

Article

Sustainable Development of the Economic Circle around Beijing: A View of Regional Economic Disparity

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Abstract: The economic circle around Beijing is a very important area that supports the development of Beijing-Tianjin-Hebei region in China. The economic growths of the economic circle around Beijing are deeply affected by the regional economic disparity. Besides the resources and environment problems, economic factors may be more prominent of regional sustainability. The objective of this paper is: (1) To find out what caused the regional economic disparity of Beijing-Tianjin-Hebei region; and (2) to assess the economic sustainable development status of the cities around Beijing, and give suggestions to narrow the regional disparity from the economic growth view. We used an assessment method based on the economic sustainable index system—the order relation method named G1 method, revised by standard deviation. The results showed that the fundamental reason for the differences lies in the disparity in production efficiency. The disparity in the regional economy increases the flow of talent to Beijing and Tianjin, so the labor productivity of Hebei Province will not improve. Thus, the economic gap among Hebei, Beijing, and Tianjin will continue to grow. This negative feedback will further exacerbate the economic growth problem. In terms of narrowing regional disparity, some implications are highlighted. Rational industrial structure, a high level of development in the manufacturing industry, and a high proportion of strategic emerging industries are important for the cities around Beijing to achieve high-level industry transfer, and the technological progress needed to promote economic growth.

Keywords: sustainable development; economic growth; regional disparity; G1 method revised by standard deviation

1. Introduction

China's economy has experienced a history of rapid growth since the 1990s, but this growth has exacerbated disparities in regional development [1–3]. In the early stage of development, China implemented a strategy of regional unbalanced development, which prioritized the development of the eastern coastal areas to enable participation in world industrial transfer. The priority development strategy enhanced the location, policy, and resource advantages of the eastern areas and accelerated the economic growth of the Beijing-Tianjin-Hebei region, the Yangtze River Delta, and the Pearl River Delta. However, China's regional economic development efficiency is low and imbalanced [4], and regional non-synergy is becoming increasingly prominent [5]. The disparity in regional development among the eastern, central, and western regions of China is the main problem to be addressed in the future.

This disparity is not only reflected on the regional scale, such as in East and West China, but also in the urban economic circle. For example, in the Beijing-Tianjin-Hebei region, especially in the economic circle around Beijing, the gap in regional development between the rich and the poor is prominent. The capital of China is situated in the Beijing-Tianjin-Hebei region, gathering a large amount of capital, policy, and high-tech resources in one area, but its overall economic development lags behind that of the Yangtze River Delta. In the area around Beijing and Tianjin, more than 20 poverty-stricken counties still exist, which are typically rare in China. The geographic relationship of the regions can be seen in Figure 1.

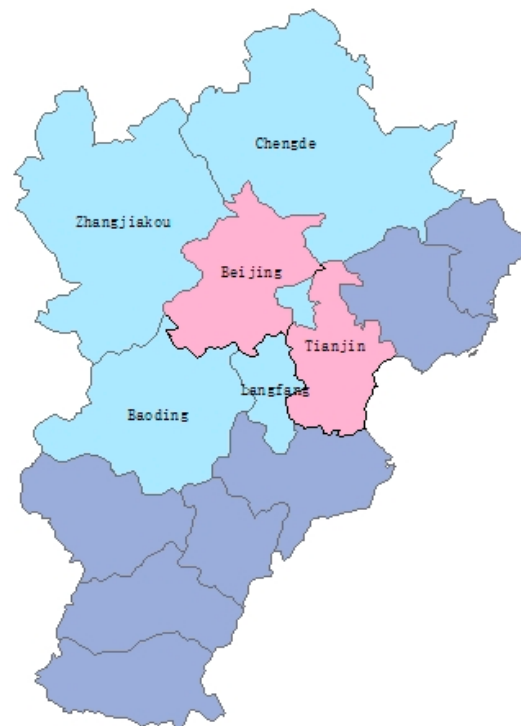


Figure 1. The geographic relationship of Beijing-Tianjin-Hebei region, and the economic circle around Beijing.

Addressing the issue of sustainable development requires the scientific and reasonable measurement of the ecology, environment, and resources thresholds, and accurately judging whether economic activities exceed these thresholds [6–8]. The determination of which of the sustainable development goals should be prioritized is left up to each participating nation [9]. According to the 2030 Agenda for Sustainable Development, it clearly presents the relatively low level of correlation between the results obtained by individual European Union Member States on the subsequent levels of monitoring the implementation of EU strategy [10]. In the Americas, Shaker measured the three major divisions of sustainability (economic growth, social equity, environmental integrity), and ranked Belize best overall, followed by Guyana, Panama, Uruguay, and Canada; Barbados ranked worst, preceded by Haiti, Trinidad and Tobago, Mexico, and Cuba [11]. The BRICS (Brazil, Russia, India, China and South Africa) group of countries is widely held to offer the prospect of a new approach to sustainable development, renewable energy and green economic growth in Africa, China and India have a significant existing and growing capacity to help move this forward [12]. The importance of sustainable cities and communities are recognized in the sustainable development goals by the United Nations, as are sustainable economic development and industrial production, which contributes to the sustainable development of cities [13]. The disparity in regional economic development has caused more problems for China's economic sustainability than the restriction of resources and the environment. The goal of sustainable development is economic sustainability, but the implementation

of sustainable development has weakened economic growth [14–16]. The regional disparity problem will considerably effect future sustainable economic development. A broad set of empirical studies exhibited roust and consistent findings that regional disparities will aggravate population mobility, especially the flow of talent. This will, in turn, further worsen regional disparities [17–22]. The development trend in the Beijing-Tianjin-Hebei region supports these findings, and the “population siphon” phenomenon is obvious. This kind of unsustainable problem caused by pure focus on economy is attracting the attention of the government, as well as scholars. Finding a method to narrow the regional differences in the Beijing-Tianjin-Hebei region, especially in the economic circle around Beijing, has become the focus. Figure 2 reflects the trends of per capita gross domestic product (GDP) and GDP growth rate in the Beijing-Tianjin-Hebei region since 2007. Beijing and Tianjin had similar per capita GDP values. The gap between Hebei, Beijing, and Tianjin was relatively large, which has obviously increased. From the perspective of regional economic convergence, the gap has increased significantly. Although economic convergence can be measured by some methods [23], the most important work is to find out what caused the economic disparity and how to solve it. This paper tries to propose an assessment model to find out the detailed information about the reason why the regional economy become disparity; and then to analysis why the economic disparity would influence the economic sustainability.

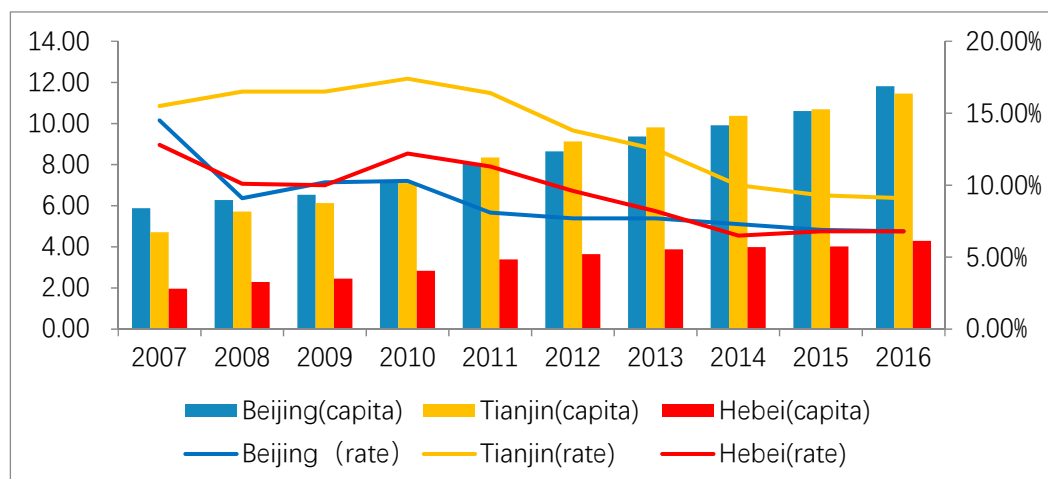


Figure 2. Per capita gross domestic product (GDP) of Beijing-Tianjin-Hebei region (10,000 yuan/person), and the GDP growth rate (%). In the figure, (capita) means per capita GDP and (rate) means the GDP growth rate.

Maintaining stable economic growth is the basic requirement of sustainable development, especially for the poor areas around Beijing. Economic growth is a necessary condition for poverty reduction, and economic development is at the core of poverty eradication and sustainable development [21,22,24]. The goal of economic sustainable development is to comprehensively represent the sustainable development of the economic subsystem of the economic circle around Beijing. In contrast to literature review, much less attention is paid to the issue of how to achieve economic sustainable development. This study analyzes the economic sustainable development of the economic circle around Beijing from the perspective of regional economic disparity.

2. Materials and Methods

The sustainability assessment model is described as one possible mechanism through which governments could gain important information, especially for policy-making [25–27]. Therefore, the sustainability assessment model has received increasingly attention given its crucial role in further improving the efficiency of government sustainable development decision-making. In this paper, an empirical study of the sustainable development evaluation of the economic circle around Beijing was

completed in order to illustrate the potential of the proposed method and highlight some implications for policy-making. We first built an indicator system for the regional economic system. The methods can be divided into two parts. First, we used the econometrics method to estimate the production function to determine what caused the regional disparity from the perspective of the production input factors. Second, we used the order relation method named G1 assessment model revised using standard deviation to determine the exact cause of regional disparity based on the detailed indicator system.

2.1. Data

2.1.1. Data on Production Factors of Beijing-Tianjin-Hebei Region

We used production factors data to analyze what caused economic disparity in Beijing-Tianjin-Hebei region. Three important factors affected economic growth: Population, capital, and technology level in the area. The data were collected from the yearbooks of Hebei, Tianjin, and Beijing from 2007 to 2016.

As shown in Figure 3, in the early period, the population growth rates of Beijing and Tianjin were relatively high. Beijing and Tianjin absorbed a large number of the labor force in Hebei, resulting in a higher population growth rate in the two cities and a far lower population growth rate in Hebei. As reported by Feng et al., the characteristics of population agglomeration are more and more obvious in Beijing-Tianjin-Hebei region, the population of Hebei province mainly flows to Beijing and Tianjin [28]. The population of Tianjin and Beijing has gradually become saturated, and the rate of population growth has dropped rapidly. Tianjin's per capita investment in fixed assets is significantly higher than that of Beijing and Hebei. However, little difference exists between Beijing and Hebei in per capita investment in fixed assets. The per capita investment in Beijing was even lower than that in Hebei, especially more recently.

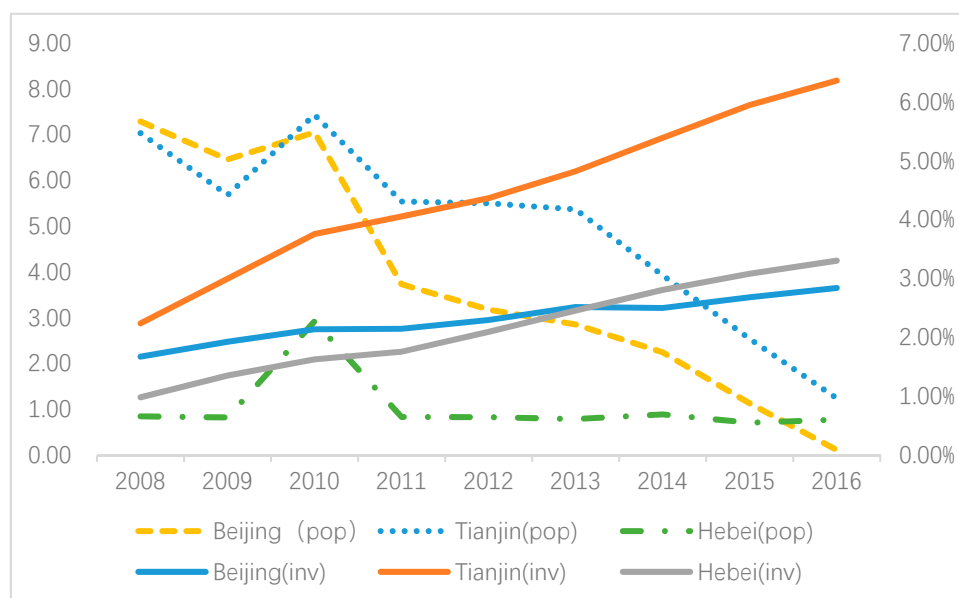


Figure 3. Population growth rate (%) and capita investment (10,000 yuan/person) in Beijing-Tianjin-Hebei region. Pop, population; inv, investment.

Therefore, from a macroeconomic point of view, the reason for the regional economic disparity between Beijing, Tianjin, and Hebei is not the scale of investment or the population; it is a problem of production efficiency—the technology level difference between Beijing, Tianjin, and Hebei. Thus, we used the method of estimating the production function to quantify the degree of technological differences in the Beijing-Tianjin-Hebei region.

2.1.2. Indicator System

Affected by factors, such as capital accumulation, technological progress, and labor mobility, there are regional differences in economic growth in the economic circle around Beijing. It is necessary to analyze the dynamics of industrial development and structural changes, and its impacts on sustainable development [29,30]. Industrial transfer is the cross-regional flow of production factors. Whether industrial transfer promotes productivity growth and narrow regional disparity depends on the industrial structure in the economic circle around Beijing. Moreover, we should pay much attention to the detailed information of manufacturing industry, service industry and the agriculture industry, because the development level of these industries may determine the economic growth rate and how to improve them by investment policy [31]. Thus, we would like to construct the index from these aspects.

We conducted a large-scale search for a system of indicators focused on industrial structure and aggregated economy, and we prioritized the indicators that were adopted more frequently based on quantitative screening. Then, we accepted the indicators selected through means of goal-oriented bureaucrat consultation, which is consistent with most indicator values of the government management's use of objectives. Subsequently, we established a hierarchy of the indicator system in accordance with sustainable economic development. The top level is the target level, which provides a general description of the evaluation criteria. The middle level is the standard level, which is a specific description of the test criteria. The bottom level is the indicator level, which is a refinement of the attribute and evaluation criteria. The indicators reflecting economic sustainability are provided in Table 1.

Table 1. The indicator system for sustainable economic development.

Target Level	Standard Level	Indicator Level	Value
Sustainable economic development	Aggregate economic activity	Average annual growth rate of GDP	≥8.5%
		Average annual growth rate of financial revenue	≥11%
		Average annual growth rate of urbanization	≥3.7%
		Average annual growth rate of total fixed asset investment	≥15%
	Industrial structure	Proportion of the value added by the three strata of industry	10:52:38
		Proportion of the value added by strategic emerging industries to the GDP	≥10%
		Average annual growth rate of the value added by strategic emerging industries	≥25%
	Agriculture	Average annual growth rate of the value added by agriculture	≥3.5%
		Ratio of agricultural industrialization	65–68%
		Participation rate of rural households in agricultural industrialization	≥63%
		Ratio of processed food from agricultural products	45–50%
	Manufacturing industry	Average annual growth rate of the value added by the manufacturing industry	≥10%
		Proportion of the value added by the manufacturing industry to the total commodity	≥60%
		Proportion of the net output of consumer goods to capital goods	46–52%
		Proportion of value added by high-tech industries to the manufacturing industry	≥14%
	Service industry	Average annual growth rate of the value added by the service industry	≥10%
		Proportion of value added by the service industry to the GDP	≥38%
		Proportion of the share of total employed persons in the service industry	≥30%
		Location quotient of the value added by the sector	>0

The economic circle around Beijing includes 14 counties that are under the jurisdiction of four prefecture-level cities: Chengde, Zhangjiakou, Baoding, and Langfang in Hebei province. Regarding the database containing county statistics, the data availability was too poor to identify indicators, due to considerable missing data. Furthermore, it was not feasible to obtain the disaggregated data of counties from prefecture-level cities based on statistical techniques. In this case, the four prefecture-level cities of Chengde, Zhangjiakou, Baoding, and Langfang became the evaluated objects, with overall economic census data used to evaluate the target of sustainable economic development. A variety data were

obtained from reputable sources, such as the Hebei Economic Yearbook, National Economic and Social Development Statistics Bulletin reported by provincial and municipal statistical bureaus.

2.2. Methods

2.2.1. Production Function of the Beijing-Tianjin-Hebei Region

The Harrod neutral production function was adopted here. Because the technology progress in Harrod neutral production function is the productivity of labor. This can reflect the fact that there is a great difference regarding the quality of labor forces in the Beijing-Tianjin-Hebei region. The technological progress in the production function is a form of labor enhancement, and the Harrod neutral production function is:

$$Y = f(K) = K^{\alpha} (A(0)e^{xt} \cdot L)^{1-\alpha}. \quad (1)$$

The equation can be rewritten as follows:

$$\ln y = (1 - \alpha) \ln A(0) + \alpha \ln k + (1 - \alpha) xt, \quad (2)$$

where y is the per capita output, k is the per capita capital, and x is the rate of technological progress. The econometric model is constructed as follows:

$$\ln y = a + b \ln k + ct. \quad (3)$$

2.2.2. Sustainability Assessment of Cities in Hebei around Beijing

In sustainability performance evaluation research work, the analytic hierarchy process (AHP) is a robust multiple attribute decision making (MADM) method commonly adopted for the assessment of sustainable development [32–36]. In the AHP, the weights of the relative importance of the attributes and/or indicators are decided by the decision maker for the considered application. This is either based on objective weights determined by the data of the attributes for various alternatives, on the decision maker's subjective preferences for the attributes, or on a combination of objective weights and subjective preferences [37]. As judgment matrices rarely satisfy the consistency requirement in the AHP [38,39], some work have developed the order relation method called G1 that constructs an entirely consistent judgment matrix and does not require the construction of another judgment matrix after establishing a rank order for the attributes and/or alternatives [40,41]. Although the G1 method effectively solves the consistency problem of the judgment matrix, similar to AHP, it uses the subjective weights of the attributes obtained by the limited cognitive powers of decision makers [42]. The 'entropy' concept was used to evaluate the performance of public involvement for sustainability urban regeneration [43], in which decides the objective weights of importance of attributes and does not give scope to decision maker's preferences. It is believed that measuring sustainability should be carried out keeping in view of a more holistic subjective and objective integrated MADM method. Unfortunately, at present there are neither accepted methods, nor specific standards, to be met. Derived from the G1 method and revised G1 by standard deviation, we propose a more holistic subjective and objective integrated MADM method for the sustainability assessment model. The G1 method revised by standard deviation is an optimal combination weights method considering both subjective preferences of decision makers and objective weights of importance of the attributes, which is better than pairwise comparison matrix in AHP and involves less calculation as compared to the concept of 'entropy weight'.

Normalization of Indicators

Three types of indicators are possible: Positive-valued (i.e., higher values are desired), negative-valued (i.e., lower values are desired), and interval-valued (i.e., there is a limiting value

or threshold value for its acceptance for the considered problem). The values associated with the indicators may be in different units. Hence, normalization of all the indicators was required. The values of indicators were normalized for different alternatives using the following equations:

$$x_{ij} = \frac{v_{ij} - \min_{1 \leq i \leq n}(v_{ij})}{\max_{1 \leq i \leq n}(v_{ij}) - \min_{1 \leq i \leq n}(v_{ij})}, \quad (4)$$

$$x_{ij} = \frac{\max_{1 \leq i \leq n}(v_{ij}) - v_{ij}}{\max_{1 \leq i \leq n}(v_{ij}) - \min_{1 \leq i \leq n}(v_{ij})}, \quad (5)$$

$$x_{ij} = \begin{cases} 1 - \frac{q_1 - v_{ij}}{\max_{1 \leq i \leq n} \left[\left(q_1 - \min_{1 \leq i \leq n}(v_{ij}) \right), \max_{1 \leq i \leq n}(v_{ij}) - q_2 \right]}, & v_{ij} < q_1 \\ 1 - \frac{v_{ij} - q_2}{\max_{1 \leq i \leq n} \left[\left(q_1 - \min_{1 \leq i \leq n}(v_{ij}) \right), \max_{1 \leq i \leq n}(v_{ij}) - q_2 \right]}, & v_{ij} > q_2 \\ 1, & q_1 \leq v_{ij} \leq q_2 \end{cases}, \quad (6)$$

where x_{ij} is the normalized value of v_{ij} , n is the number of evaluated objects, and q_1 and q_2 are boundary conditions.

Determination of the Weight of Indicator Level versus Standard Level

Initially, it was necessary to reorder the indicators. Experts should be invited to produce a hierarchy of indicators from the most important to the least important in an indicator set $\{x_1, x_2, \dots, x_m\}$. Experts should select the most important indicator and mark this as x_1^* . Experts should then select the most important indicator among the remaining ones ($m - 1$), and mark it as x_2^* . This is repeated until the last indicator is left, which is marked as x_m^* . Thus, we obtain the following array:

$$x_1^* \succ x_2^* \succ \dots \succ x_m^*, \quad (7)$$

where x_i^* represents the i th indicator after reordering.

Next, judge the relative importance between the adjacent indicators x_{k-1} and x_k . The ratio r_k is calculated based on the standard deviation using the following equation:

$$r_k = \begin{cases} \sigma_{k-1} / \sigma_k, & \text{when } \sigma_{k-1} \geq \sigma_k \\ 1, & \text{when } \sigma_{k-1} < \sigma_k \end{cases}, \quad (8)$$

where σ_i the standard deviation of the indicator. The calculation of the standard deviation and revised G1 method is used to find a combination of subjective and objective integrated weights. Based on the value of r_k , we can compute the weight of the m th indicator v_m versus the standard level using the following equation:

$$v_m = \left(1 + \sum_{k=2}^m \prod_{i=k}^m r_i \right)^{-1}. \quad (9)$$

Continue to obtain the remaining weights of the $m - 1, m - 2, \dots, 3, 2$ indicators by using the following equation:

$$v_{k-1} = r_k v_k. \quad (10)$$

Determination of the Weight of Indicator Level versus Target Level

If v_k represents the weight of the k th attribute versus the j th alternative and ω_j represents the weight of the j th alternative versus the evaluation criteria, we can compute the combination weight of the k th attribute of the j th alternative versus the evaluation criteria using the following equation:

$$\beta_k = v_k \omega_j (k = 1, 2, \dots, m; j = 1, 2, \dots, n). \quad (11)$$

Consequently, we can obtain the evaluation equation, in Equation (12), of the i th evaluated object based on the normalized values and the combination weights of the indicators.

$$P_i = \sum_{j=1}^n x_{ij} p_{ij}. \quad (12)$$

It is important to note that Equation (12) for the G1 method revised by standard deviation was used for the sustainability assessment model, which will help the decision maker arrive at a more holistic decision based on both objective weights and subjective preferences.

3. Results

3.1. Measurement of Technological Differences in the Beijing-Tianjin-Hebei Region

Using econometrics method based on 26 observations for each region, the estimation of the parameters can be calculated. From the results in Table 2, we can see that the capital output elasticity coefficient of Tianjin is greater than that of Beijing or Hebei. That means that Tianjin's economy is capital-intensive, which can explain why the per capita capital input of Tianjin is much higher than that of Beijing and Hebei. The above findings are in line with the situation in Beijing, Tianjin, and Hebei. Beijing is currently positioned as a political and cultural center, specializing in high-end services. Tianjin is a manufacturing center, mainly involved in secondary industry. Hebei is positioned to assume the manufacturing industries currently in Beijing and Tianjin, and its capital output elasticity is worse than those of Beijing and Tianjin.

Table 2. Estimates of production functions.

Region	Elasticity of Capital Output	Technological Progress Rate
Beijing	0.78 *	0.056 **
Tianjin	0.82 *	0.094 *
Hebei	0.77 *	0.018 **

*, ** represent a significance level of 10% and 5%, respectively. The number of observations for each region = 26.

From the perspective of technological progress, Tianjin has the highest technological progress rate, whereas Hebei has the lowest. The manufacturing industry in Tianjin is also shown to be relatively developed and technological progress relatively strong. Hebei supplies the high-quality production factor resources and human resources in Tianjin and Beijing, resulting in a low rate of technological progress in the region. The regional economic disparity will further widen if the existing technological progress rate remains unchanged.

Beijing and Tianjin have absorbed many resources from Hebei, but have not returned any to Hebei. For example, Beijing's cultural influence and the developed tertiary industry have not spread to Hebei. Tianjin's high-level secondary industry capacity and technological advantages have not been transferred to Hebei. Therefore, Hebei's poverty-stricken areas around Beijing and Tianjin have existed since 1990s, which is not conducive to coordinated development or long-term economic growth in the region. This is the difficulty faced in the regional coordination of Beijing-Tianjin-Hebei.

Many scholars suggested that industrial transfer could improve regional differences in Beijing-Tianjin-Hebei [44–47]. Promoting Tianjin's industrial upgrading, promoting Beijing's service industry investment, and accelerating Hebei's industrial transformation and upgrade are keys to improving production efficiency and reducing regional disparity. However, the transfer of industrial technology has a path-dependent effect. Whether Hebei province, especially several cities around Beijing, can undertake the industrial transfer of Beijing and Tianjin needs to be carefully studied. The economic development of a region is systematic and multifaceted. The reasons for low production efficiency need to be analyzed from a more detailed industrial level.

Although the overall level of economic development in the cities around Beijing is low, there are differences among these cities, as shown in Figure 4. Two questions need to be answered, according to Figure 3. Why does economic disparity still exist between Beijing and the surrounding Hebei cities? What caused the economic disparity among the cities around Beijing?

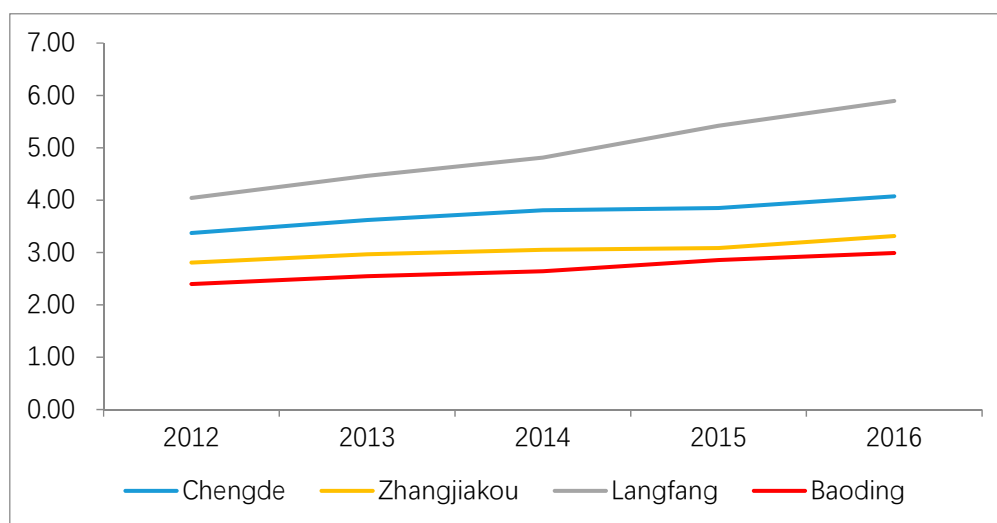


Figure 4. Per capita GDP of the cities around Beijing.

Some researchers have analyzed data with regards to the first question. Most industries that Beijing transferred to Hebei are low-end industries with low technology and have not yet undergone large-scale industrial transfer [32]. However, even if Beijing urgently needs large-scale industrial transfer, the success of Beijing's transfer industry in the economic region around Beijing is still unknown [33].

To answer the second question, we needed to conduct a detailed assessment of the sustainable economic development of the cities around Beijing, which will provide useful information to help us understand regional differences.

3.2. Indicator Calculation and Sustainability Assessment

According to Table 1, the data processing of indicators is described as below. Following the Chinese classification of manufacturing sectors [48], we computed the proportion of the net output of consumer goods to capital goods. To measure the degree of industrial specialization, the location quotient of the service industry was divided into five sectors: Transport and storage, postal and telecommunication, tourism, financial intermediation, and insurance. In the normalization of indicators, the proportion of value added by the three strata of industry was identified using the actual proportion of evaluated objects deviating from the standard value of 10:52:58. The larger its deviation from the standard value, the lower its score. Therefore, this indicator was normalized using the negative-valued equation in Equation (5). Based on boundary conditions, the indicators, such as the ratio of agricultural industrialization, ratio of processing of food from agricultural products, and proportion of the net output of consumer goods to capital goods, were normalized using the

interval-valued equation in Equation (6). The remaining indicators were positive-valued and were normalized using Equation (4). After completing the calculations in Equations (4)–(11), the results were obtained, as shown in Appendix A (Table A1).

The evaluation process can be described mathematically in terms of the sustainability assessment model. The evaluation result was then obtained by calculating Equation (12) based on the normalized data in columns 4–7 and the combination weight in column 13 of Table 3. This led us to the final city scores and ranks of the evaluation criteria and alternatives, as presented in Table 3.

Table 3. Final comprehensive evaluation scores and ranks.

Evaluated Objects		Chengde	Zhangjiakou	Langfang	Baoding
Industrial structure	Score	0.035	0.029	0.228	0.215
	Rank	3	4	1	2
Manufacturing industry	Score	0.089	0.064	0.146	0.166
	Rank	3	4	2	1
Aggregate economic activity	Score	0.152	0.088	0.060	0.122
	Rank	1	3	4	2
Service industry	Score	0.070	0.136	0.068	0.075
	Rank	3	1	4	2
Agriculture	Score	0.110	0.047	0.048	0.074
	Rank	1	4	3	2
Sustainable economic development	Score	0.458	0.363	0.549	0.653
	Rank	3	4	2	1

Overall, as can be observed from Table 3, Baoding had the highest final score with 0.653 in sustainable economic development, with Langfang in second with a final score of 0.549. This was followed by Chengde (0.458) and Zhangjiakou (0.363). The final comprehensive result was mostly determined by evaluation of alternatives for industrial structure and the manufacturing industry, leading to the conclusion that these are the key to upgrading industrial structure and accelerating new industrialization processes in order to achieve the target of sustainable economic development. The final scores and ranks of the five evaluated alternatives revealed significant differences between cities.

Through a detailed evaluation, we can answer the second question mentioned above: What caused the economic disparity among the cities around Beijing, especially when all cities adopted the policy of transferring industry from Beijing?

Langfang and Baoding were better than Zhangjiakou and Chengde in terms of overall economic system, and the difference between these cities lies in the rationing of industrial structure and manufacturing advantages. Baoding and Langfang ranked first and second, respectively, in terms of industrial structure and the development level of manufacturing industry.

Langfang and Baoding have the common advantages of reasonable industrial structure, high level manufacturing industry development, and a high proportion of strategic emerging industries. Zhangjiakou has a poor manufacturing foundation, whereas Chengde has few strategic emerging industries. Langfang and Baoding performed well in undertaking Beijing's industrial transfer. Therefore, considering the evolution of regional disparity revealed in Figure 3, we found that Langfang and Baoding successfully completed industrial transfer, due to their reasonable industrial structure and good manufacturing base. This has increased labor productivity, and the per capita GDP has also increased relatively quickly.

However, we need to pay attention to the fact that there is still a gap between Baoding and Langfang, as shown in Figure 3. The difference lies in the location of Langfang. The financial location quotient of Langfang is obviously higher than that of Baoding and so is its financial revenue. This is mainly because Langfang is located between Beijing and Tianjin. The obvious geographical advantages resulting from this location and land value added have led to the development of the financial industry and the increase in financial revenue. This could provide capital to support the development of

Langfang. Although Baoding ranks first in terms of economic aggregate, it has a large population of more than 10 million with high-quality human resources flowing to Beijing and Tianjin. Therefore, Baoding assumed some of Beijing's strategic emerging industries, but changing the relatively low level of education of the labor force in a short time is difficult [49]. The effect of industrial transfer has been diluted by its large population.

As a sensitive area surrounding Beijing, Zhangjiakou has had to abandon industrial projects in favor of constructing a series of military engineering and soil erosion prevention structures, which inevitably reduced industrial and agricultural production and regional economic development. However, the poor regional economy eventually underwent comparatively rapid development of the service industry. Compared with the alternative for the service industry, Zhangjiakou had the highest final score and ranked second in the refinement of indicators among the four cities.

Although Chengde had the highest scores in the alternatives for aggregate economic activity and agriculture, the evaluation of other alternatives revealed inherent uncertainties in the means of achieving economic growth. The results drew our attention to some consequences regarding the environmental diversity of Chengde's use of its natural resource endowment for agriculture and early industrialization. Chengde shows an over-reliance on mining, smelting, and the processing of metal ores, which contributes to the growth of Chengde's aggregate economic activity. This has caused to a severe macroeconomic imbalance.

The analysis and evaluation of sustainable economic development highlighted some implications that could assist governments in evidence-based policymaking and policy outputs. A general finding was that cities in Hebei must hasten industrial restructuring and upgrading, and substantially progress new industrialization. Restructuring is the shift in the industrial growth model and the transformation from conventional industrialization to new industrialization. Upgrading is the optimization of technological, organizational, and industrial structures. The post-industrial economy of Beijing, strong technology, and knowledge spillovers play a significant role in promoting the transformation from conventional industrialization to new industrialization in cities around Beijing via infiltration and integration with host high-technology outsourcing. This process addresses the continuing marginalization resulting from multi-regional industry homogeneity. For these reasons, the pursuit of a new industrialization-oriented development strategy may persist in the long run. The difference in the evolution of regional industrial structure between new industrialization and post-industrialization is a conceptual framework that requires successful co-operation, which provides strategic alliances opportunities for the growth of cities around Beijing and integration into Beijing's metropolitan economy.

4. Conclusions

Whereas most researchers have studied the sustainable development of Beijing, Tianjin, and Hebei from a resources and environment perspective, we examined the problem of economic sustainable development from the perspective of disparity in regional economic growth—the impact of economic disparity on economic sustainable growth.

The difference in the productivity of the labor force is the main reason for the differences between Beijing, Tianjin, and Hebei. At present, the driving force of economic growth in Hebei province is the expansion of the capital scale. Beijing mainly relies on technological progress to promote economic growth. Tianjin's economic growth depends on capital investment and technological progress. If we do not minimize the regional disparity, it will further lead to serious labor loss in Hebei, and regional disparity will be further exacerbated. Industrial transfer can effectively improve the productivity differences in the regional labor force.

Due to the path-dependence of industrial transfer, it was necessary to systematically analyze the economic structure and characteristics of the different regions in Hebei province. We examined four cities around Beijing as the research object using an index system of economic sustainable development using the G1 method revised by standard deviation. The G1 method revised by standard

deviation proposed in this paper is simple, convenient, and corresponds to the weighted sum method. The proposed method uses both subjective and objective weights to account for the preferences of decision makers. The standard deviation concept of determining the objective weights of the attributes is comparatively simpler than other methods suggested in previous studies. The rank value judgment on the subjective weights of the qualitative attributes introduced by the G1 method does not need a consistency test and will be more useful to designers than currently available methods.

We found that a region with an optimized industrial structure has stronger economically sustainable development. Rational industrial structure and advanced industry would lead to more easily achieved industrial transfer that will narrow the economic disparity gap. Talent is important for achieving high labor efficiency. Resource-dependent cities are more limited in terms of industrial transfer. One new idea receiving attention posits that new industrialization and economic growth of the cities around Beijing should mainly depend on producer services, and other specialized services offered by Beijing business process outsourcing firms—rather than cities independently developing their own service industries. This is while considering the competitive disadvantage and homogenous pattern in the industrial structure of the cities surrounding Beijing, compared with the post-industrial economy in Beijing.

Author Contributions: The idea was conceptualized by Z.C. and C.L. The methodology was prepared by Z.C. and G.L. Validation was performed by Z.C., C.L. Formal analysis was completed by C.L. Data curation was performed by Z.C., K.G. The original draft was written by C.L., Z.C., and K.G. Review and editing of the draft were completed by Z.C. and C.L.

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Appendix A

Table A1. The order relation method named G1 method revised by standard deviation for obtaining weights.

Item	Standard Level	Indicator Level	Evaluated Objects and Normalized Data					Weight of Indicator Level versus Standard Level		Weight of Standard Level versus Target Level		Weight of Indicator Level versus Target Level	
			Chengde	Zhangjiakou	Langfang	Baoding	Standard Deviation	r_k	v_k	r_k^*	ω_j	β_k	Rank
1	Industrial structure	Proportion of value-added by strategic emerging industries to GDP	0.000	0.214	0.786	1.000	0.470	–	0.362	–	0.270	0.098	1
2		Proportion of value-added by the three strata of industry	0.410	0.000	1.000	0.361	0.414	1.136	0.319			0.086	2
3		Growth rate of value-added by strategic emerging industries compared with last year	0.000	0.090	0.754	1.000	0.492	1.000	0.319			0.086	3
4	Manufacturing industry	Proportion of value-added by high-tech industries to manufacturing industry	0.000	0.240	0.800	1.000	0.468	–	0.264	1.2	0.225	0.059	4
5		Proportion of the net output of consumer goods to capital goods	0.000	0.906	0.594	0.938	0.435	1.076	0.245			0.055	6
6		Growth rate of value-added by manufacturing industry compared with last year	0.625	0.000	1.000	1.000	0.472	1.000	0.245			0.055	7
7		Proportion of value-added by manufacturing industry to the total commodity	1.000	0.000	0.200	0.000	0.476	1.000	0.245			0.055	8
8	Aggregate economic activity	Growth rate of GDP compared with last year	1.000	0.375	0.000	1.000	0.493	–	0.280	1.1	0.204	0.057	5
9		Growth rate of financial revenue compared with last year	0.000	0.658	1.000	0.355	0.427	1.157	0.242			0.049	9
10		Growth rate of total fixed assets investment compared with last year	1.000	0.000	0.219	0.000	0.475	1.000	0.242			0.049	10
11		Growth rate of urbanization compared with last year	0.967	0.726	0.000	1.000	0.465	1.021	0.237			0.048	11

Table A1. Cont.

Item	Standard Level	Indicator Level	Evaluated Objects and Normalized Data					Weight of Indicator Level versus Standard Level		Weight of Standard Level versus Target Level		Weight of Indicator Level versus Target Level	
			Chengde	Zhangjiakou	Langfang	Baoding	Standard Deviation	r_k	v_k	r_k^*	ω_j	β_k	Rank
12	Service industry	Proportion of value-added by service industry to GDP	0.032	1.000	0.419	0.000	0.466	–	0.142	1.2	0.170	0.024	16
13		Growth rate of value-added by service industry compared with last year	0.286	0.643	0.000	1.000	0.434	1.073	0.132			0.023	17
14		Proportion of the share of total employed persons in service industry	1.000	0.680	0.240	0.000	0.447	1.000	0.132			0.023	18
15		Location quotient of transport and storage	0.686	1.000	0.411	0.000	0.424	1.053	0.126			0.021	19
16		Location quotient of postal and telecommunication	0.000	0.941	0.817	1.000	0.466	1.000	0.126			0.021	20
17		Location quotient of tourism	0.782	1.000	0.398	0.000	0.440	1.058	0.119			0.020	21
18		Location quotient of financial intermediation (not include insurance)	0.000	0.572	1.000	0.656	0.415	1.061	0.112			0.019	22
19		Location quotient of insurance	0.525	0.505	0.000	1.000	0.408	1.016	0.110			0.019	23
20	Agriculture	Growth rate of value-added by agriculture compared with last year	1.000	1.000	0.000	0.750	0.473	–	0.268	1.3	0.131	0.035	12
21		Ratio of agricultural industrialization	0.800	0.000	1.000	0.500	0.435	1.088	0.246			0.032	13
22		Ratio of processing of food from agricultural products	0.583	0.167	0.000	1.000	0.448	1.000	0.246			0.032	14
23		Participation rate of rural households in agricultural industrialization	1.000	0.200	0.500	0.000	0.435	1.030	0.239			0.031	15

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