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The inequality of educational resources and its countermeasures for rural revitalization in southwest China

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Abstract: Equal access to education has long been a global concern and is important for rural revitalization strategy in the new era. However, little is known about the regional differences of educational resources in China, especially southwest China, where the spatial heterogeneity of human and physical geography is extremely significant. Using a dataset of primary and secondary schools of southwest China at county level in 2015, this study builds an index system to comprehensively measure the supply of educational resources, investigates the spatial pattern of educational resources via exploratory spatial data analysis (ESDA), and explores its influence factors through spatial econometrics. Results indicated that the supply level of educational resources in southwest China was relatively low; the high-high clusters of the supply of educational resources were mainly located in Sichuan Basin and the east of Western Sichuan Plateau, while the concentrated poverty-stricken areas of Guizhou and the border areas of Yunnan-Sichuan-Guizhou, especially Wumeng mountain area, were characterized by the low-low clusters. Furthermore, this study suggested that altitude, population density, local government revenue and rural residents' income were positively correlated with the supply of educational resources, while the negative influences were exerted by proportion of ethnic minority population and urbanization rate. And there were differences in the specific objects of actions of each factor. Ultimately, we proposed that village relocation and combination, as well as sustainable urbanization and regional development were practical paths to optimize the supply of educational resources in rural areas, thus promoting the modernization of agriculture and countryside.

Keywords: Educational resources; Rural revitalization; Spatial heterogeneity; Spatial error model; Southwest China

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Introduction

Education, which is mainly provided by the government, is fundamental for individual and regional development. To build a moderately prosperous society in all respects as scheduled, education plays an important role in making up the short board through the accumulation of human capital (Xu and Mei 2018). Therefore, the Chinese government has given priority to education to promote national economy and social development since the reform and opening-up in 1978, and has

continuously increased investments in education (Niu et al. 2010; Wang and Bergquist 2003). According to National Bureau of Statistical (NBS), government appropriation for educational has increased from 10 billion yuan in 1978 to 2922 billion yuan in 2015. Many policies supporting educational development also have been put forward to promote the modernization, popularization and balanced development of education, providing a powerful driver for economic development (Chen and Feng 2000; Fan and Zhang 2004; Nelson and Phelps 1966). Taking the period of 1981-2000 as an example, the contribution rate of educational development to economic growth in China has reached 31.17% (Ye et al. 2003).

Due to its significant role in individual and social development, China's education system has attracted widespread attention from many disciplines, such as economics, management, and psychology. Most publications pay attention to the relationship between education and economic development (Chen and Feng 2000; Démurger 2000; Fan and Zhang 2004; Zhang et al. 2005; Zhou et al. 2018), educational reform (Dello-Iacovo 2009; Hawkins 2000; Liu and Fang 2009; Tsang 1996), the impacts of education on health (Cheng et al. 2014; Peng et al. 2004; Zhang et al. 1990), returns to education (Byron and Manaloto 1990; de Brauw and Rozelle 2008; Heckman and Li 2004; Li 2003), international comparisons (Altbach 2009; Huang 2006; Gereffi et al. 2008), and spatial inequalities (Qian and Smyth 2008; Zhang and Kanbur 2005). Meanwhile, education is an important part of poverty studies, including the antipoverty effects of educational development (Brown and Park 2002; Knight et al. 2010; Senadza 2012; Song 2012), mental problems of poverty-stricken students (Xie and Cheng 2002; Long 2003; Pang and Zhou 2009), and left-behind children (Wen and Lin 2011; Lu 2012; Zhou et al. 2015). Existing studies on education system of China are mainly qualitative researches, involving characteristics, significances, as well as problems and countermeasures from either provincial-level or prefectural-level. However, quantitative studies on the spatial pattern and mechanism of educational resources at county level are insufficient.

After a long period of development, China is stepping into a critical stage of transformation (Guthrie 2012; Steele and Lynch 2012), and improving people's livelihoods becomes the initial concern of economic development (Zheng 2017). However, due to the unbalanced development strategy, there has been an apparent spatial differentiation of eastern, central and western China (Démurger et al. 2002; Fan 1997; Yang 2002), especially in the field of public services such as educational resources (Han et al. 2015; Zhang and Kanbur 2005). In central and western China, educational resources are insufficient in quantity, low in quality and uneven in distribution (NESG 2006), which restricts individual and social development. To win the battle against poverty and promote rural revitalization, it is necessary to strengthen the infrastructure construction and increase the supply of educational resources in backward areas. Therefore, it is urgent to study the spatial pattern of educational resources in China and explore its mechanism, especially the poverty-stricken areas, supporting their poverty alleviation and development.

Primary and secondary schools are indispensable parts of educational system (Friedman 1955). The differences of natural condition and social economy in southwest China are remarkable, which is a microcosm of China's development. Using a dataset of primary and secondary schools of southwest China in 2015, this study evaluates the supply level of educational resource (SLER) at county level, and improves our knowledges of regional inequalities in the distribution of educational resources. Then, it employs spatial econometrics to investigate factors which affect the supply of educational resources. These findings will shed light on guiding local planning and policy-making to promote the equalization of public services and rural revitalization.

1 Materials and Methods

1.1 Data sources

This study fully analyzes the figures of educational resources in southwest China at different spatial scales. The administrative boundaries and road network data are collected

from National Geomatics Center of China (http://www.ngcc.cn/). Removing the units without data on educational resources available, a total of 424 counties and districts are obtained. Data on schools, students and full-time teachers are collected from the 2016 statistical yearbooks of Sichuan, Chongqing, Guizhou and Yunnan, as well as the 2015 statistical reports on the national economic and social development of each counties, and the data are divided into primary and secondary schools. Data on social and economic development are also obtained from these statistics. Digital elevation model (DEM) with a resolution of 90m×90m is downloaded from WebGIS (http://www.webgis.com/index.html). Since the latest data on population are not available, urbanization and minorities are deprived from the tabulation of 2010 population census of the People's Republic of China by county.

1.2 Study area

Southwest China in this study refers to Sichuan, Guizhou, Yunnan and Chongqing. In terms of topography, southwest China can be roughly divided into three parts: Sichuan Basin, Yunnan-Guizhou Plateau and Western Sichuan Plateau (Li et al. 2012) (Figure 1). Influenced by the complex natural environment, the geological hazards are frequent and the ecosystems are extremely fragile in southwest China (Jia et al. 2016; Shi & Li 1999). Due to these obvious disadvantages, the level of economic and social development is low. In 2015, the urbanization rate was 47.65%, and the per capita gross domestic product (GDP) was 35855 yuan, which were only 84.94% and 71.72% of the national average, respectively (NBS 2016). In terms of socioeconomic development, Sichuan Basin, especially the Chengdu Plain, is a developed area, while the plateau and mountain areas are backward areas. According to the statistics, more than half of the counties in southwest China are distributed in the concentrated poverty areas with special difficulties (CPASDs) (http://www.cpad.gov.cn/art/2012/6/14/art_50_23717.html), and their rural poverty can be characterized by large in quantity, wide in distribution and deep in degree (Liu et al. 2017).

1.3 Index system and the initial selection of influencing factors

Educational resources refer to the sum of resources that are occupied and consumed in the process of receiving education (Gu 1998). In China, the state-run educational system includes elementary education, secondary vocational education, higher education and adult education. Under the influences of reform and development, most school-age children have entered schools. Thus, the supply level of educational resource (SLER) is subject to the quantity and quality of schools and teachers. Since it is difficult to obtain quantitative data on the quality of teachers and schools, such as teaching skills and equipment, this research mainly analyzes the SLER at county level from the perspective of the number of teachers and schools shared by students in school. Enlightened by existing researches (Malczewski and Jackson 2000; Senadza 2012; Zhang and Kanbur 2005), this study constructs a comprehensive index system to measure the SLER at county level in

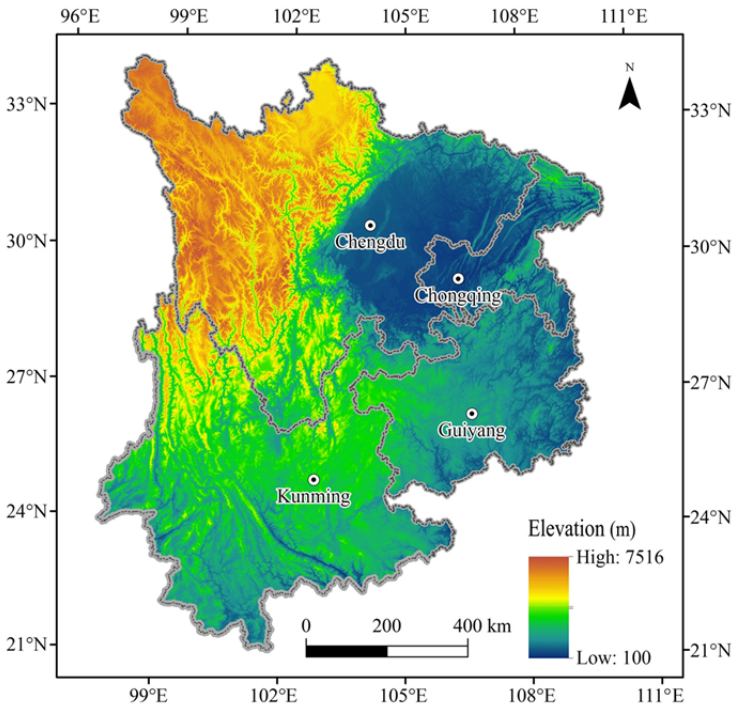

Figure 1 The location and administrative division of study area.

southwest China, including primary and secondary schools. Teacher-student ratio (TSR) is the quantitative relationship between teachers and students, and shows a positive correlation with SLER. Number of teachers (NTS) and students (NSS) per school reflect the average size of teachers and students in each school of the county, respectively. The former is positively correlated with SLER, while the later shows a negative correlation (Gillies 2012). The weight of each indicator is calculated with Delphi method (Dalkey and Helmer 1963) (Table 1). Thus, SLER can be calculated as follows:

$$SLER = SLP + SLS = \sum_{i=1}^{3} PR_{ij}\omega_{PRi} + \sum_{i=1}^{3} SE_{ij}\omega_{SEi} \quad (1)$$

where *SLP* and *SLS* denote the supply level of primary and secondary schools, respectively; *i* refers to the indicators, and *j* stands for the counties.

Education is essentially a public good decided by supply and demand (Lazear 2001). For the former, government is the main provider, and its management ability, which is mainly affected by per capita general public budget revenue (GPDR), is an important factor influencing educational development (Friedman 1955). Since transportation infrastructure is of great significance in enhancing the accessibility of educational resources, road density (RDen) is chosen in our study (Linneker and Spence 1996). Meanwhile, the proportion of ethnic minority population in total population (PMin) is also included to investigate the causes of spatial heterogeneity since the policy differences in ethnic areas. In terms of demand, people are the fundamental factors. We use population density (PopDen) to reflect the scale of demand, and per capita disposable incomes of households, encompassing urban (DIUH) and rural (DIRH), to characterize people's abilities to meet their needs. In a broader sense, per capita gross domestic product (GDP) and urbanization rate (UR) are also used to measure the level of socioeconomic development, which is the decisive factor of SLER. Moreover, as a human activity on the earth's surface, the distribution of educational resources is inevitably influenced by the geographical environment, especially topography, which can be characterized by average elevation (AE), proportion of areas with a slope not less than 15 degrees (Slope15), degree of fragmentation (DFG) and so on (Guo et al. 2018).

1.4 Spatial econometric model

Generally, there is a spatial correlation between geographical objects or phenomena in different regions, and the objects in proximity are more related than the distant ones (Tobler 1970). Regression is one of the most frequently used methods to explore this correlation. But conventional regression methods, such as ordinary least squares (OLS), generalized method of moments (GMM) and maximum likelihood estimation (MLE), do not take spatial effects into consideration. Thus, spatial econometric models of cross-sectional, including spatial lag model (SLM) and spatial error model (SEM) (Anselin 1988), are employed in this study. SLM can be specified as follows (Lesage and Pace 2009):

$$y_s = \delta \sum_{j=1}^{n} W_S y_j + \beta x_{si} + \mu_i + \varepsilon_s ,$$
$$\varepsilon_s \sim i.i.d\left(0, \delta^2\right) \quad (2)$$

where y_s and x_{si} (i=1, ..., n) are dependent variables and independent variables, respectively; δ is the coefficient of spatial autoregression; s denotes the spatial location of units; β denotes the coefficient of corresponding explanatory variables to be estimated; μ_i refers to the spatial fixed effect; W_s is

Table 1 Comprehensive evaluation index system for the supply level of educational resource (SLER) at county level in southwest China

Dimension	Indicator	Weight (ω)	Direction
Primary school (PR)	PR1: Teacher-student ratio in primary school	0.10	+
	PR2: Number of students per primary school	0.11	-
	PR3: Number of teachers per primary school	0.15	+
Secondary school (SE)	SE1: Teacher-student ratio in secondary school	0.20	+
	SE2: Number of students per secondary school	0.20	-
	SE3: Number of teachers per secondary school	0.24	+

a spatial weight matrix; ε_s is an error term following the normal independent distribution. SEM is based on the following equation:

$$y_s = \beta x_{si} + \mu_i + \varphi_s,\ \varphi_s = \rho\sum_{j=1}^{n} W_s\varphi_s + \varepsilon_s,$$
$$\varepsilon_s \sim i.i.d\left(0, \delta^2\right) \quad (3)$$

where φ_s denotes the error term of spatial autocorrelation, and ρ is the spatial autocorrelation coefficient of the error terms.

2 Results and Analysis

2.1 Spatial patterns of SLER

SLERs of each county are calculated through analytic hierarchy process (AHP), and the values range from 0.23 to 0.64 with a mean of 0.38. Specifically, the values of SLER in most counties are less than 0.50, while only 11 counties exceed 0.50 (Table 2). SLER is extremely low in the deep mountain areas of Wumeng, where the values are less than 0.25 in Weining and Zhenxiong, with Yiliang and Nayong being very close to that level. On the other end of the spectrum are three counties in Western Sichuan Plateau with SLERs exceeding 0.60. In terms of SLP and SLS, both values in most counties are also below 0.5. Concretely, the values of SLP are very low in Jianyang (0.21), Wenjiang (0.21) and Anyue (0.26) of Sichuan province, while the counties with the highest values of SLP are suggested to be Lixian (0.64) and Xichong (0.62), locating in Western Sichuan Plateau. As to SLS, the four counties with the lowest SLS are exactly the four counties with the lowest values of SLER; and the four counties with the highest values are Deqin in Yunnan, as well as Baoxin, Qingchuan and Lixian in Sichuan. Using ArcGIS, Figure 2 shows the spatial distribution of SLER in southwest China. Counties with high SLER are mainly located in Western Sichuan Plateau and the north of Sichuan Basin, while those with low SLER are concentrated in the border areas of Yunnan-Sichuan-Guizhou. The spatial distribution of SLS is similar to that of SLER, while SLP shows its own characteristics of relatively homogeneous distribution.

Furthermore, the Moran's I statistic is calculated to detect whether there are spatial correlations between SLERs in different counties. The global Moran's I statistics of SLER, SLP and SLS are 0.43, 0.49 and 0.49, respectively, all of which are greater than the expected indexes at the significance level of 5%. This means there is a significant positive correlation in the distribution of SLERs in southwest China. Meanwhile, local Moran's I statistic is also calculated to investigate the spatial homogeneity and heterogeneity of SLER. Figure 3 shows that high-high clusters of SLER are mainly located in Sichuan Basin and the east of Western Sichuan Plateau, while the low-low clusters are concentrated in CPASDs of Guizhou and the border areas of Yunnan-Guizhou-Sichuan, especially the Wumeng mountainous area. With respect to the dimensions of SLER, counties characterized by high-high clusters of SLP are mainly in Qinba mountainous area, as well as the east and south of Western Sichuan Plateau, and counties with low-low clusters are mainly located in Wumeng mountainous area; the spatial pattern of SLS is largely similar to that of SLER.

2.2 Mechanisms of the spatial differentiation of SLER

Taking the SLER and its dimensions at county level in southwest China as dependent variables, the influencing factors are analyzed and their

Table 2 Statistics of the supply level of educational resource (SLER) at county level in southwest China

	SLER					SLP	SLS
	Guizhou	Sichuan	Yunnan	Chongqing	Total		
(0.15, 0.30]	7	8	11	1	27	7	57
(0.30, 0.40]	79	85	82	30	276	332	227
(0.40, 0.50]	1	79	24	6	110	77	125
(0.50, 0.60]	0	7	0	1	8	6	10
(0.60, 0.70]	0	2	1	0	3	2	5
Total	87	181	118	38	424	424	424

Note: SLP and SLS denote the supply level of primary and secondary schools, respectively.

mechanisms are discussed in this part. Collinearity statistics show that except slope15 and DFG, the variance inflation factors (VIF) of other pre-selected independent variables are smaller than 5.0, and their tolerances are greater than 0.2. These mean there is no obvious collinearity among these variables, and they can be used for the model fitting analysis. Furthermore, spatial dependence diagnostics of SLER show that both Lagrange Multiplier (lag) (LM-lag) and Lagrange Multiplier (error) (LM-error) are significant, and robust LM-error is significant while robust LM-lag is not significant (Table 3). The same is true of its dimensions. Thus, SEM is the more appropriate

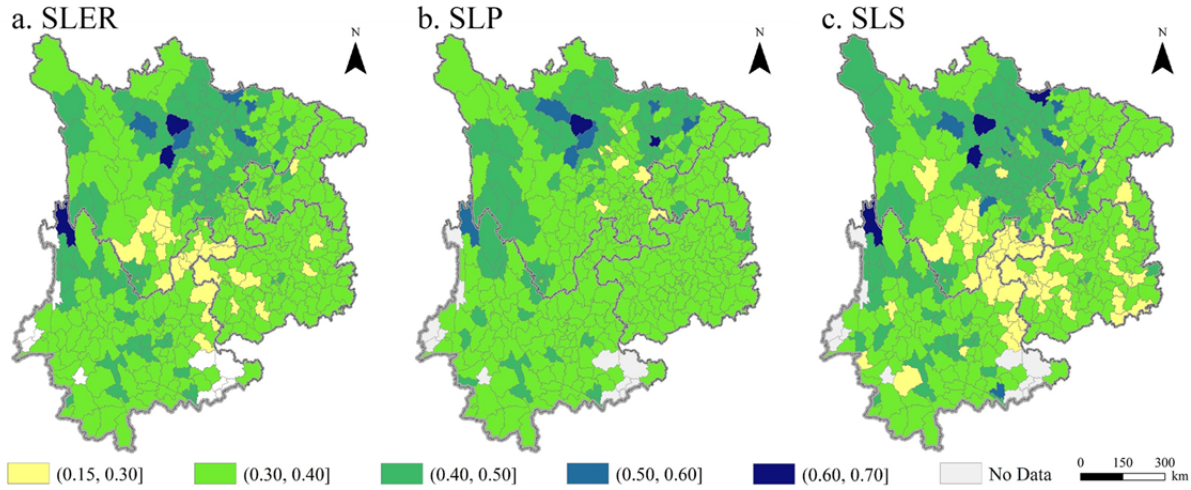

Figure 2 Spatial distribution of the supply level of educational resource (SLER) at county level in southwest China. (SLP and SLS denote the supply level of primary and secondary schools, respectively)

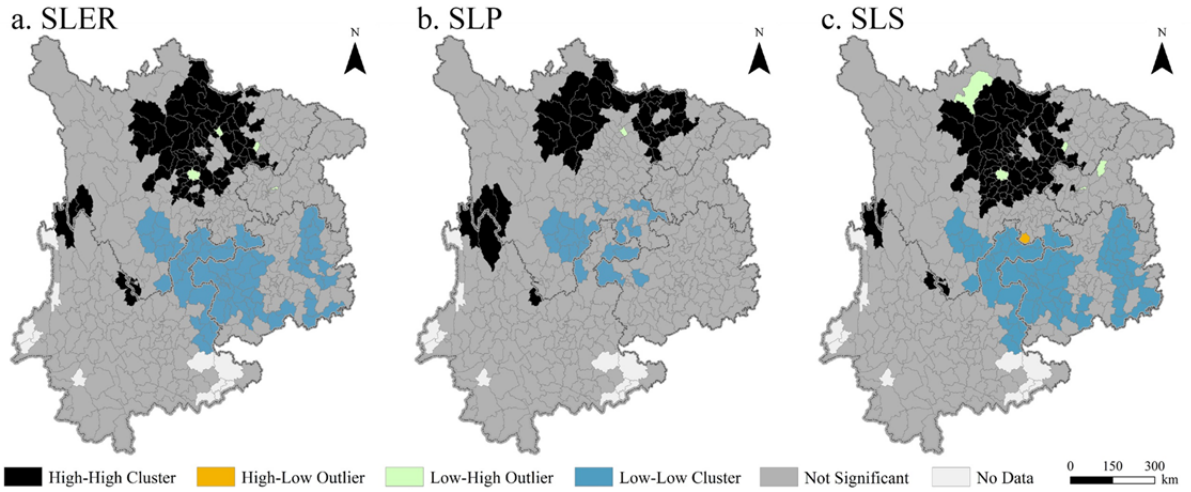

Figure 3 Spatial autocorrelation results of the supply level of educational resource (SLER) at county level in southwest China. (SLP and SLS denote the supply level of primary and secondary schools, respectively)

Table 3 Results of diagnostics for spatial dependence

Test	SLER	SLP	SLS
Moran's *I* (error)	12.9529*	12.9400*	11.5486*
Lagrange Multiplier (lag)	71.5570*	60.8674*	71.2979*
Robust LM (lag)	0.1492	0.2599	0.4048
Lagrange Multiplier (error)	150.3333*	150.0246*	118.5821*
Robust LM (error)	78.9255*	89.4171*	47.6890*
Lagrange Multiplier (SARMA)	150.4825*	150.2845*	118.9869*

Notes: * Statistically significant at the level of 1%.

model in this study.

The results of SEM show that AE, PopDen, per capita GPDR and per capita DIRH are positively correlated with SLER in southwest China, while PMin and UR are negatively correlated with SLER (Table 4). In terms of SLP, there are positive correlations between SLP and the factors that pass the significance test, including AE, PopDen and per capita GPDR. The factors affecting SLS are PopDen, per capita DIRH and UR, where the former two show positive correlations and the last one shows a negative correlation. Specifically, AE only affects the supply of primary schools, and does not play a role on the overall supply of educational resources in the county; PMin only affects the overall supply of educational resources in the county; PopDen plays its role on the overall supply of educational resources through influencing the supply of primary and secondary schools; per capita DIRH, per capita GPDR and UR affects the overall supply of educational resources in the county through its role on secondary schools, primary schools and secondary schools, respectively.

Altitude is an important feature of the terrain and plays a significant role in population distribution (Breetzke 2012). In general, the higher the altitude is, the more dispersedly the population distribute, and the more obvious the barrier effect of natural environment is (Zhao and Deng 2015). Therefore, the government needs to provide more primary schools and teachers to meet the demands of school-age children, thus protecting their rights to receive education. Under the interference of national policies, the gaps between minority and nonminority areas are narrowing. However, since the ethnic minorities in southwest China are mainly distributed in remote areas, the well-educated teachers are reluctant to work there, resulting in a shortage of teachers. Thus, it reduces SLER in ethnic areas. Population density reflects the demand scale of educational resources in a region; the higher it is, the more educational facilities and teachers are needed, thus improving the SLER. Per capita general public budget revenue is the foundation for the government to perform its roles in ensuring the wellbeing of people and improving their livelihood. A larger per capita GPDR means the government has a stronger ability to guarantee the supply of educational resources. But the increasing role of market in the supply of secondary schools makes the impact of per capita GPDR on the supply of primary schools significantly stronger than that of secondary schools. Generally, comparing with primary schools, secondary schools are mainly distributed in cities and towns. Thus, urbanization development, which refers to the aggregation of population and educational resources, reduces the supply level of secondary schools through improving the availability of secondary schools, further it plays a role in the overall supply of educational resources in the county. Meanwhile, as argued by Maslow, the change of people's needs is an evolutionary process from low to high, only when the basic demands have been met will the more advanced and socialized needs arise (Maslow 1943). Secondary schools, especially the high school, are the higher stages of education. In line with the increasing disposable incomes of rural residents, their demands for

Table 4 Estimated results of spatial error model (SEM)

Variable	SLER		SLP		SLS	
	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.
Constant	0.3701000	0.0000000	0.4075000	0.0000000	0.3380000	0.0000000
AE	0.0000077	0.2172000	0.0000132	0.0078000	0.0000056	0.4607000
PopDen	0.0000050	0.0114000	0.0000034	0.0375000	0.0000057	0.0267000
PMin	-0.0002000	0.0937000	-0.0002000	0.1376000	-0.0003000	0.1516000
Per capita GDP	0.0000002	0.2554000	0.0000001	0.5272000	0.0000003	0.2310000
Per capita GPDR	0.0000048	0.0405000	0.0000040	0.0368000	0.0000045	0.1345000
Per capita DIUH	-0.0000010	0.4164000	-0.0000016	0.1189000	-0.0000005	0.7412000
Per capita DIRH	0.0000032	0.0995000	-0.0000011	0.5009000	0.0000062	0.0129000
UR	-0.0006000	0.0038000	-0.0001000	0.4623000	-0.0008000	0.0013000
RDen	-0.0020000	0.6117000	-0.0021000	0.5083000	-0.0023000	0.6488000
LAMBDA	0.6772000	0.0000000	0.6545000	0.0000000	0.6364000	0.0000000

Notes: AE, PopDen, PMin, per capita GDP, per capita GPDR, per capita DIUH, per capita DIRH, UR and RDen refer to average elevation, population density, proportion of ethnic minority population in total population, per capita gross domestic product, per capita general public budget revenue, per capita disposable incomes of urban households, per capita disposable incomes of rural households, urbanization rate and road density, respectively. LAMBDA is an anonymous function. SLP and SLS denote the supply level of primary and secondary schools, respectively.

higher-level education and their abilities to meet these demands will continue to develop. In this context, the role of per capita DIRH in secondary schools is significant and positive, while it is not significant in primary schools since it is a basic demand.

3 Discussion

Education is one of the most powerful and effective tools for sustainable development (Bonnett 1999; Vare and Scott 2007), most countries around the world have made great efforts to promote educational development (Banks 1993; Tooley et al. 2007). Previous studies on the education of China are mainly macroscopic researches at the national or provincial scale (Chen and Feng 2000; Dello-Iacovo 2009; Zhang and Kanbur 2005; Li 2003), with a lack of attention to the spatial pattern of educational resources at county level and its mechanism (Han 2001). This study reveals that there are significant spatial heterogeneities in educational resources at county level in southwest China, which are mainly influenced by average altitude, population density, proportion of ethnic minorities, government receipts, rural household incomes and urbanization. These differences are also true at the national level (Yang et al. 2014). China is still a developing country with unbalanced regional development (Li and Wei 2010), especially in public services such as education. This situation cannot be effectively solved in short-term, and will exerts a profound impact on social and economic development (Chen and Feng 2000).

Since the reform and opening-up of China in 1978, an enormous progress has been achieved in educational development. However, because of the urban-rural dual structure and unbalanced development strategy, educational resources in urban areas are superior to those in rural areas (Fu and Ren 2010), and the eastern areas are better than the central and western regions (Yang et al. 2014). Meanwhile, many rural populations move to urban areas under the background of rapid urbanization, resulting in rural decline (Liu 2018; Liu and Li 2017; Xu et al. 2018). Correspondingly, educational development in rural areas is facing a series of problems, such as the scattered distribution of school-age children and the loss of students and qualified teachers, while educational resources in urban areas are under the pressure of insufficient supply (Du and Ge 2016). Besides, sub-replacement fertility is becoming increasingly serious in China owing to the declining total fertility rate. According to the official statistics, the proportion of people aged 0-14 in total population has decreased from 26.73% in 1995 to 16.52% in 2015, and the declining rate in rural areas was significantly faster than that in urban areas (NBS 1996, 2016). In 2015, the universal two-child policy was implemented to increase birthrate, but its impact on childbearing behavior is weaker than expected (Mu 2018; Zeng and Hesketh 2016). These bring new challenges to the supply of educational resources and call for the coordination between current needs and long-term planning, thus allocating educational resources scientifically and promoting social and economic development.

To overcome rural poverty and build the well-off society by 2020 as scheduled, it is necessary to promote the accumulation of human capital through educational development (Li et al. 2016, 2017). Furthermore, it lays a solid foundation for regional social and economic development. The key to promote educational development in Western Sichuan Plateau and the border mountain areas of western Yunnan lies in improving the quality through the integration of educational resources, which helps to advance teachers' vocational abilities and meet the demands of rural schools. If possible, standardized boarding school is also a feasible choice to guarantee quality education in remote areas. While Sichuan Basin, eastern Yunnan-Guizhou Plateau and Wumeng mountain area should pay more attention to the quantity of educational resources. There are also differences in the structure of educational resources. Increasing the supply of elementary education resources, including schools and teachers, is the focus of educational development in Sichuan Basin, and employing more qualified teachers is the major task for eastern Yunnan-Guizhou Plateau. As to Wumeng mountain area, more qualified teachers are needed for both primary and secondary schools, and building more secondary schools is also necessary.

China's education can be divided into two parts, i.e. compulsory and non-compulsory

education. The former contains elementary and junior high school, and the latter includes other types of education (Yang 2002). When analyzing the supply of secondary schools, the internal structural differences are not taken into consideration in this research. Meanwhile, this study focused on the quantity of students, teachers and schools, with a lack of attention to their qualities, such as the educational attainment of teachers and the status of teaching equipment. The supply of educational resources is a dynamic process (Blossfeld and Huinink 1991). However, cross-sectional data were used rather than panel data in this study; thus, we could not investigate their spatiotemporal pattern. In future research, the qualities of educational resources should be taken into consideration to fully understand the educational development in specific regions. Meanwhile, the spatiotemporal pattern and urban-rural gap of educational resources and the differences between compulsory and non-compulsory education also deserve to be further studied.

4 Conclusions and Policy Implications

Education plays a significant role in regional sustainable development by promoting the all-round development of human beings (Schultz 1961). Influenced by natural and social conditions, there are obvious spatial heterogeneity in the regional development of southwest China (Zhou et al. 2013), especially in public services such as education. In this study, we explored the spatial pattern of the supply of educational resources in southwest China, and probed the mechanism behind the regional differences through spatial econometrics. Results indicated that the overall supply level of SLER in southwest China is relatively low in 2015. In terms of spatial distribution, Sichuan Basin and the east of Western Sichuan Plateau were dominated by high-high clusters of SLER, particularly the secondary schools; high-high clusters for primary schools were mainly located in Qinba mountainous area as well as the east and south of Western Sichuan Plateau, while low-low clusters were concentrated in CPASDs, especially the Wumeng mountainous area. Further analysis suggested that natural factors, such as altitude, and human elements, including population density, local government revenue, proportion of ethnic minority population, rural residents' income and urbanization rate, were the main influencing factors of SLER at county level in southwest China. Among them, average altitude and proportion of ethnic minority population only affected the supply of primary schools and the overall supply of educational resource in the county, respectively; population density affected the supply of educational resources through its role on the supply of primary and secondary schools; Comparing with that local government revenue played its role on the overall supply of educational resource through influencing the supply of primary schools, both rural residents' income and urbanization rate worked through their influences on the supply of secondary schools.

After more than forty years of development, China is in the critical stage of transformation and upgrading, the principal contradiction facing Chinese society has changed to the contradiction between unbalanced and inadequate development and the people's ever-growing needs for a better life. And the outstanding embodiment of unbalanced and inadequate development lies in rural areas. To reverse this unfavorable situation and break the urban-rural dual structure, it is of great significance to make up the shortage of educational resources in southwest China, especially in rural areas, to promote the implementation of rural revitalization strategy in the new era. First, village relocation and combination are practical options in the high-altitude areas, especially Western Sichuan Plateau and Hengduan mountain area, to promote population agglomeration and optimal allocation of educational resources. In these areas, population is scattered, ethnic minorities are widely distributed, and the barrier effect of topography is significant. These makes educational resources face the problems of low quality and poor availability. Second, deepening hukou system reform is important to promote the citizenization of agricultural transfer population and urbanization development. Cities and villages are the two components of an organic, only the sustainable development of the two can support the prosperous development as a whole (Liu and Li 2017). The urbanization development helps to alleviate the human-environment contradiction in rural areas,

and also promote rural development through its polarization effect, thus realizing educational development in rural areas. Moreover, it is necessary to actively promote the regional economic development. On the one hand, it helps to increase the local government revenue, improving their abilities in the supply of educational resources; on the other hand, it helps to improve farmer's income, promoting the transformation and upgrading of their demands, and improve their abilities to meet these needs. Nowadays, China is fighting for the Two Centenary Goals, the important role of education makes it necessary to provide educational resources with enough quantity, reasonable structure and excellent quality, thus making-up for the shortage of rural development and laying a solid foundation for rural revitalization and regional coordinated and sustainable development.

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