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Spatial-temporal Heterogeneity of the Contribution of Land to China's Economic Growth—An Empirical Analysis Based on Provincial Panel Data in the View of Resource Curse

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Abstract: In this paper, considering the resource value theory system into land resource abundance index, we use the time dynamic panel data model and the spatial recursive panel data model to analyze the spatial-temporal heterogeneity of the contribution of land to China's economic growth based on provincial panel data in the view of resource curse. Furthermore, the "blessing" and "curse" of land resources that cause the land resource curse are calculated by size coefficients. The results show that, (1) the phenomenon of "resource curse" really exists on the time scale of China's land resources, whereas there is no "resource curse" phenomenon on spatial scale; (2) China's land resource curse mainly transmit through the urbanization rate, education investment, construction land resource abundance, fixed investment and abundance of cultivated land; (3) among the contribution of land to economic growth, 28.676% comes from the cultivated land resources' "Welfare" effect, and 71.324% from the abundance of land for construction of "curse" effect, i.e., construction land abundance relative influence degree is 2.48724 times of cultivated land.

Key words: land value; resource curse; transmission mechanism; time dynamic panel data model; spatial recursive panel data model; "blessing" and "curse"

JEL codes: H73, O13, R14

1. Introduction

It is well known, land is a scarce natural resource, and is the irreplaceable factor of production to social and economic development as well (Lu, 2007). For a long time, how to allocate resources efficiently and rationally and to promote sustainable economic development in a region, is one of the core issues in economic studies (Peng & Cao, 2009), and is also what the governments focus on. Implementing land policies is not only related to the use and protection of land resources, but also influent the sustainable development of national economy. Since the

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reform and opening up, the eastern coastal regions have achieved long-term economic growth albeit resources are relatively poor. In contrast in mid-west of China, where resources are relatively richer, economic grows slowly. Therefore, spatial differences have been presented in regional economy in varying degrees (National Bureau of Statistics research group, 2007). Furthermore, with the strategy of gradient dominant development, the original uneven pattern of regional economic development is widening among eastern, central and western regions. Especially in the current period of economic development and institutional transition, unbalanced regional economic development issues have become increasingly prominent (Dong, 2000). Regional economic development is a cyclic gradual process that is changing from non-equilibrium to equilibrium and then to the unbalanced development, but its ultimate goal is balanced, recycling, and sustainable development. And now, the government decides to promote the construction of ecological civilization, implement the coordinated regional development strategy, and give full play to the comparative advantages of each district, indicating that China's economic development strategy will shift from unbalanced development to balanced development.

With the constraint of resource, balanced economic growth and sustainable development have an important theoretical and practical significance in the Chinese economy (Fang et al., 2008). In this moment, reversing the situation of imbalances between different districts is particularly necessary (Wood & Berger, 1997). After using the tight land policy to control the national economy in 2003, which achieved a remarkable success, land policy has become an important part of national macro-control system (Zhang, 2007). To realize a balanced development of regional economy, using the macroeconomic policy rationally and harmonizing the relationship between regional economy and development resources are the keys. Generally, most classical economists believe that rich natural resources benefit economic development (Adam, 1776; Malthus, 1798; David, 1957). However, since the mid-20th century, an interesting economic phenomenon has been discovered that the economic growth became stagnation or stayed negative in many resource-rich countries. To describe this phenomenon, Auty (1993, 1999) proposed the concept of "resource curse" in 1993 for the first time, and he thought under a certain condition, especially in the period of economic transition, abundant natural resources may be a curse rather than a blessing for economic development. Since then, numerous scholars confirmed the hypothesis of "resource curse" through all kinds of empirical analysis (Sachs et al., 1995, 1999 and 2001; Richard, Auty, 1999; Gylfason et al., 1999; Jerey, 2001; Papyrakis et al., 2004). Recently, both domestic and foreign experts have made varying degrees of progress in factor matrix, methodology, study area, and the object about the hypothesis of "resource curse" (Auty, 2007; Cheng, 2007; Liu et al., 2009; Liu, 2009; Pu, 2011). In details, the abundance index gradually tends to be diversify (Lee et al., 2011; John Boyce et al., 2011); methods become more complex, and mostly they based on panel data (Hotte, 2013; Lasse, 2013; Liu, 2014); the objects usually are focused on fixed non-renewable resource, like coal at first, then change to renewable resources whose abundances are more difficult to be measured (Tian et al., 2013; Liu, 2014); and the scale of study area transformed from the international scale to provincial and municipal, turning out to be a smaller one (Stella Tsani, 2013; Wen & Zhang, 2013).

"Resource curse", in essence, is a state of unsustainable development in regions where natural resource is rather rich (Li & Wang, 2010). With the uncoordinated problem of the balanced economic development between urban and rural areas becoming worse and worse, many researchers found the phenomenon of "resource curse" in China (Cheng, 1998; Liu et al., 2009; Wang, 2010; Xu et al., 2006; Shao et al., 2008, 2011, 2013). Meanwhile, most of the domestic researches focus on the point resources, like mine. In fact, as early as the nineteenth century, the classical economists stated land resources, may be a constraint to the growth of per capita GDP (Richard, 2007), Wood and Berger (1997) used the per capita arable land of resource as abundance indicator to test the existence of this hypothesis. So for the national condition of China, does the phenomenon of "resource curse" really exist in China's land resources? Is land resource a "curse" or "blessing" in the period of transition in China? How about the degree of "curse" and "well-being"? What is the spatial-temporal heterogeneity of the contribution of land to China's economic growth? How to achieve the balanced regional economic development through unbalanced development of land resource?

Considering the questions all above, we take the "resource curse" as our research perspective. On the basis of identification and accounting of resource abundance on land, we counted the abundance of land resource on the country's 31 provinces, selected the indicators related, and used time dynamic panel data model and spatial recursive panel data model to analyze the spatial-temporal heterogeneity of the contribution of land to China's economic growth. And we tried to find a path to achieve balanced economic development by allocating land resource, and to provide technical support to promote regional coordination and sustainable development.

2. Definition and Estimation of the Abundance of Land Resources

Resource abundance is the degree of enrichment of resources, and can be quantified by using individual indicators, or by a combination of some certain type resources' abundance (Cheng, 1998). Some researches take per capita of resource as the abundance index (Yang, 2008). In general, we believe that the more abundance natural resources are, the more value they produce, and thus, in some papers, the ratio of the output of resource and regional GDP is accounted as the abundance index (Shao et al., 2008). Some scholars incorporated the concept of entropy to measure the resource enrichment as well (Yao, 2011). Compared with quantity, the quality or the value of resource is what we more concern. What's more, considering the conflict between economic development and food security is rather fierce, beside the land resource abundance, we divided the land into two parts, namely construction land and cultivated land to make a further study. Thus, land resource is mainly divided into two parts, namely construction land and cultivated land, to reflect the conflict of economic development and food security. As a consequence, resource abundances we choose are arable land resource value of per unit area, construction land value of per unit area, and land resource abundance respectively, which is a combination of the both two abundance foregoing. All data come from "China region Statistical Yearbook from 1998 to 2012", "City Statistical Yearbook from 1998 to 2012", "China Rural Statistical Yearbook from 1998 to 2012" and some provincial statistical yearbooks.

2.1 Estimation of the Resource Abundance of Cultivated Land

Cultivated land is the most important land resource, and it is also the important natural capital in people's life and production. With reference to the economic evaluation of environmental projects in OECD, the total value of natural capital is composed by the direct use value (products which can be consumed directly, such as food, materials, entertainment, health, etc), indirect use value(functional benefit, such as ecological functions, protecting flood, etc.), option value (direct or indirect use values in the future, such as biodiversity), bequest value (a prospective value of reserved for future use value and use value for our posterities, such as habitat) and existence value (the value of understanding and existence sustainably, such as habitat, endangered species, etc.) (Xie et al., 2001). Based on the concept of ecosystem proposed by Tansley (1935), Costanza et al. (1997) further proposed "ecosystem services", namely refers that, ecosystem provides goods and services collectively, through its own structures, processes and functions. They thought natural assets contain many corresponding value of their ecosystem services, and they can be measured with the help of this concept in the field of ecological economics.

Finally, they successfully estimated the value of ecosystem services of global biosphere in 1997. Combing with the actual situation in China, Xie et al. (2003) revised the value of global ecosystem services of Costanza, on the basis of more than 200 questionnaires of scholars in ecology, and worked out China's ecological equivalent factor table of per unit area of ecosystem service value in terrestrial, where the value of ecosystem services of farmland equivalent is shown in Table 1.

Table 1 Per Unit Area of Farmland's Ecosystem Service Value in Chinese Terrestrial

Service Function	Air Regulation	Climate regulation	Water conservation	Soil formation and erosion control	Waste disposal	Biological diversity	Food	Raw materials	Recreation and culture
Farmland	0.5	0.89	0.6	1.46	1.64	0.71	1	0.1	0.01

The value of ecosystem services ecosystem equivalency factor, defined as how much 1 hm^2 farmland can product natural food every year in average, is the relative contribution of the potential ability of ecosystems to produce the ecological services, which means the weighting factor table above can be converted into an ecosystem services price tables. After a comprehensive comparative analysis, Xie et al. presented per economic value of ecosystem services equivalent factor was equal to 1/7 of the market value of the whole country's grain yields in average. Due to cultivated land includes irrigation of arable land, dry land, and vegetable plot, its output value is not only the grain production, but also all the value of crops planted on the surface of all arable land that should be included. Since what we concern is the differences in the level of inter-provincial in this study, we define the value of ecosystem services equivalent factor is equal to the 1/7 of market value of each district grain yields in average. Usually, the greater the biomass, the stronger the function of ecosystem services, therefore scholars used to assume there is a linear relationship between biomass and the use of ecosystem services. Because the per capita arable land is an important indicator of the scarcity of arable land resources in an area, this paper assumes there is a linear relationship between the per capita arable land and biomass. In other words, there is a linear relationship between the intensity of ecological services of area land and per capita arable land. Therefore, in this paper, we use the ratio of the per capita arable land area in region and that in national to correct the farmland ecosystem services price, and the corrected price is the resource abundance of cultivated land's ecosystem services, which is shown in Equation 1.

$$E(g)_{it} = (rd_{it} / RD_t)P_{it} \tag{1}$$

Where E (g) is referred to the corrected value of per unit area land's ecosystem services in different years and in different areas' land, namely, the abundance of arable land resources in different regions and in different time; i = 1, 2, · · · · · · 31, which represents the 31 provinces in China; t = 1997, 1998, · · · · · · 2011, which expressed in different years from1997 to 2011; P_{it} is the standard price of arable land ecosystem service in different years and different district which scaled according to Table 1; rd_{it} represents capita arable land in i district and in t year; RD_t denotes the per capita arable land in the country.

2.2 Estimation of the Resource Abundance of Construction Land

Generally speaking, the ecological value of construction land is 0 (Ouyang et al., 1999), for we always focus on natural ecosystems. Some scholars, however, insist on that there still exist ecosystem service value of construction land (Dong et al., 2006). Since the purpose of this paper is to explore the spatial-temporal relationship of land resources and economic development, the resource abundance of arable land is mainly characterized by the ecosystem services of land, on the other hand, construction land abundance here mainly emphases the economic value of land resources. Hua Wen et al. (2005) thought in the traditional value assessment of land, only the market trading value is assessed, and the cost-effective of land is not considered, causing serious external effects of land use. And they used the market valuation method to estimate the whole value of the different types of construction land respectively. With the development of construction land, we think, the development of commerce, industry and other service sectors have been developing rapidly, thus the economic value of land is far more than the price of the construction land. According to the idea of Hua Wen, the value of the different types of construction land of each district is calculated in different ways in this paper. In order to obtain data more easily, we regard the output value of unit area construction land used for commerce, industry and other service industries as the construction land abundance, which is shown in Equation 2.

$$E(b)_{it} = GDP_{it}^{2,3} \big/ m_{it} \tag{2}$$

Where E(b) corresponds to the construction land resource abundance at different time in different regions; i = 1, 2, · · · · · · 31, representatives of 31 provinces in China; t = 1997, 1998, · · · · · · 2011, represents different years from 1997 to 2011, $GDP_{it}^{2,3}$ means the output of commerce, industry and other service industries of i region in t year; m_{it} represents the construction area of i region in t year.

2.3 Estimation of the Land Resource Abundance

To get the total value of the land resource, we let the two individual resource abundance, namely the abundance of construction land and the abundance of cultivated land resource, multiply their respective area. And then we use the total value of land resource divide the area of each administrative regions, in this way, we get the total land resource abundance, as it shown in Equation 3.

$$E(t)_{it} = \frac{E(g)_{it} \times a_{it} + E(b)_{it} \times m_{it}}{A_i} \tag{3}$$

3. Methodology

3.1 Models

The degree of balanced economic development is described with the per capita GDP in this paper, assuming that if the per capita GDP is negatively correlated with the resource abundance. It indicates the phenomenon of "resource curse" really exists, and vice versa, land resource is not a "blessing" but a "curse" for the economic development of one region. At the same time, some kinds of factors that affect regional economic development will be added to control this model. And a panel data model is used to better reflect the time and cross-sectional characteristics. The basic model is as follows:

$$y_{i,t} = \partial_0 + \partial_1 E(t)_{i,t} + \partial_2 E(g)_{i,t} + \partial_3 E(b)_{i,t} + \partial_4 Z_{i,t} + \varepsilon_{i,t} \qquad \text{(Model 1)}$$

Where $y_{i,t}$ represents the per capita GDP in each region; i is corresponding the cross-sectional data of each province; t represents the year; $Z_{i,}$ represents the control indicators. Model 1 is called static panel data model, and in this model, the error term is independent and identically distributed. A lot of theory analysis and empirical studies, however, show that there is a time autocorrelation and spatial autocorrelation in economic growth with different time scales and different spatial scales (Liu, 2009).

In this paper, drawing on the idea of Liu Hongmei, we add the first ordered-lag variable of "y" in the model 1 to reflect the time lag effects of dependent variable itself in time scales. Thus we get time dynamic panel data model like this:

$$y_{i,t} = \partial_0 + \partial_1 E(t)_{i,t} + \partial_2 E(g)_{i,t} + \partial_3 E(b)_{i,t} + \partial_4 Z_{i,t} + \partial_5 y_{i,t-1} + \varepsilon_{i,t} \qquad \text{(Model 2)}$$

Anselin (1999) hold the view that when spatial dependence exists in the substantive variables, the spatial lag variables must be treated as endogenous variables, otherwise, the estimate of OLS would be inconsistent. For this reason, spatial econometrics is needed to explain the relationship between variables (You & Wu, 2010). Similarly, the first-order lagged dependent variable is introduced in model 1 to explain the spatial correlation of the dependent variable itself. As a result, the spatial panel data model is defined as Model 3.

$$y_{i,t} = \partial_0 + \partial_1 E(t)_{i,t} + \partial_2 E(g)_{i,t} + \partial_3 E(b)_{i,t} + \partial_4 Z_{i,t} + \rho W y_{i-1,t} + \varepsilon_{i,t} \qquad \text{(Model 3)}$$

In model 3, ρ means the spatial autocorrelation coefficient; *W* represents the spatial weight matrix, if the two regions is adjacent (excluding itself), we think the "resource curse" may have a mutual influence between the two regions, denoting 1. On the contrary, it will be denoted by 0; $y_{i-1,t}$ is the spatial lag variables, which, in fact, is the per capita GDP of other regions in t year.

3.2 The Selection and Description of Variables

The degree of market development reflects the relationship of market supply and demand, and the high degree of market development is good for its economy to achieve balanced economic development. So we choose the value of annual wholesale and retail (shich) to indicate the degree of market development, which is positive with the degree of market development. With the increasing levels of urbanization, coordinating population and economic development is particularly important, so the urbanization rate (ch) is selected. A country's fiscal revenue is an important indicator of government finance, and the quality and quantity of public goods and services that the government can supply is largely determined by the revenue. Thus we use the proportion of the local fiscal revenue to GDP, namely a region's average yield (i), to indicate institutional factors. The input of the economic investment in material and capital with a radio of the whole social investment and GDP (gt). The ratio of the output of secondary and tertiary industries to GDP (dj) is selected to describe the structure of regional industry, which is also an important criterion to measure the balanced economic development in the period of economic transition. The talent to college education in the proportion of the number of total employment is used to measure the investment in human capital (edu). Usually, the more investment in education, the more skilled labor produced efficiently, thus the greater role in promoting economic development.

Put these factors above into model 2, and then we get the specific time dynamic panel data model in this paper:

$$\begin{aligned} y_{i,t} &= \partial_0 + \partial_1 E(t)_{i,t} + \partial_2 E(g)_{i,t} + \partial_3 E(b)_{i,t} + \partial_4 shich_{i,t} + \partial_5 ch_{i,t} \\ &+ \partial_6 i_{i,t} + \partial_7 gt_{i,t} + \partial_8 dj_{i,t} + \partial_9 edu_{i,t} + \partial_{10} y_{i,t-1} + \varepsilon_{i,t} \end{aligned} \qquad \text{(Model 4)}$$

Similarly, adding them into the model 3, we get the specific recursive panel data model of this article:

$$\begin{aligned} y_{i,t} &= \partial_0 + \partial_1 E(t)_{i,t} + \partial_2 E(g)_{i,t} + \partial_3 E(b)_{i,t} + \partial_4 shich_{i,t} + \partial_5 ch_{i,t} \\ &+ \partial_6 i_{i,t} + \partial_7 gt_{i,t} + \partial_8 dj_{i,t} + \partial_9 edu_{i,t} + \rho W y_{i-1,t} + \varepsilon_{i,t} \end{aligned} \qquad \text{(Model 5)}$$

∂_1、∂_2、∂_3, in this two models, are the coefficients, which measure "resource curse" effects of the land resources, farmland resources, construction land respectively existing or not. And the greater the absolute value, the greater the corresponding effects.

4. The Empirical Analysis of Land Resources

4.1 The Test and Results of the Time Dynamic Panel Data Model

We use time dynamic panel data model to test the time effect of "resource curse" in land resource of China. After the panel unit root test and co-integration test for individual variables, we use the two-stage GMM method to estimate parameters. Adding each of the control variables one by one to model 4, we get nine regression equations, and the results in detail is shown in Table 2. What we can see in Table 2 is that the value of P of Sarga test for each corresponding regression equation is greater than 5% significance level, that is to say, they cannot refuse the null hypothesis of GMM estimates that "it's correct to over-constrained models", and the model estimation is rather accurate.

Table 2 The Results of the Time Lag Effects in Land Resource Curse with Time Dynamic Panel Data Model (GMM)

	Eq11	Eq12	Eq13	Eq14	Eq15	Eq16	Eq17	Eq18	Eq19
α_1 (E(t))	-0.004583 (0.000000)***	-0.002623 (0.000000)***	-0.002501 (0.000000)***	-0.002548 (0.000000)***	-0.001875 (0.000000)***	-0.002184 (0.000000)***	-0.002532 (0.000000)***	-0.002076 (0.0055)***	-0.003063 (0.0238)*
α_2 (E(g))		0.069774 (0.000000)***	0.056851 (0.000000)***	0.056315 (0.000000)***	0.058315 (0.000000)***	0.048231 (0.000000)***	0.063180 (0.325508)	0.052339 (0.000000)***	0.058001 (0.0004)***
α_3 (E(b)			0.000148 (0.000000)***	0.000144 (0.000000)***	0.000112 (0.000000)***	1.07E-05 (0.7740)	2.83E-05 (0.4965)	0.000208 (0.0047)***	0.000422 (0.0055)***
α_4 (shich)				0.041032 (0.6104)	0.362286 (0.0001)***	0.662081 (0.0137)**	0.476201 (0.2390)	1.109941 (0.0563)	0.859203 (0.3507)
α_5 (ch)					4696.011 (0.0418)*	5157.597 (0.000000)***	5807.202 (0.000000)***	7825.580 (0.000000)***	4022.594 (0.0105)**
α_6 (i)						32761.02 (0.000000)***	38939.40 (0.000000)***	77347.72 (0.000000)***	59517.40 (0.0001)***
α_7 (gt)							-1851.759 (0.0018)***	-2554.297 (0.0734)	-3791.271 (0.0246)*
α_8 (dj)								-22569.92 (0.000000)***	-20820.60 (0.000000)***
α_9 (edu)									65784.78 (0.000000)***
α_{10} y(-1)	1.194569 (0.000000)***	1.132208 (0.000000)***	1.104716 (0.000000)***	1.104370 (0.000000)***	1.059331 (0.000000)***	1.033716 (0.000000)***	1.036530 (0.000000)***	0.957912 (0.000000)***	0.879300 (0.000000)***
Sarga inspection	0.461311	0.382630	0.376048	0.302243	0.309808	0.255140	0.2554200	0.329888	0.432317
sample volume	465	465	465	465	465	465	465	465	465

Note: The instrumental variables is used as the dependent variable second moment, in parentheses is the value of P, *** on behalf of P < 0.01, ** on behalf of P < 0.05.

When there is only land resource abundance variable *tf*, per capita GDP and the land resource abundance correlate very significant negatively, and the correlation coefficient is 0.004583, as shown in Eq11 (Table 2). We think it doesn't have a strong persuasiveness to be a single indicator of the presence of land resources to test this phenomenon of "resource curse", and the correlation coefficient is not big enough to conclude China's land resources exists "resource curse". And therefore, other variables need to be considered to test there still have a negative correlation between the abundance of land resources and per capita GDP.

To further distinguish the contribution of arable land resources and construction land to the economic development in a region, the abundance of arable land resources "gf" and the abundance of construction land "jf" were added to Eq12 and Eq13 respectively. According to Table 2, after adding the resource abundance indicators, we can see the abundance of arable land resources has positive effect on the regional economy, which is very significant with the coefficient of 0.056851. And the abundance of land resource is still very significant negative correlating per capita GDP, but with the influence of arable land resource, their value of correlation coefficient is reducing (becomes 0.002623). Similarly, when we added the abundance indicator of construction land in Eq13, the correlation between the abundance of construction land and regional economies is very significantly positive (0.000148), while the correlation between land resources and per capita GDP is keeping very significant negative (-0.002501).

After adding the amount of wholesale and retail trade (shich) to model 4, we have got the regression equation Eq14. The degree of market development in the region has a positive effect on economic development (0.041032), but the coefficient does not pass inspection. And the abundance of land resource (tf) remained negative (-0.002548), and the relationship with per capita GDP is very significantly negative. At the same time, the abundance of farmland and construction land resource remains a very significant positive effect on economic development, and the corresponding coefficients are 0.056315 and 0.000112.

After adding urbanization rate variable (ch), regression equation Eq15 has appeared. Shown by Table 2, the rate of urbanization has a significant positive effect on economic development with the correlation coefficient 4696.011, which has been greatly promoting the economic development. After joining the urbanization rate, the market also played a significant positive effect. With the effects of urbanization rate and degree of market development, the coefficient of the abundance of land resource is still negative, but the absolute value becomes decreased (0.001875). The abundance of cultivated land and construction land maintain a very significant positive effect on economic development.

It can be seen from Eq16 in Table 2 that after adding variables (i), the increase of revenue could improve the level of economic development. And the degree of market development also has a significant impact on the economic development. Stilly, there shows a significant negative correlation (-0.002184) between the abundance of land resources and economic development. The abundance of farmland and construction land resource also positively correlated with economic development, but the coefficient of construction land abundance did not pass the parameter test.

Eq17 in Table 2 shows the result of adding the ratio of fixed investment to GDP (gt). The corresponding coefficients of abundance of arable land resources, construction land and the degree of market development are all positive, but they all failed the test. The abundance of land resource remained significant negative effect (-0.002532) on economic development, and the negative correlation between social fixed investment and economic development is in general.

According to the result of Eq18 in Table 2, after adding economic transformation variables (dj), we can see the economic restructuring variable is significant negative correlated with economic development, while the abundance of arable land and construction land have a significant positive effect on economic development, and the rate of urbanization and fiscal revenue also have a significant positive impact on economic growth. The abundance of land resource and economic development remain a significant negative correlation, but with the effect of "dj", the absolute value of the corresponding coefficient is reducing (becomes 0.002076). At the same time, social investment and economic development still maintain a negative correlation, but the corresponding coefficients do not pass the 5% of significance test.

The last column in Table 2 is Eq19, which is the regression result of adding the jobs talent variables (edu). This result turns out that the effective investment in human capital is the key in stimulating economic development in the theory of economic growth. The correlation coefficient of the abundance of land resource is still negative significantly, with fluctuating slightly (-0.003063). There is still very significant positive correlation with the abundance of arable land resource and construction land to economic development. And the relationship between other variables and the economic development does not change compared with that in Eq18.

4.2 Spatial Recursive Panel Data Model and Test Results

Firstly, we use Moran'I index to test the per capita GDP, the dependent variable, then the result of Moran'I index is 0.31, and the value of statistic is 3.44. Because the marginal probability is tested to be 0.000581, they pass the test successfully. That is to say, the per capita GDP of each region is showing significant positive correlation and agglomeration effect in spatial for the correlation coefficient is 0.31. Besides, it also shows that the model is reasonable.

Based on the model 5, we use the spatial recursive panel data model to get nine regression equations. After considering the function of spatial autocorrelation into model, the result is totally different, compared with the result of time dynamic panel data model. The spatial lag coefficient (ρ) is positive in the nine equations, besides, indexes including the abundance of land resource, the abundance of arable land, the abundance of construction land, all show a positive correlation with the regional economic development. Furthermore, the abundances of land resources and construction land resource were significantly positively correlated with per capita GDP, while the abundance of arable land resources only passed the test of Eq22, Eq23 and Eq29. This results in Table 3 show that the phenomenon of land resource curse does not yet exist in the spatial scale.

Table 3 Effect of Land Resource Curse Recursive Spatial Panel Data Model Test Results

	Eq21	Eq22	Eq23	Eq24	Eq25	Eq26	Eq27	Eq28	Eq29
α_1 (E(t))	0.02213 (0.000000)***	0.02377 (0.000000)***	0.01644 (0.000000)***	0.01476 (0.000000)***	0.00812 (0.000000)***	0.00766 (0.000000)***	0.00771 (0.000000)***	0.00776 (0.000000)***	0.00591 0.000000)***
α_2 (E(g))		0.16532 (0.000149)***	0.08409 (0.035548)*	0.06013 (0.117580)	0.00361 (0.891526)	0.02911 (0.263619)	0.02704 (0.325508)	0.03447 (0.264249)	0.06201 (0.015998)*
α_3 (E(b))			0.00223 (0.000000)***	0.00193 (0.000000)***	0.00141 (0.000000)***	0.00114 (0.000000)***	0.00114 (0.000000)***	0.001113 (0.000000)***	0.00127 0.000000)***
α_4 (shich)				3.76499 (0.000000)***	3.01291 (0.000000)***	3.29854 (0.000000)***	3.33700 (0.000000)***	3.29258 (0.000000)***	3.99762 0.000000)***
α_5 (ch)					38050.70509 (0.000000)***	31912.15273 (0.000000)***	31903.98023 (0.000000)***	31574.02342 (0.000000)***	14230.55061 0.000000)***
α_6 (i)						74643.51289 (0.000000)***	73729.19865 (0.000000)***	75095.09859 (0.000000)***	-6073.73436 (0.635976)
α_7 (gt)							472.2749 (0.8139)	250.26916 (0.902889)	3414.827230 (0.046942)*
α_8 (dj)								1815.81331 (0.594994)	-4024.67068 (0.159930)
α_9 (edu)									118004.79177 (0.000000)***
ρ ($Wy_{i,t}$)	0.12632 (0.000000)***	0.11202 (0.000000)***	0.04506 (0.000002)***	0.03343 (0.000239)***	0.03446 (0.000000)***	0.03770 (0.000000)***	0.03702 (0.000000)***	0.03736 (0.000000)***	0.01857 (0.001278)***
R2	0.6718	0.6819	0.7405	0.7628	0.8881	0.8955	0.8956	0.8956	0.9284
Sigma^2	75519948.0165	73356029.4672	59963426.1345	54934138.2049	25976180.6896	24297599.0478	24347922.3180	24386265.9363	16768209.2022
sample volume	465	465	465	465	465	465	465	465	465

Note: we use maximum likelihood to estimate, what in parentheses is the value of P, ***denoted P < 0.01, ** denoted P < 0.05.

When the variables are only the space lag and the abundance of land resource, we may see spatial lag and the abundance of land resource positively correlated with per capita GDP, and the coefficient of the abundance of the land resource is 0.02213.

In Eq22 and Eq23, the coefficients are positive and all have passed the significant test. Under the action of the arable land abundance and the construction land abundance, the coefficient of the abundance of the land resource became decreased. In Eq22, with the influence of abundance of the arable land E(g), the abundance of land resources E(t) has increased slightly, indicating that cultivated land resources development has little positive effect on the economy in space scale. After adding construction land abundance index E(b) in Eq23, α_3 is positive and very significant, but α_1 and α_2 became less, showing that the abundance of land for construction has a positive role in promoting economic development, while, to some extent, has weakened the role of land resources and arable land resources to the development of economy.

α_4, the corresponding coefficient, is positive and very significant through the test in Eq24. α_1, α_2 and α_3 are still positive, but all of them have been reduced, which is showing that, to a certain extent, the degree of market development has a positive role in promoting economic development in space, and also weakens the role of land resources for economic development at the same time.

When we put urbanization rate variable (ch) into regression equation Eq25, we can see α_5 is also positive and significant. Comparing with Eq24, α_1, α_2 and α_3 are all positive like that in Eq24, and the difference between Eq24 and Eq25 is that α_1 and α_2 fell steeply, while α_3 fell only in a little which shows that the urbanization rate has a large positive role in promoting economic development in space, and can weaken the dependence of economic growth on land resources, especially arable land resources. Similarly, α_6, the coefficient of the variable of a percentage of local revenue and GDP (i) in Eq26, is positive and significant too. What's more, α_1, α_2 and α_3 are slightly reducing.

α_1, α_2 and α_3 all keep positive in both Eq27 and Eq28. But in Eq27, α_7 doesn't pass the significance test. By the same, the two coefficients, α_7 and α_8 in Eq28, are positive, but they can't pass the test of significance.

Finally, after adding variable named employment talent (edu), we have got Eq29, where coefficient α_9 is positive, and have a very significant positive correlation with the economic development. The coefficients, α_1, α_2 and α_3, are still positive, and all through the test of significance. Comparing with that in Eq28, α_1 becomes greatly reduced, while α_2 and α_3 increase slightly. Namely, the employment talent has a significantly positive role in promoting economic development in space, and can strengthen the positive role of arable land resources and construction land resource in promoting economic development.

In summary, in the time scale, the phenomenon of the land resource curse really exists, but the effect on the economic development of the coefficients is small; while on the spatial scale, there does not yet exist "land resource curse", where the land resource abundance, abundance of arable land and the construction land resource abundance all have a positive correlation with economic development.

5. Transmission Mechanism Analysis of Land Resources Curse

5.1 Pathway Analysis

The relationship between the land resource curse variable and corresponding substitution can reflect the transmission mechanism of resource curse (Papyrakis & Gerlagh, 2007; Shao & Qi, 2008; Liu et al., 2009; Wen & Zhang, 2013). From these literatures, we use the index of land resource abundance as the dependent variable, setting up linear regression equation. Taking into account that some parameters did not pass the significance test in the time of the dynamic panel data model (Model 4) and spatial recursive panel data model (Model 5), we choose variables into our regression model that both passed significant test in Model 4 and Model 5. Finally, the variables we choose are urbanization rate (ch), fixed investment (gt), college employment ratio (edu), construction land resource abundance (E(b)), as well as the abundance of arable land resources (E(g)).The regression model is as follows :

$$E(t) = \beta_0 + \beta_1 ch_{i,t} + \beta_2 gt_{i,t} + \beta_3 edu_{i,t} + \beta_4 E(b)_{i,t} + \beta_5 E(g)_{i,t} + \mu_{i,t} \quad \text{(Model 6)}$$

Based on the Model 6, by using the panel data between 1997 and 2011, the results of normalized regression are shown in Table 4. As we can see from Table 4, the model has pass the F test, with the value of F is 90.44, and (Pr > F) < 0.0001. All the variables selected through the 0.05 significance level test, and among the corresponding coefficients, only β_2 and β_5 are negative, the others are significantly positive.

Table 4 The Transmission Mechanism of Land Resources Curse Effect Test Results

	T Value	Pr > |t|	Standardized Estimate
β_0	0.83	0.4055	0
β_1 (ch)	2.19	0.0293	0.12989
β_2 (gt)	-6.48	< 0.0001	-0.24838
β_3 (edu)	3.90	0.0001	0.24204
β_4 (E(b))	10.79	< 0.0001	0.46286
β_5 (E(g))	-5.91	< 0.0001	-0.24130
Model	F = 90.44，（Pr > F）< .0001		

According to Table 4, the negative effect of the land resources curse on the economic development plays a role by reducing investment in fixed assets (with the coefficient is -0.24838) and the abundance of arable land resources (with the coefficient is -0.24130). Especially after the reform and opening, the secondary and tertiary industries get a lot of development, while the development of the first industry is relatively slow, whose socio-economic status is also declining. Meanwhile, with the expansion of urbanization, the raising of urbanization rate, the increasing of high intellectual talent employment, and the great agglomeration effect of industry, a large amount of cultivated land force to convert to construction land. And the more construction land, the more economic benefits, which makes the cultivated land resource endowment shrinking and the value of the cultivated land cannot be reflected in economic development. As a result, the land resource curse emerged in the scale of time.

5.2 Measurement of the "Curse" and "Blessing" of Land Resources

In order to further discuss the contribution of construction land abundance and abundance of arable land resources in land resource curse, the path coefficients of construction land abundance and arable land abundance are used to analyze the relative influence of construction land and farmland to the total land recourse. According to the definition of the path coefficients, we know they, in fact, the path coefficients are the standardized regression coefficients of the independent variable, namely the coefficient β in Table 4. For example, β_4, the standardized coefficient of construction land in Model 6, is the direct path effect of construction land abundance to the total land recourse abundance. Indirect path coefficients of A through B, is the arithmetic product of the simple correlation coefficient of A and B and the direct path coefficient of B. So that we mark the simple correlation coefficient of the abundance of construction land to other indicators as γ_i, and mark the simple correlation coefficient of the arable land abundance to other indicators as γ_j in this study. Namely, the indirect effect of construction land abundance refers to the effect that the construction land to the abundance of land resources through the other variables in the regression (ch, gt, edu, E (b)), and the corresponding formula is $\gamma_i\beta_i$. The overall effect of construction land to the total land is the sum of the direct path coefficient and all the indirect path coefficients, which can be expressed as $\eta_{E(b)} = \sum_i \gamma_i \beta_i$. Similarly, the indirect effects of arable land to total land is equal to $\gamma_j\beta_j$, and it's overall effect is expressed as $\eta_{E(g)} = \sum_j \gamma_j \beta_j$. The results are in Table 5.

According to Table 5, the influence of construction land abundance to abundance of total land resources is 0.43741, and the influence of arable land resource abundance to the total resource abundance is -0.17586. Absolute the both two value, so the relative degree of influence that construction land abundance on land resource abundance ($\theta_{E(b)}$) is the ratio of the absolute influence of construction land abundance on the sum of these two absolute value, which is calculated as 0.71324 (in Table 5). In the same way, the relative abundance of arable degree of influence ($\theta_{E(g)}$) worked out is 0.28676 (in Table 5). Defining that the degree of "blessing" is the relative influence degree of indicators that are negatively correlated with land resource abundance, and the extent of "curse" is the relative influence of indicators that are positively correlated with land resource abundance. Therefore, the degree of "well-being" is 0.28676, and the extent of "curse" is 0.71324. Namely, in the whole resource curse effect of land resource to economic development, there is 28.676% comes from arable land resources' "welfare", and 71.324% comes from construction land's "curse" effect. Indeed, the relative influence of construction land is 2.48724 times to that of arable land, in other words, the abundance of construction land is the main force to promote phenomenon of land resource curse.

Table 5 Pathway Impact Analysis

Pathway	(E(b))γ_i	(E(g))γ_j	β	η	θ
ch	0.49194	0.14369	0.12989		
gt	0.51108	0.46532	-0.24838		
edu	0.51108	-0.01163	0.24204		
E(b)	1	0.35684	0.46286	0.43741	0.71324
E(g)	0.35684	1	-0.24130	-0.17586	0.28676

6. Conclusions and Policy Implications

6.1 The Main Conclusions

By using the value of ecosystem services system of Costanza and the value of ecosystem services equivalent that Xie et al. estimated, we calculated the ecosystem services value of arable land resource, measured the abundance of land resources with the theory of resource value, and tested the phenomenon of land resource curse both in spatial and time scales. Furthermore, we analyzed the transmission mechanism, and according to the results, we got the following conclusions:

(1) Using per unit area of land value as the abundance of resources, we prove that the phenomenon of "land resource curse" really exists on the scale of time, but it does not exist on the spatial scale. This conclusion reflects that "resource curse" is a stage of economic phenomena, which is consistent with the "resource curse" theory that Auty proposed. In time dynamic panel data model, the total land resource abundance negatively correlates with economic development, while construction land abundance and arable land resource abundance relate to economic development positively with just little functions; However, in recursive spatial panel data model, the overall abundance of land resource, construction land abundance and abundance of arable land all positively correlated with economic development.

(2) Through the transmission mechanism analysis, we may conclude that the land resource curse mainly transmits through several indicators, such as urbanization rate (ch), college employment ratio (edu), construction land resource abundance (E(b)), fixed investment (gt) and the abundance of arable land resources (E(g)).

Reducing the social fixed investment and the abundance of arable land resources would increase the negative effect of land resource curse on economic development. While increasing the rate of urbanization, college employment ratio, abundance of construction land, will bring about the increasing of land resource abundance, which can exacerbate the negative effects of land resource on economic development.

(3) According to the path analysis of conduction land abundance and the abundance of arable land, the curse effect has been estimated. In the total land resources curse effect, 28.676% is the "welfare" coming from arable land resources, and 71.324% is "curse" effect coming from construction land. In addition, the latter is 2.48724 times to the former.

6.2 Discussions and Suggestions

Nowadays, in terms of the definition of resource abundance, the existing literatures usually describe it as the stock of resource (in quantity), or the contribution of resource to industry in economy, but the valuation of resources was seldom mentioned. However, as one of the most important public goods and strategic resources, the value endowment of land resource, especially the externality value of land resource, is the key to measure the value of land resources correctly and scientifically. The value of land resources abundance is an innovation in this paper, but the value of construction land mainly represents it's economic value, and it's externalities have not yet been considered, for the data is not easy to get. So we just select an alternative variable substitution here, and that couldn't guarantee the estimation is accurate enough.

Through the examination of land resource curse, we can find the spatial-temporal heterogeneity of land resource curse clearly. Since the land resource curse phenomenon exists only in the time scale, the key to get rid of "curse" is making full use of the space correlation among regions to strengthen the coordination of regional land resources and balanced development of economy. Indeed, in order to reach the target of "flat equilibrium" in space (Fujita Chang, 2013), forming a continuous space multiple regions by concentration of industry and population, we should use "space for time" strategy for the regional economic development.

According to the degree of "curse" and "welfare" we measured, we conclude that the abundance of land resource is mainly influenced by construction land abundance ("curse" level is 2.49 times the level of "blessing"). This moment, the economic value of construction land can promote economic development largely, and can lead to the land resource curse as well in the scale of time, making the real value of a large number of land resource do not be realized. Therefore, protecting the farmland resources, and enhancing the value of arable land, especially the value of positive externality, is the must to achieve the path of reform to land resources and the balanced development of the economy in future.

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