trade, increase government investment (financial support), give priority to the expansion of industrial land and science and technology investment, and gather more technology and innovation-minded talents
Development	Optimize inventory	Expand foreign trade and industrial land use, increase public financial expenditures, especially science and technology expenditures	Focus on exploring and making use of demographic advantage, moderately relax real estate development and investment, and take into account opening up and technological innovation
Mature	Improve quality	Expand the economy (GDP) and foreign trade, increase government investment (fiscal expenditure) and give priority to promoting industrial development	Optimize real estate development and investment management and control policies, and further innovate technology investment and talent aggregation policies

The game and balance between the central and local governments have a significant impact on the construction of new towns. The central government must play a crucial part in new town site selection (quantity and location control), planning (functional positioning and strategic mission control), institutional design and governance policies (reform control and interest game) and other fields. Wu believes that some national new district development policies formulated by the Chinese government not well targeted and operable, and suggests that the central government should strengthen comprehensive and systematic policy analysis and implement policy guidance by classification and division as the “policy designer”, and that the local governments, as “policy implementers”, should be more involved in the design and decision-making of policies adapted to the local conditions, to achieve “co-governance by the central and local governments” [21]. Any provincial or city government expects to set up its own national new districts, but the non-linear enhancement effect showed by the population factor in interaction reflects that the central government should ensure the quality of new town location and management. The current layout plan and management-control system of national new districts are the product of complex game and balance.

This article further states that although the city government and the provincial government are both local governments, they have different driving mechanisms and strategic goals. Therefore, they need to divide their tasks reasonably and compete with each other, and they should provide complementary, accurate and effective support policies for the development of the new town, to prevent the “anti-magnetic-force” weakening of the new town caused by policy and planning errors [19], while building a multi-factor coupled symbiotic growth governance system with the help of governance mechanism creation or institution reforms [87]. These matters reflect on a more profound level the cross-game and comprehensive balance of office power, financial power, development rights and their corresponding responsibilities among the central government, provincial governments, and city governments.

In general, new towns are bound to be hot spots for urban and regional development in countries where urbanization is accelerating. To depend on new towns to create growth momentum, it is required to place the planning and development of the new town in the mother city, hinterland area and even the national development strategy for comprehensive weighing. Governments at different levels should dynamically adjust their policies in accordance with environmental changes in innovation, population, industry, and investment, so as to establish a close interaction between the development of the new town, the mother city and the hinterland area [90]. Otherwise, it is hard to implement the policy, and even more serious is the decline of the new town due to the lack of effective support from the mother city and hinterland areas.

5. Conclusions

National new districts are new geographical spaces that affect the development of cities, regions, and even the country. As an important carrier of new urbanization and local economic construction, the national new districts are profoundly changing China’s economic geography and territorial spatial development pattern. Based on 18 national new districts and their hinterland provinces and cities as samples, this paper constructs an analysis framework of development heterogeneity and hinterland driving factors for national new districts including 15 indicators on the two scales of city and province and in the three dimensions of inventory, increment and quality, finding the leading factors and their interaction effects that affect the development capacity level, speed, and quality of national new districts, revealing the driving mechanism of hinterland provinces and cities to promote the sound, rapid and high-quality national new district development, and putting forward the policy suggestions for the provincial and city governments according to the development stage of the national new districts.

Although the development of new town has a history of more than 100 years, its theoretical system and practical mode are still in dynamic evolution and continuous

innovation. With the change of practice, the functional orientation, industrial structure, spatial relationship, planning and management of new towns are marked by features of a given era and a region. Different countries and regions should act according to local conditions in the policy design for new towns [91]. Due to the mutual support between the new town and the mother city, and a two-way interaction between the new town and the hinterland, for the city and provincial governments, the goal is to drive the development of cities and regions depending on the new towns, by means of specific policies to catalyze and activate the new towns. They are two sides of the same coin, equally important. New towns in most countries and regions are still in the initial stage of construction and development at present, especially in Africa, Asia, Central, and Eastern Europe. The conclusions reached and suggestions made in this paper based on the case of China are applicable to these countries, such as Vietnam, Thailand, India, Saudi Arabia, the United Arab Emirates, Iran, Egypt, Ethiopia, Belarus, and other countries that have entered and will soon enter the stage of rapid urbanization or are in the course of transformation. Of course, affected by natural conditions, economic development stages, and cultural and institutional factors, there may be some changes in the sensitive factors of new town policy and their interaction effects. Therefore, we call for more empirical studies and establishment of reasonable policy suggestions and scientific planning strategies based on the findings.

Due to the diversity of new town types and the many factors that affect the new town development performance and sustainability, it has become a real dilemma for all countries and governments at all levels as for how to screen out the factors that can play a key role from many others, and leverage new city construction and governance to achieve sustainable development as soon as possible by making use of the factor interaction. The paper *Transforming Our World: The 2030 Agenda for Sustainable Development* puts forward 17 sustainable development goals, including elimination of all forms of poverty worldwide and adoption of sustainable consumption and production patterns. First of all, the development of new town has greatly contributed to the achievement of Sustainable Development Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable. New town construction and old city renewal are two trends of urban spatial development. This article analyzes the main influencing factors and growth mechanism of new city construction, and helps the government to adopt more appropriate strategies to promote its healthy development. Of course, the research including many indicators such as GDP, Population, and Industrial land, which are closely related to Goal 8 (Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all and Goal 9 (Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation). With the help of Goals 8, 9, and 11 new towns showing great potential in promoting sustainable economic, environmental, and social development.

The research methods and analysis framework constructed in this paper based on the samples of national new districts in China provide references for empirical studies on other new town types as well as cross-type and cross-space studies. The research framework and analysis methods constructed in this paper will be applicable but not limited to the case as follows: the first is the research on the relationship and policy process between a certain type of new town and its mother city in a country, such as the satellite cities in Belarus, high-speed rail new cities in China; the second is the research on the relationship and policy process between the same type or even cross-type new towns and their mother cities in a region, such as comparative studies on industrial cities, eco cities, low carbon cities, science cities, university cities, port cities, and airport cities in Africa and Asia.

New town is the product of the combined action of political, economic and other factors. The current development practice of new towns has actually become the “policy tool” for urban space production [92]. Within this context, how municipal, provincial and even the central governments introduce and implement a scientific and reasonable “policy package” for new town development in compliance with the development trend and response to the phased development demands of new towns in different life cycles

has become the key to restrict the sustainable development of the new town, and also a new topic worthy of in-depth exploration and investigation in the academic circles. An analysis tool is put forward in this paper for identification of key points and measurement of their interaction effect in new town policy design. It is helpful to know the acting point and strength of the policies in driving the development of new towns, and further reveals the comprehensive effect of different policies when they are superimposed. It is of great academic and practical value for achieving policy synergy and improving policy efficiency.

However, restricted by the difficulty of data acquisition, method limitations and other factors, there are some shortcomings in this paper. As an important carrier of spatial growth by urban extension, new towns are in close connection with the economy, society, culture, and even the administrative system of their mother cities in emergence and development. For example, Byahut [10], Zhao [36], and Spires [93] believed in the study that institution reforms and land use diversity are also important factors or obstacles affecting the development of new towns. However, it is hard to acquire such data, so they are not included in the research framework. Despite some shortcomings, fortunately, we have made a critical step forward in this field. We call on more scholars to join in the follow-up research on the new development trend of new towns and the new difficulties encountered by them. Of course, it is also what we are trying to do.

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