Natural Resources and Economic Development in the Western Regions of China

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Abstract. This paper examines the impact of natural resources on economic development in western China. The provincial panel data from 2005 to 2016 were analyzed using time series analysis and fixed effect regression models. It reveals the correlation between natural resources and economic development in the western region. The results show that water resources, cultivated land resources, natural resource reserves and natural resource development are positively related to economic development; forest resources are negatively correlated with economic development. Studies have shown that water resources, cultivated land resources, natural resource reserves and natural resource development have played a certain role in promoting economic development in the western region, while forest resources have hindered economic development in the western region.

1. Introduction
As the main source of human means of production and living, resources are the important material basis for human survival and social development. With the rapid development of social economy, the consumption of resources is increasing, especially in the western region of China, where resources and energy are the main material basis for development.

Different scholar has different opinions about the question as to how the natural sources have effected economic development. Rostow and Murphy believe that natural resources have a significant role in promoting economic growth[1]. The Prebisch-Singh Hypothesis suggests that more poverty occurs in the countries with bountiful natural resources, according to the theory of comparative advantage[2]. In 1977, The Economist magazine puts forward the proposition of "Dutch Disease" to explain the phenomenon that the economic recession of the country was caused by the enormous benefits of abundant natural resources[3]. Auty had the "resource curse" hypothesis in 1993, which means that region rich in natural resources has not achieved the expected economic growth, on the contrary, resource-poor areas have achieved faster economic growth than resource-rich areas[4]. In 1995, Sachs and Warner found that natural resource endowment negatively correlated with economic growth rate when investment rate and trade policy were controlled[5]. In 2004, Papyrakis and Gerlagh pointed out that there are two kinds of effects between natural resources and economic growth. On the one hand, there is a positive direct effect between the two, on the other one hand, there are also negative indirect effects. The "resource curse" hypothesis is only true when the negative effects outweigh the positive ones[6]. In 2007, Arezki and Ploeg proved that natural resource exports of one nation may hinder the growth of per capita income after its openness and system are controlled. In the
meanwhile, the lower the degree of openness, the more likely a country is to produce a "resource curse"[7]. Though the research on 130 countries' export data, Collier and Goderis arrived at the conclusion that the resource curse does exist[8].

This article examines influence of the natural resources on economic development in the western region of China, digging deeper into the major driving factors for economic development. Based on quantitative analysis, it reveals relationships between natural resources and economic development.

2. Data and methodology

2.1 Data

This paper chooses the water resources, forest resources, cultivated land resources, mineral resources and per capital fixed assets investment of 12 provinces in the western region from 2005 to 2016 as the proxy indicators of natural resources, and takes the development and livelihood index (DLI) as the proxy indicators of economic development level to analyze the relationship between natural resources and economic development.

2.2 Indicator construction and method selection

2.2.1 Indicator construction

Independent variables include water resources, forest resources, cultivated land resources, natural resources reserves and natural resources development. The proxy indicators select the hydroelectric power output, the forestry output value, the agricultural output value and the coal reserves converted from crude oil and natural gas in a certain proportion, and the average per capital investment in fixed assets. The control variables include the stock of human capital, institutional quality, material capital investment, the development of manufacturing industry, the level of openness and technological innovation. The direct source of human capital is education, so in the measurement of human capital investment, we first focus on education. It uses the proportion of education investment in GDP of each province to measure. Governance structure and legal system are almost identical among provincial regions in China, and there is no systematic index to measure the competitiveness of each provincial government. Therefore, this paper takes the entrepreneur activity index as the index to measure the system. It uses the number of private enterprise investors and individual investors to calculate the entrepreneur activity index. The purpose of the development of manufacturing industry is to test whether the Dutch disease effect exists at the provincial level in China. This paper chooses the ratio of industrial added value to GDP to represent the development of manufacturing industry. Material capital investment is expressed by the ratio of fixed assets investment to GDP in each province. The opening level is expressed by the proportion of import and export trade to GDP; the level of technological innovation is selected as the proxy variable to measure. The selection of specific indicators is as follows:

Table 1. Variable and index.

| Symbolic | variable implicature | index |
|----------|----------------------|-------|
| Y1       | Western provinces' economic Development (DLI) | Development and people's Livelihood Index |
| X1       | Per GDP in each province | GDP/cap |
| X21      | Water resources (W) | Hydropower output per Province |
| X22      | Forest resources (T) | Province's forestry output value |
| X23      | Land (L) | Agricultural output of cultivated |
| X24      | Natural Resources Reserve (RR) | Provincial Resources Reserve = Crude Oil Reserve * 1.43 + Natural Gas Reserve * 1.33/1000 + Raw Coal Production * 0.714 |
X25 Natural Resources Development (RD) Per Capital Energy Fixed Asset Investment = Provincial Annual Energy Fixed Asset Investment / Year-end Permanent Population

X3 Human capital stock (RC) Education investment in each province / Province GDP

X4 Institutional Variable (SY) Entrepreneurial Activity Index = (Employment of Private Enterprise Investors + Employment of Individual Investors) / Year-end Permanent Population

X5 Manufacturing industry development status (MI) Industrial added value of provinces / provinces GDP

X6 Material capital input (MC) Total social fixed assets investment in provinces / provinces GDP

X7 Opening level (OPE) Import and export volume of provinces / provinces GDP

X8 Level of Scientific and Technological Innovation (ST) Patent Technology Applications per 10000 People = Provincial Patent Technology Applications / Resident Population at the End of the Year * 10000

2.2.2 Method selection
In this paper, the regression model is used to analyze the economic development and natural resources of the western region. The regression model is set up as follows:

\[ Y_t = \alpha_0 + \alpha_1 \times \frac{GDP_t}{CPA} + \alpha_2 \times NR_t + \alpha_3 \times Z_t \]

\[ Y_t \] is a measure of economic development, DLI as a proxy indicator, \( \frac{GDP_t}{CPA} \) on behalf of per capita GDP, \( NP_t \) on behalf of natural resources, \( Z_t \) on behalf of other control variables. The impact of natural resource endowment on economic development is clarified through the solution of \( \alpha_2 \).

2.3 Empirical test of the relationship between natural resources and economic development

2.3.1 Descriptive statistics
Based on the last 12 years panel data of 12 provinces, the relationship between natural resources and economic development is verified by descriptive statistical analysis using relevant software.

Table 2. Statistical description of natural resources and economic development.

| Symbolic | variable implication | Mean   | Std. Dev. | Maximum | Minimum | Observations |
|----------|----------------------|--------|-----------|---------|---------|--------------|
| Y1       | Western provinces' economic development (DLI) | 52.29  | 9.66      | 79.26   | 35.22   | 144          |
| X1       | Per capita GDP in each province          | 25956.75 | 14457.75 | 71936.9 | 5305.79 | 144          |
| X21      | Water resources (W)                      | 459.96 | 607.88    | 3061.25 | 11.18   | 144          |
| X22      | Forest resources (T)                     | 240.8  | 2039.54   | 24526   | 1.75    | 144          |
| X23      | Land Resources (L)                       | 930.83 | 764.6     | 3710.97 | 25.48   | 144          |
| X24      | Natural Resources Reserve (RR)           | 13286.06 | 22352.93 | 86088.04 | 0.07    | 144          |
| X25      | Natural Resources Development            | 0.32   | 0.28      | 1.27    | 0.04    | 144          |
The table shows that the per capita GDP of the western region is quite different. The average value of DLI is 52.29 and the standard deviation is 9.66, which indicates that there is a big difference in the level of economic development. In the meanwhile, the average resource development is 0.32 and the standard deviation is 0.28. It indicates that the distribution of natural resources is uneven and resource utilization is quite different.

The scatter plot of natural resources and Development Livelihood Index (DLI) is made.

![Correlation between water resources and economic development](image1)
![Correlation between forest resources and economic development](image2)
![Correlation between cultivated land resources and economic development](image3)

Figure 1. Correlation between natural resources and economic development.

This shows that the water resources, cultivated land resources, natural resources reserves and natural resources development are positively correlated with the economic development, but in the meanwhile forest resources is passively correlated with the economic development.
2.3.2 Stationarity and cointegration test
In order to ensure the reliability of statistical analysis results, we carry out LLC test and KAO test on all variables to determine the stability among variables.

The result indicates that all variables LLC test P values are less than 1, so we can judge that the explanatory variables are stationary, that is, the panel data is stationary.

The KAO test shows that the P value is less than 0.01 to denote long-term equipoise among variables.

2.3.3 Model selection
According to the panel data, natural resources and control variables are examined using Hausman and Likelihood Ratio. The main result is that the P value of both tests is less than 1, and the smaller is P value of Likelihood Ratio test, the more is stability. So the fixed effect model is selected to do regression analysis on natural resources and economic development.

2.3.4 Model regression result

| equation | C | GDP/cap | resource | RC | SY | MI | MC | OPE | ST | R-squared | Adjusted R-squared |
|----------|---|---------|----------|----|----|----|----|-----|----|-----------|-------------------|
| 1        | 0.62 | 0.33 |       | 0.97 | 0.96 |
| 10.48 | 55.86 | 0.00 | 0.00 |
| 21 | 0.79 | 0.28 | 0.06 | 0.98 | 0.97 |
| 13.36 | 29.71 | 6.15 | 0.00 | 0.00 |
| 22 | 0.59 | 0.34 | -0.01 | 0.97 | 0.97 |
| 9.23 | 44.66 | -1.27 | 0.00 | 0.21 |
| 23 | 0.91 | 0.23 | 0.11 | 0.97 | 0.97 |
| 9.89 | 8.95 | 3.95 | 0.00 | 0.00 |
| 24 | 0.64 | 0.33 | 0.00 | 0.97 | 0.97 |
| 10.83 | 54.28 | 2.16 | 0.00 | 0.03 |
| 25 | 1.03 | 0.30 | 0.04 | 0.97 | 0.97 |
| 7.09 | 22.79 | 3.06 | 0.00 | 0.00 |
| 3 | 1.07 | 0.28 | 0.06 | 0.06~0.1 | 0.98 | 0.97 |
| 8.48 | 28.20 | 5.68 | 2.48 | 0.00 | 0.00 |
| 4 | 1.85 | 0.22 | 0.05 | 0.06 | 0.08~0.09 | 0.98 | 0.98 |
| 9.74 | 16.20 | 5.91 | 2.58 | 5.16 | 0.00 | 0.00 |
| 1.05 | 0.27 | 0.03 | 0.02 | -0.23~0.24 | 0.99 | 0.99 |
| 6.11 | 22.58 | 4.17 | 3.33 | 1.61 | 9.09 | 0.00 | 0.00 |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.11 | 0.00 |
| 5 | 1.39 | 0.24 | 0.02 | 0.02 | -0.17 | 0.1~0.12 | 0.99 | 0.99 |
| 9.01 | 21.32 | 3.52 | 1.76 | 1.71 | -8.25 | 7.00 | 0.00 | 0.00 |
| 7 | 1.42 | 0.24 | 0.02 | 0.02 | -0.17 | 0.11 | 0.01 | 0.99 | 0.99 |
| 9.22 | 21.14 | 3.67 | 1.88 | 1.70 | -8.38 | 7.26 | 1.81 | 0.00 | 0.00 |
| 8 | 1.47 | 0.23 | 0.02 | 0.02 | -0.17 | 0.10 | 0.01 | 0.01 | 0.99 | 0.99 |
| 8.99 | 18.97 | 3.64 | 2.03 | 1.64 | -8.26 | 6.43 | 1.64 | 92 | 0.00 | 0.00 |
| 0.00 | 0.00 | 0.00 | 0.04 | 0.10 | 0.00 | 0.00 | 0.10 | 0.36 |
| 9 | 1.43 | 0.25 | 0.04 | 0.02 | -0.19 | 0.11 | 0.01 | 0.01 | 0.99 | 0.99 |
| 8.35 | 20.52 | 2.36 | 1.20 | -9.03 | 6.73 | 1.31 | 0.98 | 0.00 | 0.19 |
| 0.00 | 0.00 | 0.23 | 0.00 | 0.00 | 0.19 | 0.33 |

Through the model analysis, the regression coefficient of per capital GDP and economic development in the western region is 0.33, which shows that the per capital GDP and economic development are
consistent, that is, the higher the level of economic development, the higher the per capita GDP. Through equation (21), it indicates that water resources development can promote economic development. Regression coefficient of equation (22) is -0.01, which indicates that forest resources may hinder economic development. The equation (23), (24) and (25) show that cultivated land resources, natural resources reserves and natural resources development have a positive effect on economic development. From equation (3) to equation (8), the results show that the relevant variables can be used as explanatory variables for economic development. Water resources, arable land resources, natural resources reserves and natural resources development promote the economic development and forest resources hinder the economic development.

3. Results
Through the regression analysis of the proxy indicators of various natural resources, it can be seen that the regression coefficient of cultivated land resources and economic development is the greatest, and it plays the greatest role in promoting economic development. Water resources and natural resources development have a moderate role in promoting economic development. The regression coefficient of natural resources reserves and economic development is the smallest, which has little impact to promoting economic development. The regression coefficient of forest resources and economic development is negative, which hinders economic development. The results show that natural resources are more conducive to economic development during the study period.

In addition to the development of manufacturing industry, other variables also play an important role in promoting economic development. Natural resources not only directly affects economic development, but also indirectly affects other control variables of economic development.

4. Conclusions
Through the analysis, the western region is rich in natural resources. Water resources, land resources and forest resources changed little in time series, but changed large in regional. Mineral resources not only is more diversified in region, but also changes in time series. Economic development is steadily rising.

This paper examines the role of water resources, forest resources, land resources, natural resources reserves and natural resources development on economic development of the western region. Research results show that water resources, land resources, natural resources reserves and natural resources development are promoting western regions economic development; forest resources for the economic development play a negative role.

Through analysis we can see that the regression coefficient of cultivated land resource and economic development is the biggest, on a larger role in promoting economic development; water resources and natural resources development play a middle promoting role to economic development; the regression coefficient of natural resources reserves and economic development has less effect.

The results show that most of the natural resources play an important role in promoting the economic development, only individual resources has hindered the economic development. However, natural resources are not as single variable plays the role of economic development, we must also consider the influence of human capital, institutional, manufacturing, science and technology openness on economic development.

Acknowledgments
This paper is financially supported by the scientific and technological projects of Guizhou province (No: SY[2012]3040) and humanities and social sciences researches projects in the universities of Guizhou province.

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