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Research on Resource Curse Effect of Resource-Dependent Cities: Case Study of Qingyang, Jinchang and Baiyin in China

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Abstract: For a specific small-scale region with abundant resources, its copious resources tend to dictate the basic direction of its development, and may subsequently give rise to an industrial structure centered on the advantageous resources. This can give rise to an economic structure that lacks diversity, causing the economic development in the entire local region to fall into the dilemma of the resource curse. The present study conducts a case study from the perspective of small-scale regions, incorporating various types of resource-dependent cities in China, including Qingyang, Jinchang, and Baiyin, to interpret and analyze the resource curse effect by calculating a resource curse coefficient. Moreover, based on the regression model, the present study further discusses the empirical relations associated with the resource curse phenomenon. The results show that, regardless of whether a resource-dependent city is in the early, intermediate or late stage of its resource development, economic development is always plagued by the resource curse effect to a certain degree. Resource development cannot promote economic development, rather, it inhibits economic growth to some extent, resulting in an array of effects that are unfavorable to economic development, rendering the development unsustainable. For different types of resource-dependent cities, resource curse effect exhibits distinct characteristics. The resource curse effect is strongest for a resource-dependent city during an economic recession, is less severe during a development period, and is weakest during maturation. Resource development not only has a direct adverse impact on economic growth, but also often affects economic growth in multiple ways and on various levels through the Dutch disease effect, the crowding out effect, and the institution weakening effect. Until now, most results show that there is no obvious resource curse effect at the national and provincial level. The verification results of small-scale regions show that the resource curse effect at the city level still exists. In addition, the resource curse effect differs across different types of resource-dependent cities.

Keywords: resource curse; economic growth; resource-dependent city; China

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1. Introduction

The relationship between natural resources and economic growth has always been an important research topic [1]. "Resource curse", which has happened frequently in developing countries, refers to the paradox that countries with an abundance of non-renewable natural resources tend to have less economic growth or worse development outcomes than countries with fewer natural resources. The term "resource curse" was first used to describe how countries rich in mineral resources were unable to use that wealth to boost their economies, and how these countries had lower economic growth than countries without an abundance of natural resources [2], for example, Sachs and Warner [3] conducted empirical tests by selecting 95 developing countries as their sample, and the outcomes revealed that economic growth demonstrates a strong negative correlation with resource endowment, and that this persists even after the introduction of more explanatory variables. In addition, some scholars carried out research about resource curse, looking at small-scale areas. Based on the data of 3092 counties in the United States, James and Aadland [4] used a generalized least squares (GLS) regression model to analyze the relationship between natural resources and economic growth for all the counties in the states of Maine and Wyoming, and found that the level of economic growth was not high in resource-dependent cities, even when they excluded the factors of policy influence, population difference, income and spatial relations. Weber [5] used a regression model, taking 362 counties in the south of the United States as the research object, to analyze the relationship between gas exploitation and economic growth, and found that there is no obvious resource curse phenomenon, which indicated that economic development is not blindly dependent on the exploitation of natural resources. Obeng-Odoom [6] studied Sekondi-Takoradi, West Africa, and found that the resource curse phenomenon of oil-dependent cities is not absolute, but both resource curse and "resource blessing" exists. Most of the literature describes three primary types of effect: Dutch disease effect, crowding out effect, and the institution weakening effect [7]. For example, Gylfason [8] built the Dutch disease effect model and found that the energy industry lacks linkage effects and externality and places a low demand on human capital. Excessive development of the resource sector can therefore lead to economic recession. Gasimov [9] built the Dutch disease model to analyze the impact on economy, society and policy of Azerbaijan's petroleum resources, and found no evidence of the resource curse phenomenon. In the case of the crowding out effect, Sachs and Warner [10] concluded that an abundance of natural resources inhibits economic growth mainly by exerting a crowding out effect on certain factors, including investment of human capital, investment in education, and technological innovation, which promote economic growth. Papyrakis and Gerlagh [11] concluded that abundant resources tends to inhibit entrepreneurial and innovative behaviors by attracting potential innovators and entrepreneurs to instead engage in the production of primary goods. In the case of the institution weakening effect, Sala-i-Martin and Subramanian [12], by taking Nigeria as a case study, found that the institution weakening effect is the root cause of the resource curse effect, as abundant resources can induce rent-seeking behaviors through greed. The resource curse effect seems quite common in developing countries, for example, Smith [13] found that resource curse effects vary significantly between OECD and non-OECD treatment countries, with effects concentrated within the non-OECD group. Elbra [14] also concluded that South Africa has failed to benefit from natural resource wealth and can be classified as a resource cursed state. Furthermore, natural resources are not only those related to industry, but also agricultural resources, tourism resources, etc. Some scholars studied how to manage the relationship between various human activities in an integrated manner in the areas with these resources as their main economic drivers, in order for them to continue to develop sustainably [15,16].

As the largest developing country, the resource curse effects also happened in China at different levels. In relation to tests of the resource curse phenomenon, Xu and Wang [17], He and Wang [18], and Huang et al. [19] all verified the presence of the resource curse effect in China. Through provincial-level research, Han et al. [20] and Zhang et al. [21] verified the existence of the resource curse effect in many provinces in China. Lu et al. [22] studied the city of Bijie in Guizhou province, which is a typical example of regions in Western China that are underdeveloped yet rich in resources, and concluded that such regions have been plagued by the resource curse effect. In relation to the effect of the resource curse, Xu and Hu [23] pointed out that the existence of the resource curse in Inner Mongolia is mainly driven by the Dutch disease effect, which is induced by resource development. Zhang and Jing [24] demonstrated that, in resource-rich regions, as the manufacturing industry creates a high demand for investment in human capital, there is a preference for investment in the resource sectors, which can in turn lead to path-dependency of development and inhibit economic growth. Zhao et al. [25] showed that manufacturing industry recession and institution weakening induced by intensive and excessive exploitation of resources is a key factor limiting economic growth. Shao and Qi [26] found that energy development inhibits economic growth through its crowding out effect on investment in human capital, science, and technology. Hu and Xiao [27] revealed that the magnitude of investment in human capital is a decisive factor in the development of the resource curse phenomenon at a provincial level. Zheng and Luo [28] revealed that the action of the resource curse effect is reflected by the Dutch disease effect, that is, the impact of the crowding out effect and the institution weakening effect on education, science, and technology expenditure. The impact of the crowding out effect on science and technology expenditure is most pronounced. In relation to the avoidance of the resource curse issue, analysis by Gao et al. [29] revealed that, in addition to implementing the industrial transformation policy dictated by governmental regulation and the emphasis laid on the investment in human capital, study of the sustainable development of resource-dependent cities from the resource curse perspective should be reinforced. Liu [30] conducted research on the sustainable development of resource-dependent cities and proposed a multitude of policy-related recommendations aimed at avoiding the resource curse effect.

The carrying capacity of resources and environment is central to regional sustainable development [31]. As China possesses abundant natural resources and numerous resource-dependent cities, the resource curse effect can potentially have a significant impact on economic growth at both national and regional levels. While significant progress has been made through researching the resource curse effect, there are still some research gaps that need to be filled in, for example, existing studies are mainly focused on large- and meso-scale regions, and very few on small-scale representative regions; moreover, the relevant analysis carried out so far has been mostly geared toward a single region in an isolated manner, and thus lacks a systematic and comprehensive comparison incorporating an array of regions of various types.

In fact, there is a vast difference in resource endowment and the economic growth pattern in different regions, and this threatens the accuracy of research outcomes pertaining to large- and medium-scale regions. As for a specific small-scale region with abundant resources, its copious resources tend to dictate the basic direction of its development, and may subsequently give rise to an industrial structure centered on the advantageous resources. This can give rise to an economic structure that lacks diversity, causing the economic development in the entire local region to fall into the dilemma of the resource curse. Moreover, for different regions the corresponding extents and characteristics of resource development and utilization may differ, as might the stages that resource development and utilization fall into. Therefore, resource development and utilization in different regions can be classified into different types. With different regional types, the corresponding resource curse effects also exhibit a variety of features and patterns, which makes systematic and comprehensive comparative research based on a single study particularly important. Due to this consideration, the present study, from the perspective of small-scale regions, conducts a case study incorporating various types of resource-dependent cities in China, including Qingyang, Jinchang, and Baiyin, to interpret and analyze the resource curse effect. The present study further discusses the empirical relations associated with the resource curse phenomenon. This study is a systematic and comprehensive comparative investigation of the resource curse effect. Furthermore, this study effectively addresses the existing issues and limitations associated with previous studies and can also provide certain references to the coordinated relationship between humans and land, in addition to the sustainable development of resource-dependent cities. The findings are, thus, of profound theoretical and practical merit.

This research has strong theoretical significance, which takes small-scale regions as the case study, verifies the resource curse effect from a small spatial scale, carries out comparative research for different types of resource-dependent cities, and summarizes the rules and characteristics of the resource curse effect. At the same time, the research results can be applied directly to the transformation and development of resource-dependent cities, so it has strong practical significance to guide the optimization of industrial structure and promote sustainable development.

2. Brief Profiles of Cases

Qingyang is located in the east of Gansu province, which is part of western China's underdeveloped area (Figure 1). Classified as a typical resource-dependent city, Qingyang is in the southwest of the Ordos basin, which is richly endowed with energy resources [32]. Total reserves of oil and natural gas resources in Qingyang amount to 4 billion metric tons, accounting for 37% of the overall resource reserves in the Ordos basin. The coal reserve is estimated to be 236 billion tons, accounting for 96.4% and 11.8% of the overall estimated reserves in Gansu province and the Ordos basin, respectively. The estimated reserve of coalbed gas is 1358.8 billion cubic meters, accounting for 30% of the overall coalbed gas reserve in the Ordos basin. Since the beginning of this century, the local government has been gradually strengthening exploitation of the resources, and the scale of resource development and utilization has steadily increased. Currently, resource development and utilization is still in its initial stages, that is, the development period.

Jinchang is located in the west of Gansu province, which is part of western China's underdeveloped area, and is in the Hexi Corridor (Figure 1). It is a typical resource-dependent city with copious mines of nonferrous metals. The local nickel mine reserves are massive, being ranked second worldwide and first in China. Jinchang's reserves of twenty different metals, including nickel, platinum, palladium, cobalt, selenium, and copper, are ranked first in Gansu province. Since the 1950s, China has been gradually developing and utilizing its local resources. Since the founding of Jinchang in 1981, the scale of development and utilization of local resources has increased dramatically, leading to vigorous development of resource-intensive industries. Development over the past few decades has propelled resource development and utilization in Jinchang to the intermediate stage, that is, the maturation period.

Baiyin is located in the middle of Gansu province, part of western China's underdeveloped area, and is in the transition zone between the Loess Plateau and the Tengger Desert (Figure 1). It is also a representative resource-dependent city with abundant mineral resources of more than thirty types of minerals, such as coal, limestone, gypsum, copper, lead, zinc, gold, and silver. The reserves of coal, limestone, and gypsum are 1.6 billion tons, 140 million tons and 200 million tons, respectively. Since the founding of the People's Republic of China in 1949, the country has carried out massive development and utilization of local resources, pushing local resources to the verge of depletion. Consequently, Baiyin has been named by the Chinese government as one of the first resource-depleted cities in urgent need of industrial transformation. Therefore, Baiyin has reached the late stage of its resource development and utilization, that is, the recession period.

After several decades of development, these three cities have formed a complete set of industrial chains from resource exploitation to processing and output.

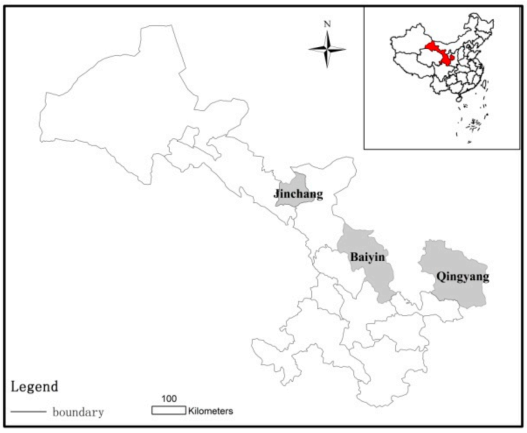

Figure 1. The location of case areas (Qingyang, Jinchang and Baiyin).

3. Methodology

3.1. Source of Dataset

The benchmark dataset is derived from the "Statistical Yearbook of Qingyang," the "Statistical Yearbook of Jinchang," and the "Statistical Yearbook of Baiyin," and also includes some other statistical material from the relevant government functional departments [33–35]. There are 30 years of sample data for each of the three cities, dating from 1988 to 2017.

3.2. Research Methodology

3.2.1. Resource Curse Coefficient

The resource curse coefficient is a measure of the extent to which economic development (primarily the development of the secondary industry) of a region deviates from its regional resource advantage. It reflects the degree to which the resources are cursed in a region. The determination of the resource curse coefficient was based on the Chinese national level as a baseline. A resource curse coefficient of 1 means that the ability of creating wealth by resource exploitation is consistent with the national average level; when the coefficient is below 1 it implies that the ability of creating wealth by resource exploitation is higher than the national average level, that is, the resource development has promoted regional economic growth effectively; and when the coefficient exceeds 1, the ability of creating wealth by resource exploitation is lower than the national average level, in other words, the resource development in this region has failed to promote regional economic growth—this is regarded as the resource curse effect. The severity of the resource curse increases with the coefficient value. By contrast, in a case where the resource curse coefficient is below 1, the resource curse effect would be considered to be absent in that region. Following the aforementioned definition, the resource curse coefficient was adopted in this paper, which can be computed as follows [36]:

$$ES_i = \frac{E_i / \sum_{i=1}^{n} E_i}{SI_i / \sum_{i=1}^{n} SI_i} \tag{1}$$

where ES_i denotes the resource curse coefficient in region I, n denotes the count of regions, E_i denotes the resource production in region I, and SI_i denotes the output value of the secondary industry in region i.

The classification standard of resources curse degree was adopted in this paper based on the research of "Chinese regional differences and its driving force analysis of the resource curse" [36]. According to the results, based on the deviation degree of economic advantage and resource advantage, the classification of resource curse degree can be divided into four types: region free of resource curse, region with borderline resource curse, region severely plagued by resource curse, and region with high risk of resource curse. The criteria of the resource curse effect type classifications are shown in Table 1.

Table 1. The divided threshold and basic characteristics of the resource curse (RC).

Region	Threshold	Characteristics	Curse Severity
Region free of resource curse	RC < 1	Economic growth outpaces the development rate sustained by its own resource endowment	None
Region with borderline resource curse	2 > RC ≥ 1	The resource curse effect starts to appear, yet the severity is limited. There is a risk of a more severe resource curse developing	Mild
Region severely plagued by resource curse	4 > RC ≥ 2	The resource advantage fails to generate economic advantage; the resource curse is severe.	Severe
Region with high risk of resource curse	RC ≥ 4	The resource advantage completely fails to generate economic advantage; the resources fail to promote regional economic development; urgent actions are needed to deal with the issue.	High-Risk

3.2.2. The Empirical Relations Model of Resource Curse

Many scholars have used regression analysis models to study the resource curse effect in different spatial scale. For example, Harkness [37] studied the relationship between mineral activities and economic development of Kentucky State Coal Counties in the United States by the ordinary least square (OLS) regression model. Gasimov [9] used a regression model to analyze the impacts on economy, society and policy of petroleum resources in Azerbaijan. Oyinlola et al. [38] used a regression model to study the relationship between natural resources and economic growth in Africa. Wang et al. [39] used the regression model to study the resource curse effect and transmission mechanism in the western region of China. Wang and Li [40] studied the impacts on economic development of coal resource development in China. By integrating the previous investigation outcome with the practical situation, the present study constructs the following regression model, which is derived from Xu and Wang's study [17]:

$$y_t = \alpha + \beta_1 E_t + \beta_2 MIN_t + \beta_3 Z_t + \varepsilon_t \tag{2}$$

where y denotes per capita GDP growth rate, E denotes intensity of resource development, MIN denotes the level of investment in the manufacturing industry, Z denotes a set of vectors consisting of the other control variables to be introduced to the model, t denotes year, α is a constant vector, β_1, β_2, and β_3 are coefficient vectors, and ε denotes the stochastic perturbation term.

To integrate the analysis outcomes concerning the factors that influence economic growth, and to facilitate the analysis concerning the impact of proxy variables on economic growth, one needs to substitute the selected proxy variables into Equation (2), which yields the following regression equation:

$$\ln y_t = \alpha + \beta_1 lnE_t + \beta_2 lnMAN_t + \beta_3 lnEDU_t + \beta_4 lnST_t + \beta_5 lnOPEN_t + \beta_6 lnMKZ_t + \beta_7 lnDL_t + \varepsilon_t \tag{3}$$

where the coefficient of E_t, β_1, reflects the extent of the impact of the resource development intensity variable on economic development; if β_1 is much smaller than zero, the resource curse effect exists, whereas a positive β_1 indicates the absence of the resource curse effect. β_2, β_3 .... denote the extent to which the resource development intensity variable, through affecting the other proxy variables introduced, affects economic growth. The model here reflects the correlation between capital investment and economic output.

The selection of variables in the model was carried out based on existing research outcomes and practical conditions, which are mainly the accessibility of relevant regional statistics, and the characteristics of socio-economic development and resource utilization. The selected variables were derived from existing research and are frequently and representatively used by scholars [41–45]. Specifically, the per capita GDP growth rate was selected as the benchmark variable of economic growth, denoted as Y, and the ratio of mining industry output value to the overall industrial output value was selected as the benchmark variable of resource development intensity, denoted as E. According to the existing research outcomes, it is believed that the resource curse effect occurring during economic growth manifests itself primarily as the Dutch disease effect, the crowding out effect, and the institution weakening effect. The Dutch disease effect mainly refers to the process whereby the resource development activity causes the manufacturing industry to shrink, which results in labor resources in the manufacturing industry migrating to the resource industry. This measures the investment of labor resources in the manufacturing industry. As the Dutch disease effect mainly occurs in the industrial sector, the ratio of the number of employees in the manufacturing industry to the overall number of employees in the entire industry was selected as a proxy variable of the Dutch disease effect, denoted as MAN. The crowding out effect is generally considered to be the result of the reduction in expenditure on science and technology, in addition to education. Therefore, we selected the ratios of expenditure on science and technology, and expenditure on education, to overall financial expenditure, as the proxy variables for the crowding out effect, denoted as ST and

EDU, respectively. The institution weakening effect in the present research mainly concerns economic policy. As there are numerous ways to select variables of the institution weakening effect without a commonly agreed standard, we selected three commonly used variables to serve as the proxy variables of the institution weakening effect, which measure the degree of openness, marketization, and denationalization, respectively. The variables are shown in Table 2.

Table 2. The definition of relevant indicators.

<table>
<tr><th colspan="2">Metric name</th><th>Variable</th><th>Metric Calculation</th></tr>
<tr><td colspan="2">Economic growth</td><td>Y</td><td>ln $(Y_t/Y_t - 1)$</td></tr>
<tr><td colspan="2">Resource development intensity</td><td>E</td><td>Ratio of mining industry output value to overall industrial output value</td></tr>
<tr><td colspan="2">Dutch disease effect</td><td>MAN</td><td>Ratio of number of employees in the manufacturing industry to number of employees in the entire industry</td></tr>
<tr><td rowspan="2">Crowding out effect</td><td>Education</td><td>EDU</td><td>Ratio of educational expenditure to overall financial expenditure</td></tr>
<tr><td>Science and technology</td><td>ST</td><td>Ratio of science and technology expenditure to overall financial expenditure</td></tr>
<tr><td rowspan="3">Institution weakening effect</td><td>Degree of openness</td><td>OPEN</td><td>Ratio of total value of import and export trade to GDP</td></tr>
<tr><td>Degree of marketization</td><td>MKZ</td><td>Ratio of capital investment to state budget</td></tr>
<tr><td>Degree of denationalization</td><td>DL</td><td>Ratio of private industrial output value to overall industrial output value</td></tr>
</table>

In summary, the resource curse coefficient and regression model were used to study the resource curse effect of resource-dependent cities. Firstly, the resource curse effect was judged by calculating the resource curse coefficient for each of the three cities. Secondly, the regression model was used to analyze the resource curse effect in the three cities in depth. Finally, a comparative analysis was carried out for different types of resource-dependent cities based on the first two steps.

4. Results and Analysis

4.1. Test and Analysis of Resource Curse Coefficient

4.1.1. Development Period of Resource-Dependent Cities

During 1988–2017, the resource curse coefficient of Qingyang constantly stayed above one, indicating that the region was subject to the resource curse effect throughout that period (Figure 2). The process roughly consisted of four stages: Stage I lasted from 1988 to 1997, during which time the resource curse coefficient gradually increased, showing the gradual aggravation of the resource curse, which dragged the situation from the region of a borderline resource curse into the region of a severe resource curse. Stage II lasted from 1997 to 2008, during which time the resource curse coefficient gradually decreased, implying the gradual mitigation of the resource curse. Specifically, the period of 1997–2004 corresponded to the region having a severe resource curse, while the period after 2004 corresponded to the region having a borderline resource curse. Stage III lasted from 2008 to 2014, during which time the resource curse coefficient started to gradually increase, indicating the gradual aggravation of the resource curse, which dragged the situation back into the region of a severe resource curse. Stage IV lasted from 2014 to 2017, when the period indicated that the region had a severe resource curse, but the resource curse coefficient started to gradually decrease towards the end of this period. In addition, the red line in Figure 2 shows the trend line of the resource curse coefficient from 1988 to

2017. It can be seen that during the development period, the resource-dependent city was subject to the resource curse effect throughout the economic development process, and the situation persists.

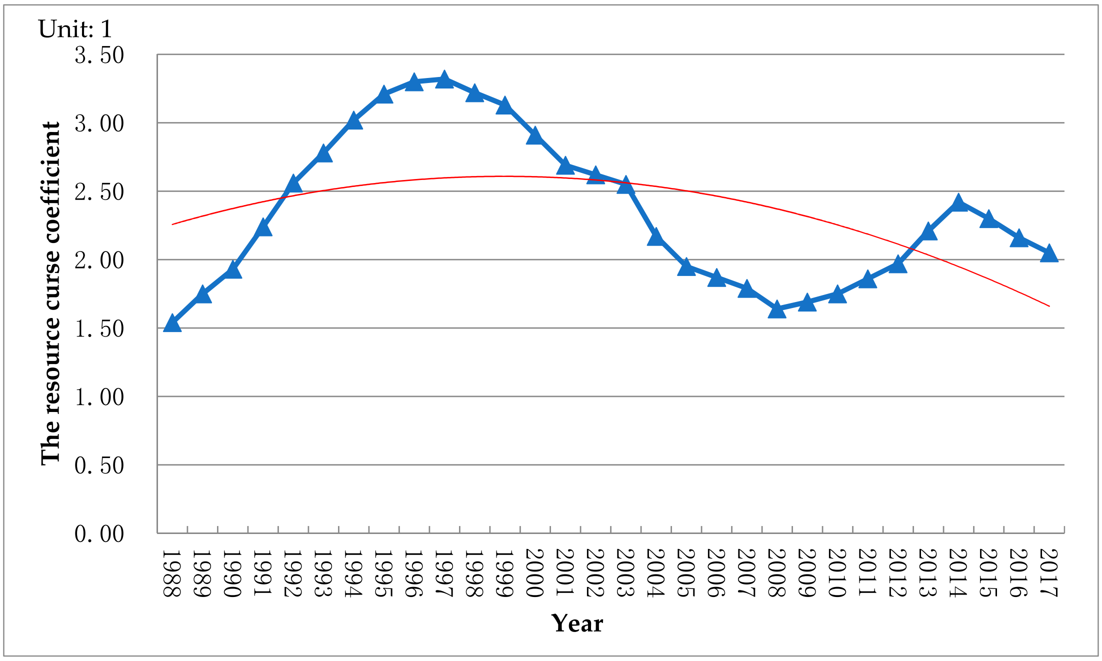

Figure 2. The resource curse coefficient for Qingyang.

4.1.2. Maturation Period of Resource-Dependent Cities

From 1988 to 2017, the resource curse coefficient of Jinchang experienced dramatic fluctuations. During that period, there were many years during which the resource curse coefficient exceeded one, implying the existence of the resource curse effect (Figure 3). The period can be roughly split into four stages: Stage I lasted from 1988 to 1999, during which the resource curse coefficient gradually increased. Specifically, from 1988 to 1990 the resource curse coefficient was below one, indicating the absence of the resource curse effect, whereas from 1991 to 1999 the resource curse coefficient stayed above one, indicating the emergence of the resource curse effect. The resource curse gradually intensified, pushing the situation into the borderline resource curse region. Stage II lasted from 1999 to 2005, during which period the resource curse coefficient gradually decreased, indicating the gradual mitigation of the resource curse. Starting in 2001, the resource curse coefficient went below one, marking the temporary elimination of the resource curse effect. Stage III lasted from 2005 to 2013, during which time the resource curse coefficient resumed a sharp upward trend. During 2005–2007, the resource curse coefficient remained below one, indicating no resource curse effect. Starting from 2008, however, the resource curse coefficient went above one, indicating the recurrence of the resource curse effect. The degree of the resource curse intensified rapidly, pushing the situation into the borderline resource curse region, which was even more severe than previously. Stage IV lasted from 2013 to 2017, during which time the resource curse coefficient started to gradually decrease again, and the resource curse was mitigated. However, the resource curse coefficient was still above one, indicating the existence of the resource curse effect. Also, the red line in Figure 3 shows the trend line of the resource curse coefficient from 1988 to 2017. It is clear that, during the maturation period, this resource-dependent city was subject to the resource curse effect throughout the economic development process, and the situation persists.

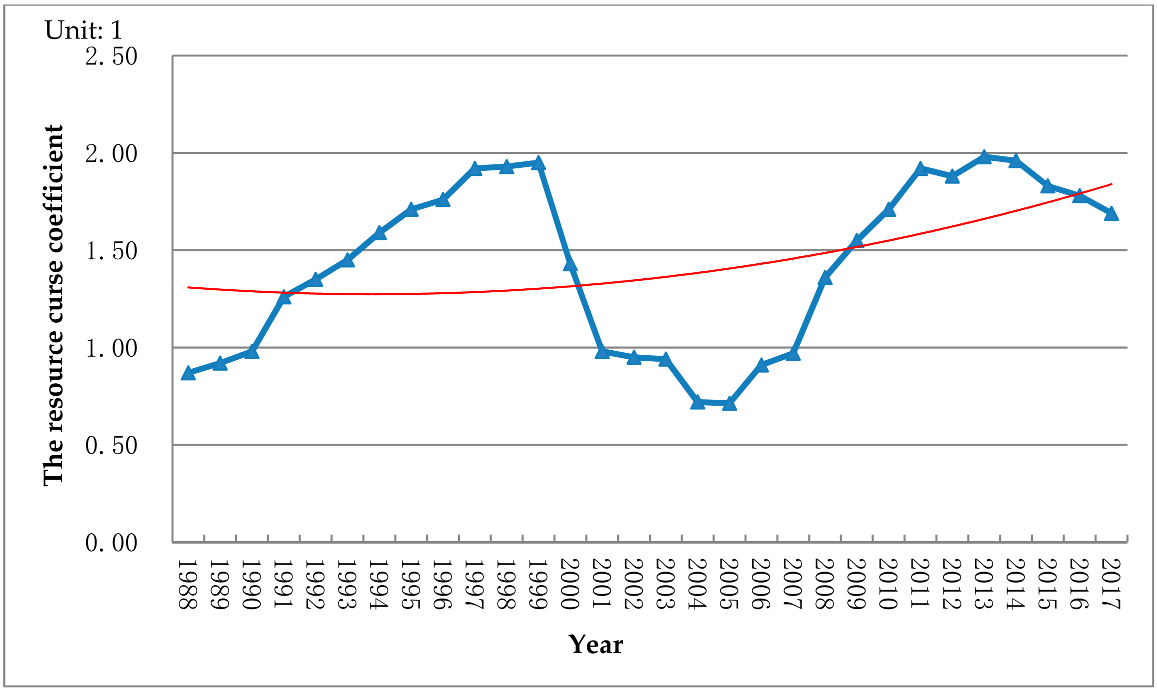

Figure 3. The resource curse coefficient for Jinchang.

4.1.3. Recession Period of Resource-Dependent Cities

From 1988 to 2017, the resource curse coefficient of Baiyin stayed above two, indicating that the region was subject to a severe resource curse effect, as shown in Figure 4. This period can be roughly split into four stages: Stage I lasted from 1988 to 1998, during which time the resource curse coefficient gradually increased. This corresponded to the gradual aggravation of the resource curse, marking the transition from a situation of being severely plagued by the resource curse to a situation of there being a high risk of the resource curse. From 1988 to 1996, the situation was one of a severe resource curse, whereas the years of 1997 and 1998 gradually shifted the situation into a high risk of resource curse scenario. Stage II lasted from 1998 to 2002, during which period the resource curse coefficient gradually decreased. This implied the gradual alleviation of the resource curse, yet the situation was still one of a severe resource curse. Stage III lasted from 2002 to 2005, during which time the resource curse coefficient increased again, indicating the gradual intensification of the resource curse, which once again pushed the situation from a severe resource curse scenario into one of a high risk of resource curse. Stage IV lasted from 2005 to 2017, during which time the resource curse coefficient started to gradually drop again, and the resource curse was gradually mitigated. However, the situation was still one of a severe resource curse, which was still a cause for major concern. The red line in Figure 4 shows the trend line of the resource curse coefficient from 1988 to 2017. It is clear that, during the recession period, the resource-dependent city suffered from a severe resource curse effect throughout the economic development process, and the situation persists.

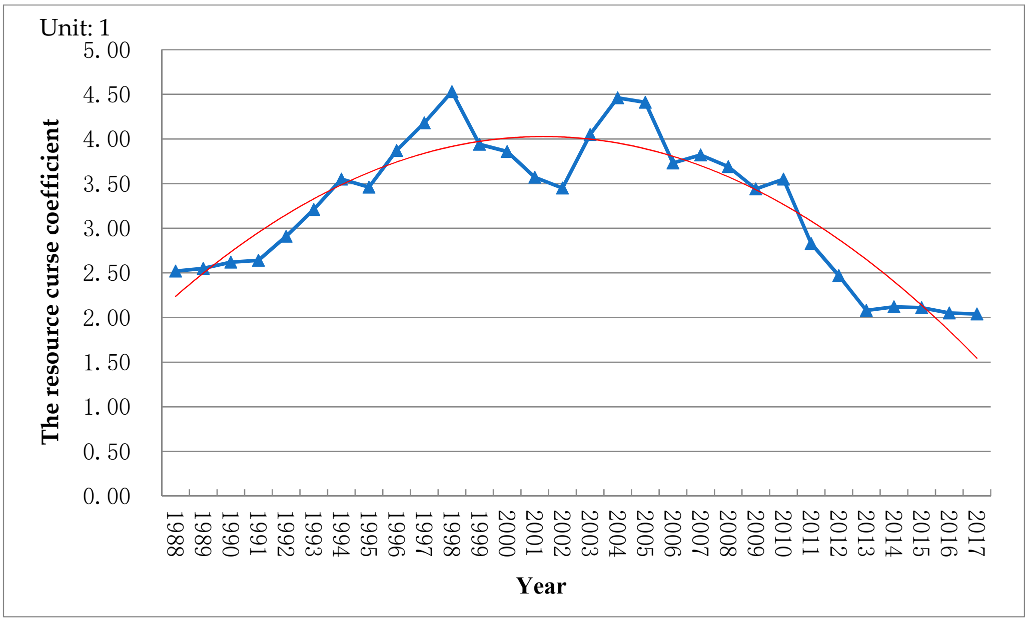

Figure 4. The resource curse coefficient for Baiyin.

4.1.4. Comprehensive Comparison and Analysis

Overall, regardless of whether resource-dependent cities are in the initial (development period), intermediate (maturation period) or late stage (recession period) of the resource development process, there is always some degree of resource curse effect during economic development, and this can compromise the sustainability and stable development of the region. However, for different types of resource-dependent cities, the characteristics of the corresponding resource curse effect differ.

During the recession period, the resource-dependent city suffered from a relatively strong resource curse effect, and was essentially in the region of severe resource curse or high risk of resource curse, and the impact of the resource curse on economic development was most pronounced. This was because the resources in such cities were on the verge of depletion; thus, the development and utilization of resources there cannot be effectively sustained. Subsequently, the development of resource-intensive industry can become subject to an enormous crisis, and it becomes impossible for the economic development mode to undergo a rapid transformation within a short timeframe. Consequently, the economic growth lacks strong support, which greatly inhibits and limits the sustainable development of the regional economy.

During the development period, the resource-dependent city had a less severe resource curse effect than was the case for the resource-dependent city in the recession period. However, the resource curse effect was still quite strong, corresponding to the regions with severe resource curse and borderline resource curse; therefore, the impact of the resource curse on economic development was very pronounced. This is because such cities are in the initial stage of resource development and utilization, and the efficiency of resource development and utilization is low. Consequently, the development of resource-intensive industry is far from being fully-fledged, making it hard to fully convert the resource advantage into an economic development advantage. Thus, there is a reasonably evident resource curse effect.

During the maturation period, the resource-dependent city had the weakest resource curse effect, basically having either a borderline resource curse or no resource curse. The impact of the resource curse on economic development was relatively weak. This is mainly because such cities are in the mature stage of resource development and utilization, and the efficiency of resource development and utilization has been essentially maximized. The development of resource-intensive industry has become relatively mature, and the resource advantage has been converted fully into the advantage of economic development. Hence, the resource curse effect is relatively weak.

4.2. The Analysis of Empirical Relations Associated with the Resource Curse

In accordance with the construction workflow of the aforementioned model, the sample data were processed using log transformation. After that, the stepwise regression technique was used to introduce the control variables to the model in a stepwise fashion. The test of normal distribution and auto correlation was carried out. On the whole, it indicated that the error was in accord with the normal distribution hypothesis, and there was no significant auto correlation. Therefore, the accuracy of the results can be guaranteed to a certain degree.

4.2.1. Development Period of Resource-Dependent Cities

The results are shown in Table 3. The coefficients of the resource development intensity variables in the first row are all well below zero, indicating that the resource curse effect existed during economic development for the resource-dependent city in the development period (Qingyang). This is consistent with the conclusion from the previous analysis at Section 4.1.

Without accounting for the other control variables, the coefficient of the resource development intensity variable in column 1 of Table 3 is −0.5685, which clearly indicates that the local resource curse effect existed. After adding a variable to column 2 to account for the level of human resource investment in the manufacturing industry, the coefficient of the resource development intensity variable is still −0.2780, the absolute value of which is less than that in column 1. This indicates that the introduction of the variable accounting for the level of human resource investment in the manufacturing industry can mitigate the resource curse effect. However, the impact of the resource curse effect was still strong, implying the presence of the Dutch disease phenomenon in the local area.

Starting with column 3 of Table 3, variables accounting for the crowding out effect are introduced to the model. Firstly, after adding the education variable, the coefficient of the resource development intensity variable is −0.2171, the absolute value of which is less than that of column 2, showing that the introduction of the education variable can mitigate the resource curse effect. When the variable concerning science and technology is added in column 4, the coefficient of the resource development intensity variable becomes −0.2043, the absolute value of which is further reduced compared to column 3, showing that the addition of the science and technology variable can mitigate the resource curse effect. Nonetheless, the coefficient of the resource development intensity variable remained negative.

Starting from column 5, the institution variables are added to the model, which account for the degree of openness. The resulting coefficient of the resource development intensity variable becomes −0.1915, the absolute value of which is slightly less than that of column 4. However, as the variables accounting for the degrees of marketization and denationalization are added to the column 6 and 7, respectively, the coefficient of the resource development intensity variable becomes −0.1994 and −0.2097, respectively, both of which are larger than the coefficient in column 5 in terms of the absolute value. This indicates that the addition of these two variables intensifies the resource curse effect. The coefficients of the variables accounting for the degree of openness and marketization are found to be not pronounced, which is mainly attributed to the underdevelopment of traffic in the local region.

Many relevant studies have confirmed that partial correlation coefficients and multiple correlation coefficients can be used to test the sensitivity of parameters for linear regression models [46–50]. Therefore, the sensitivity of parameters was analyzed by calculating partial correlation coefficients and multiple correlation coefficients in this paper. The results of this are shown in Table 4. The partial correlation coefficients and multiple correlation coefficients are larger and significant, which means that the relationship between independent variables and the dependent variable were relatively close. Therefore, the single and multiple impacts of independent variables on the dependent variable are relatively sensitive. Therefore, for the multiple linear regression model in this study, the sensitivity of parameters is generally strong, which can ensure the accuracy and rationality of the model.

Table 3. The results of resource curse effect in Qingyang.

Variables	1	2	3	4	5	6	7
lnE	−0.5685 *** (−4.7990)	−0.2780 ** (−2.7786)	−0.2171 ** (−2.2009)	−0.2043 ** (−2.3082)	−0.1915 ** (−1.9927)	−0.1994 * (−2.0433)	−0.2097 ** (−2.3828)
lnMAN		−0.4684 *** (−4.7888)	−0.4242 *** (−4.5089)	−0.3584 *** (−4.0138)	−0.3441 *** (−3.5102)	−0.2671 * (−1.8688)	−0.2763 ** (−2.1459)
lnEDU			−0.26091 * (−1.8918)	−0.1828 (−1.4236)	−0.2225 (−1.3633)	−0.0503 (−0.1849)	−0.1929 (−0.7567)
lnST				4.0531 ** (2.2269)	3.9934 * (2.1263)	3.2887 * (1.5527)	4.0916 * (2.1003)
lnOPEN					0.1270 (0.4144)	0.0860 (0.2783)	0.0339 (0.1023)
lnMKZ						0.0849 (0.7629)	0.0117 (0.1095)
lnDL							0.0304 ** (2.0104)
a	48.8107 *** (6.5225)	55.5645 *** (10.6477)	54.5476 *** (11.1498)	46.5373 *** (8.2106)	45.5683 *** (7.2530)	37.7660 *** (3.1103)	41.4812 *** (3.7419)
R^2	0.5613	0.8132	0.8474	0.8853	0.8867	0.8914	0.9187
Adj.R^2	0.5369	0.7913	0.8188	0.8547	0.8462	0.8412	0.8713
S.E. of regression	2.5494	1.7116	1.5949	1.4280	1.4691	1.4928	1.3438
F-statistic	23.0300	37.0123	29.61116	28.9431	21.9103	17.7781	19.3810
Prob. (F-statistic)	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
DW	1.1733	1.2317	1.3526	1.4368	1.5524	1.5175	1.7512

Note: The values of t are given in brackets. ***, **, * represent the different significance levels (1%, 5%, 10%).

Table 4. The results of sensitivity analysis for Qingyang.

	E	MAN	EDU	ST	OPEN	MKZ	DL
Partial correlation coefficient	−0.907 ***	−0.928 **	−0.713 *	0.752 **	0.658 *	0.575 *	0.611 **
Multiple correlation coefficient				0.904 **			

Note: ***, **, * represent the different significance levels (1%, 5%, 10%).

4.2.2. Maturation Period of Resource-Dependent Cities

The results are shown in Table 5. The coefficients of the resource development intensity variables in row 1 are highly negative, illustrating that the resource curse effect existed in the resource-dependent city (Jinchang) during the maturation period. This is consistent with the conclusion from the previous analysis at Section 4.1.

Without accounting for the other control variables, the coefficient of the resource development intensity variable in column 1 is approximately −5.8823, clearly indicating that the local resource curse effect exists. After adding a variable to column 2 to account for the level of human resource investment in the manufacturing industry, the coefficient of the resource development intensity variable is −5.7005, the absolute value of which is slightly less than that of column 1. This indicates that the introduction of the variable accounting for the level of human resource investment in the manufacturing industry can moderately mitigate the resource curse effect. However, the impact of the resource curse effect is still quite strong, implying the presence of the Dutch disease phenomenon in the local area.

Starting from column 3, variables accounting for the crowding out effect are introduced to the model. Firstly, after adding the education variable, the coefficient of the resource development intensity variable is −6.6788, the absolute value of which is slightly larger than that of column 2. This shows that the introduction of the education variable fails to mitigate the resource curse effect. As the variable concerning science and technology is added to column 4, the coefficient of the resource development intensity variable becomes −6.8234, the absolute value of which is roughly equal to that of column 3, showing that the addition of the science and technology variable also cannot mitigate the resource curse effect. Starting from column 5, the institution variables are added to the model, which included variables accounting for the degrees of openness, marketization, and denationalization, respectively.

During this process, the absolute value of the coefficient of the resource development intensity variable generally increases, indicating that the addition of the institution variables can intensify the resource curse effect. The coefficients of the variables accounting for the degree of openness and marketization were not pronounced, which can be mainly attributed to the limited total value of import and export trade, as well as the limited degree of foreign capital utilization in the local area.

The sensitivity of parameters was analyzed by calculating partial correlation coefficients and multiple correlation coefficients in this paper. The results are shown in Table 6. The partial correlation coefficients and multiple correlation coefficients are larger and significant, which means that the relationship between independent variables and the dependent variable was relatively close. Therefore, the single and multiple impacts of independent variables on the dependent variable were relatively sensitive. Therefore, for the multiple linear regression model in this study, the sensitivity of parameters was generally strong, which can ensure the accuracy and rationality of the model.

Table 5. The results of resource curse effect for Jinchang.

Variables	1	2	3	4	5	6	7
lnE	−5.8823 *** (−5.8391)	−5.7005 *** (−6.2807)	−6.6788 *** (−7.9648)	−6.8234 *** (−9.9295)	−7.7759 *** (−8.8930)	−7.5698 *** (−8.1222)	−7.9788 *** (−9.0093)
lnMAN		−0.6785 ** (−2.4584)	−0.6443 ** (−2.7465)	−0.4194 ** (−2.0551)	−0.4618 ** (−2.3480)	−0.5514 ** (−2.3454)	−1.0071 *** (−3.1527)
lnEDU			0.4286 *** (2.9577)	0.3688 *** (3.0743)	0.3368 *** (2.8977)	0.3171 ** (2.6202)	0.3674 *** (3.2040)
lnST				−6.4934 *** (−3.2268)	−7.3412 *** (−3.6889)	−6.8350 *** (−3.1975)	−8.5562 *** (−3.9564)
lnOPEN					−0.0181 (−1.6493)	−0.0220 * (−1.7774)	−0.0310 ** (−2.5172)
lnMKZ						0.0739 (0.7206)	0.2379 * (1.8760)
lnDL							0.2089 * (1.9440)
a	15.2227 *** (19.7423)	77.4524 *** (3.0586)	68.4890 *** (3.1546)	52.8704 ** (2.8730)	59.3810 *** (3.2955)	67.0978 *** (3.1672)	105.3596 *** (3.7974)
R^2	0.6188	0.7073	0.7996	0.8730	0.8905	0.8940	0.9153
Adj.R^2	0.6007	0.6780	0.7679	0.8448	0.8583	0.8542	0.8758
S.E. of regression	2.7135	2.4366	2.0687	1.6917	1.6162	1.6595	1.5134
F-statistic	34.0953	24.1639	25.2662	30.9400	27.6617	22.4861	23.1614
Prob. (F-statistic)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
DW	1.1991	1.1764	1.2869	1.7578	1.8656	1.6607	1.8731

Note: The values of t are given in brackets. ***, **, * represent the different significance level (1%, 5%, 10%).

Table 6. The results of sensitivity analysis for Jinchang.

	E	MAN	EDU	ST	OPEN	MKZ	DL
partial correlation coefficient	−0.921 ***	−0.728 ***	0.702 **	−0.852 ***	−0.557 *	0.675 *	0.639 *
multiple correlation coefficient				0.893 ***			

Note: ***, **, * represent the different significance level (1%, 5%, 10%).

4.2.3. Recession Period of Resource-Dependent Cities

Results are shown in Table 7. The coefficients of the resource development intensity variables in row 1 are highly negative, proving showing that the resource curse effect existed in the resource-dependent city in the recession period (Baiyin). This agrees with the conclusion from the previous analysis at Section 4.1.

Without accounting for the other control variables, the coefficient of the resource development intensity variable in column 1 is approximately −0.1806, indicating that the local resource curse effect indeed existed. After adding a variable accounting for the level of human resource investment in manufacturing industry to column 2, the coefficient of the resource development intensity variable becomes −0.1603, the absolute value of which is slightly reduced. It indicates that the introduction of the variable accounting for the level of human resource investment in manufacturing industry can moderately mitigate the resource curse effect. However, the impact of the resource curse effect is still relatively strong, indicating the presence of the Dutch disease phenomenon in the local area.

Starting from column 3, variables accounting for the crowding out effect are introduced to the model. Firstly, after adding the education variable, the coefficient of the resource development intensity variable becomes −0.1347, the absolute value of which is slightly smaller than that of the column 2. It shows that the introduction of education variable can mitigate the resource curse effect. As the variable concerning science and technology is added to column 4, the coefficient of the resource development intensity variable becomes −0.1281, the absolute value of which is slightly smaller than that of column 3, showing that the addition of the science and technology variable can also further mitigate the resource curse effect. Nonetheless, the coefficient of the resource development intensity variable remains negative.

Starting from column 5, the institution variables are added to the model, which account for the degree of openness. The resulting coefficient of the resource development intensity variable becomes −0.1064, the absolute value of which is slightly less than that of column 4. However, as the variables accounting for the degrees of marketization and denationalization are added to the column 6 and 7, respectively, the coefficient of the resource development intensity variable becomes −0.1161 and −0.1241, respectively, both of which are larger than the coefficient in column 5 in terms of the absolute value. This indicates that the addition of these two variables intensifies the resource curse effect.

The sensitivity of parameters was analyzed by calculating partial correlation coefficients and multiple correlation coefficients in this paper. The results are shown in Table 8. The partial correlation coefficients and multiple correlation coefficients are larger and significant, which means that the relationship between independent variables and the dependent variable was relatively close. Thus, the single and multiple impacts of independent variables on the dependent variable are relatively sensitive. Therefore, for the multiple linear regression model in this study, the sensitivity of parameters is generally strong, which can ensure the accuracy and rationality of the model.

Table 7. The results of resource curse effect in Baiyin.

Variables	1	2	3	4	5	6	7
lnE	−0.1806 * (−2.1053)	−0.1603 *** (−3.1416)	−0.1347 ** (−2.6562)	−0.1281 ** (−2.7378)	−0.1064 ** (−2.8163)	−0.1161 ** (−2.8608)	−0.1241 *** (−4.1142)
lnMAN		−0.2328 *** (−4.8108)	−0.2232 *** (−4.8568)	−0.2069 *** (−4.7735)	−0.1667 *** (−4.4396)	−0.1847 *** (−4.1351)	−0.0197 (−0.2751)
lnEDU			−0.1587 * (−1.5601)	−0.1995 * (−2.0650)	−0.4382 *** (−3.6396)	−0.3782 ** (−2.6123)	−0.4609 *** (−4.1278)
lnST				2.5705 * (1.6833)	−0.6832 (−0.3904)	−0.6774 (−0.3779)	−1.6996 (−1.2294)
lnOPEN					0.2669 ** (2.5566)	0.2568 ** (2.3842)	0.3243 *** (3.8724)
lnMKZ						0.0449 * (0.7920)	0.1111 * (2.2654)
lnDL							0.0440 ** (2.6075)
a	12.6761 *** (33.8859)	26.2664 *** (9.2693)	29.2523 *** (8.9149)	27.7495 *** (8.8213)	29.9371 *** (11.4309)	29.2436 *** (10.3645)	17.4978 ** (3.5246)
R^2	0.2697	0.7647	0.8108	0.8561	0.9208	0.9273	0.9659
Adj.R^2	0.2089	0.7220	0.7540	0.7921	0.8713	0.8650	0.9262
S.E. of regression	1.3916	0.8250	0.7760	0.7133	0.5613	0.5748	0.4251
F-statistic	4.4325	17.8776	14.2834	13.3850	18.6020	14.8839	24.2980
Prob. (F-statistic)	0.0570	0.0004	0.0006	0.0008	0.0003	0.0011	0.0005
DW	0.6572	1.5485	2.0004	2.0920	2.2782	2.3371	2.6232

Note: The values of t are given in brackets; "***, **, *" represent the different significance level (1%, 5%, 10%).

Table 8. The results of sensitivity analysis in Baiyin.

	E	MAN	EDU	ST	OPEN	MKZ	DL
partial correlation coefficient	−0.884 ***	−0.711 **	−0.892 ***	−0.692 *	0.624 **	0.596 *	0.544 **
multiple correlation coefficient				0.875 ***			

Note: "***, **, *" represent the different significance level (1%, 5%, 10%).

4.2.4. Comprehensive Comparison and Analysis

In general, regardless of whether a resource-dependent city is in the initial stage (development period), intermediate stage (maturation period) or late stage (recession period) of resource development, its economic development is always more or less subject to the resource curse effect. During economic growth, the resource advantage cannot be fully converted into the economic advantage, and the resource development limits economic growth to some extent. In other words, economic growth is suppressed and economic development cannot be promoted in a sustainable and effective manner. Resource development not only directly exerts an adverse impact on economic growth, but also often affects it in many ways and on various levels through the Dutch disease effect, the crowding out effect, and the institution weakening effect.

As far as the three different types of resource-dependent cities are concerned, the impact and influence of the Dutch disease effect stays the same. Specifically, the effect manifests itself through the excessive and imbalanced focus on developing the primary industry most closely related to the advantageous resources with relatively low added value, which leads to an undiversified regional industrial structure that inhibits and limits the development of other sectors. In particular, the development of the resource-intensive industry limits the scale of development of the manufacturing industry, suppresses its independent innovative ability, and inhibits its development. Finally, resource development ends up strongly suppressing economic growth.

The impact and influence of the crowding out effect differed among the three different types of resource-dependent cities. During the development period and the recession period, the resource-dependent cities exhibit a consistent crowding out effect, which manifests itself through the excessive development of resource-intensive industry during economic development, thereby crowding out investment in science, technology, and education, and adversely affecting the development of technological innovation and education. Consequently, education, science, and technology can only mitigate the resource curse effect and the negative impact of resource development on economic growth, without being able to completely eradicate the resource curse effect. For the resource-dependent cities in the maturation period, the crowding out effect mainly leads to a biased emphasis on the development of re-source-intensive industry during economic development, which crowds out investment in science, technology, and education, and unfavorably affects the development of technological innovation and education, thereby causing the development of education, science, and technology to lag behind, and the capacity for technological innovation to become subpar. Eventually, education, science, and technology fail to mitigate the resource curse effect and lack the ability to effectively alleviate the negative impact of resource development on economic growth. The crowding out effect during the maturation period of a resource-dependent city is more obvious and prominent than during the development or recession period of a resource-dependent city. During the maturation period of a resource-dependent city, education, science and technology cannot play a role in weakening the resource curse effect, while during the development and recession period of a resource-dependent city, education, science and technology can weaken the resource curse effect to some extent. This is primarily because a resource-dependent city in the intermediate stage (maturation period) of resource development that wishes to enhance the utilization of resource development and develop resource-intensive industry in a sustained and steady manner, must secure more cutting-edge technology and more technical talent to underpin its development. As a result, the demand for science, technology, and education increases. Due to the impact of the crowding out effect, however, the development of education, science, and technology lags behind, and the capacity for technological innovation remains limited. The existing levels of science, technology, and education cannot meet the requirements posed by development; thus, economic growth is limited, leading to the aforementioned consequences.

As for the three types of resource-dependent cities, the impact of the institution weakening effect remains the same. Specifically, the presence of institution weakening adversely affects the resource curse effect. Instead of mitigating or eliminating the resource curse effect, the existing economic institution tends to exacerbate the resource curse effect, increasing the likelihood that the effect will evolve into a more malignant form.

5. Discussion

5.1. Comparative Analysis with Existing Studies

In view of the resource curse effect of resource-dependent cities or regions in the development period, some research has been carried out, and some similar conclusions have been drawn. For example, Elbra [14] found that South Africa has not benefited from natural resource wealth and is in a state of resource curse. Furthermore, Campbell and Snyder [51] studied the relationship between resource abundance, economic freedom and economic growth using a regression model, and found that resource abundance had negative effects on economic freedom and investment, which caused the observed resource curse. In China, Zhao [52] analyzed the relationship between economic growth, energy development, industrial structure and other factors in Xinjiang Province, and found that energy development in Xinjiang and even the whole northwest of China had a restraining effect on economic growth. Li [53] studied the resource endowment and economic development in Guizhou Province by regression analysis method, and found that resource development inhibited economic development.

In view of the resource curse effect of resource-dependent cities or regions in the mature period, some research has been carried out, and some conclusions have been drawn. For instance, Douglas and Walker [54] used regression models to measure the dependence of the coal resources sector on long-term income growth in 409 counties in the Appalachian coal mining area of the United States. The conclusion of this work was that coal mining makes regional wages relatively high, but in the long run it has a negative impact on economic development. Moreover, Larsen [55] found that Norway had successfully escaped the resource curse and made the assumption that rich areas were far more capable of fighting the resource curse than poor ones. The experience of rich countries in fighting against resource curse has also been analyzed. Researchers such as Yang and Guo [56] used the resource curse index model to calculate the resource curse coefficient in Northeast China and found that Heihe, Daqing, Anshan and other cities had successfully transformed in the development of resource-based cities, and eradicated the adverse effects of the resource curse effect. Furthermore, Wang et al. [57] analyzed the relationship between resource abundance and economic development in Inner Mongolia and found that rich resources did not affect economic development. In addition, Li et al. [58] analyzed the relationship between natural endowment and economic growth in 16 cities of Anhui Province, and found that there was a positive correlation between natural resource development and economic development in Anhui Province.

With regard to the resource curse effect in resource-dependent cities or regions during the recession period, some research has been carried out, and some similar conclusions have been drawn. For example, Satti et al. [59] used the ARDL (auto regressive distributed lag) boundary test method to measure and analyze the relationship between natural resources and economic growth in Venezuela, and found that it was suffering from a very serious resource curse effect. Domestic scholars such as Han and Wu [60] used regression analysis to evaluate the degree of resource curse in Hegang City, and the results showed that it has fallen into the predicament of resource curse. Moreover, Shi [61] used regression analysis to study the relationship between the exploitation and utilization of resources and economic growth in Shanxi Province, and confirmed that there is a resource curse effect in Shanxi Province.

Current research of the resource curse effect at the city or region scale is the basis and starting point of this study. However, there is still a lack of relevant research on the resource curse effect at the small-scale. Furthermore, existing research at small scales mostly takes just one city as an example, which leads to a failure to compare the resource curse effect among different regions systematically. This study compared the resource curse effects of three different types of resource-dependent cities, which made the research of the resource curse effect at the city scale more comprehensive and profound compared with the existing studies.

5.2. Academic Value and Contribution

Generally speaking, based on the city, a small scale region, this research verifies the resource curse theory from the microscopic spatial scale, and elucidates the resource curse effect of resource-dependent cities with different types. It provides the resource curse verification results at the city scale, which can lay the foundations for comparative research at different spatial scales. It is helpful to understand and reveal the resource curse effect more comprehensively; thus, this research can enrich the theoretical connotation of economic geography, and provide the theoretical and decision-making basis for the transformation and sustainable development of resource-dependent cities. This is the academic value of this research.

Up to now, many scholars have verified the resource curse effect in China at the national level and provincial level by taking large scale and meso-scale regions as the cut-in point. Most results show that there is no obvious resource curse effect at the national and provincial levels [62,63]. However, the verification of results for small-scale regions shows that the resource curse effect at the city level still exists. In addition, the resource curse effects for different types of resource-dependent cities are different.

5.3. Limitations

Limitations exist for this study: The number of cities is not as high as was desired—only three resource-dependent cities were selected to be studied because of the lack of data. Therefore, in any further study, more resource-dependent cities should be selected for a more profound comparative analysis to reveal the resource curse effect of different resource-dependent cities in a more comprehensive and in-depth manner.

6. Conclusions

Regardless of whether a resource-dependent city is in the early stage (development period), intermediate stage (maturation period), or late stage (recession period) of its resource development, its economic development is always plagued, to a certain degree, by the resource curse effect. The city's resource development has a significant adverse impact on its economic growth. In other words, resource development cannot promote economic development, but inhibits economic growth to some extent, resulting in an array of effects that are unfavorable to economic development and render the development unsustainable. However, the resource curse effects exhibit distinct characteristics for different types of resource-dependent cities. The resource curse effect is strongest for a resource-dependent city during a period of recession, falling into either the category of severe resource curse or the category of high risk of resource curse. The resource curse effect is less severe, yet is still considered quite strong, for a resource-dependent city in the development period, falling into either the category of severe resource curse or borderline resource curse; the impact of the resource curse on economic development is also relatively pronounced. The resource curse effect is weakest for a resource-dependent city in the maturation period, falling into either the category of borderline resource curse or the category of being free of the resource curse, and the impact of the resource curse on economic development is also relatively insignificant.

Resource development not only has a direct adverse effect on economic growth, but also often affects economic growth in many ways and on various levels, through the Dutch disease effect, the crowding out effect, and the institution weakening effect. The Dutch disease effect manifests itself through an excessive and imbalanced focus on developing the primary industry most closely related to the advantageous resources with relatively low added value, leading to an undiversified regional industrial structure that inhibits and limits the development of other sectors. In particular, the development of the manufacturing industry causes resource development to strongly inhibit economic growth. For resource-dependent cities going through periods of development and recession, the crowding out effect manifests itself through the excessive development of resource-intensive industry during economic development, crowding out investment in science, technology, and education, and adversely affecting the development of techno-logical innovation and education. Consequently, education, science, and technology can only mitigate the resource curse effect and the negative impact of resource development on economic growth to a limited extent, and cannot completely eradicate the resource curse effect. For resource-dependent cities going through the maturation period, the crowding out effect mainly leads to a biased emphasis on the development of resource-intensive industry during economic development, crowding out investment in science, technology, and education and unfavorably affecting the development of technological innovation and education, thereby causing development of education, science, and technology to lag behind and the capacity for technological to drop below par. Eventually, education, science and technology fail to mitigate the resource curse effect and cannot effectively alleviate the negative impact of resource development on economic growth. The institution weakening effect adversely affects the resource curse. Rather than mitigating or eliminating the resource curse effect, the existing economic institution tends to exacerbate the resource curse effect, increasing the likelihood that the effect will evolve into a more malignant form.

It can be seen that although the resource curse effect at the national and provincial level is not evident, it does not mean there is a total elimination of the resource curse effect, and there is still a strong resource curse effect at the city level. This should be given appropriate attention, and it is necessary to take effective measures to weaken or eliminate the negative impact of the resource curse effect on the development of cities. In addition, the resource curse effects vary for different types of resource-dependent cities. The resource curse effect is relatively weak in the maturation period of resource-dependent cities, but cannot be neglected. The industrial structure optimization and transformation should be carried out early in order to realize the transformation and sustainable development of the resource-dependent cities. Otherwise, once the resource-dependent cities enter the recession period, it is more difficult to transform their economic development pattern, and it is not advantageous to realize sustainable development.

In addition, due to the presence of the resource curse and the Dutch disease effect, resource-dependent cities tend to rely excessively on the resource industry, which may compromise the industry's overall ability to withstand risks, and make regional sustainable development impossible to achieve. Nevertheless, although resource dependent cities are subject to the resource curse effect, such an unfavorable situation can change. Therefore, during resource development, it is instrumental to deeply understand the root cause of the resource curse effect and to both employ a suite of fit-for-purpose comprehensive measures and procedures and take appropriate steps to enact an array of pertinent policies and institutions to mitigate and eliminate the adverse impact of the resource curse effect.

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