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Estimating the Effect of Electric Universal Service in Rural Areas of Southwest China: From the Perspective of Equalization

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Abstract

Aiming to ensure residential electricity, the effective implementation of electric universal service can improve the electric equalization and social justice. In order to promote electric universal service of the rural areas in Southwest China, the effect of electric universal services should be evaluated from the perspective of equalization. In this paper, an electric equalization evaluation model was proposed, which contains of electric supply equalization and electric benefit equalization evaluation models. The electric supply equalization evaluation model was established based on variation coefficient method. Meanwhile, the electric benefit equalization evaluation model was conducted based on prospect theory. At last, the electric equalization degree of the rural areas in Southwest China was evaluated, which shows that the electric equalization degrees have increased from 2006 to 2013, but still are low. What's more, some suggestions are put forward to improve the implementation of electric universal service.

Keyword*: Electric universal service, Electric supply equalization, Electric benefit equalization, Southwest China*

1. Introduction

Energy poverty is widespread in the world, including China. Energy universal services help to eliminate energy poverty, safeguard the living rights and improve the people's living quality. As one of the basic energy sources, electric power is essential for people's survival in modern society. Electric universal service is of great significance to protect people's basic rights, promote the harmonious development of economy and society, and realize the equalization of energy in China. Solving the electric shortage problem in underdeveloped areas through the implementation of electric universal service can promote the regional economic development, which is the bounden social responsibility of Chinese government and electricity utilities. China will comprehensively solve the electricity shortage problem in rural areas before the end of 2015 through the household electrical engineering and rural power grid renovation project, which is planned by National Energy Bureau in 2012.

Electric universal service, led by the government and implemented by the electricity utilities, aims to improve the individual electricity quality and realize electricity equalization. The terrain of Southwest China is complex, including most of Qinghai-Tibet Plateau, Sichuan Basin, Qinba Mountain and most of Yunnan-Guizhou Plateau. The administrative divisions in Southwest are Sichuan Province, Chongqing Municipality, Yunnan Province, Guizhou Province and Tibet Autonomous Region. In2006, only 88.5% of people in Southwest China had access to electricity power, far below the national average rate of 98.3%.The rural areas of Southwest China is a part of the important regions for implementing electric universal service. Evaluating the implementation effect of electric universal service can assess the social and economic returns of electric

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universal service and the contributions of promoting social fairness in Southwest China. Therefore, we will propose an evaluation model of electric universal service from the perspective of the electricity equalization and then analyze the implementation effect of electric universal service in Southwest China.

With regard to the current research on public service equalization, most researchers put their emphasis on two aspects, which are the implementation path of equalization and equalization assessment. In terms of the implementation path of equalization, Ruixue Cui and Lina Su [1] proposed several paths to ensure all citizens' equal rights to share public sports service though the research of equal access to public fitness facilities in Hebei province. Christos Kotsogiannis, Robert Schwager [2] proposed the overall plan of fiscal equalization systems on accountability depended on the balance of some effects, including paying more attentions to the remaining variation in public good supplies, increasing the punishment charge, etc. Jia Xiaojun , Yue Ximing [3] put forward that equal financial transfer payment is the precondition for the equalization of public services and deduced a way to derive the equilibrium transfer payment in China. Wang Litan [4] suggested that the gap between local government's public service expenditure widens at an annual rate of 2.11% ~ 2.28%. China should reform on the basis of the development of economic equilibrium and gradually improve the financial payment system of the Chinese government. In terms of equalization assessment, Jiang Shijie et al.[5] used evaluation indicator system and evaluation model for the infrastructure contribution to urban-rural coordination in Chongqing Municipality to evaluate the degree of urban-rural infrastructure supply equalization. Xiaoling Zhang [6] established a multi-criteria model, which quantified the effect of individual infrastructure projects on urban-rural balance, to evaluate the contribution of the public project for narrowing the gap between urban and rural areas. Giuseppina Siciliano et al.[7] assessed social priorities linked to the impacts of a large dam in Cambodia ,and proposed that the divergence between national and local priorities brought about the an unequal distribution of costs and benefits between urban and rural areas. Zeng Hongying[8] used the factor method and established the expense and revenue standardization systems based on the state average standards developed, then calculated and evaluated the fiscal equalizing transfers of 31 provinces from the central government. Yang Ye[9] adopted the 16 indicators of the 31 regions in China as the basis of analysis and compared with the level of basic public services in various regions. Wang Xin-min, Nan Rui[10] constructed a multi-level evaluation index system of basic public services equalization, determined the index weight with AHP, and applied the grey correlation for the research of evaluating the level of basic pubic services equalization in 31 provinces. Sen Guo et al[11] used the social welfare function to evaluate the effect of electric universal service in China based on Atkinson's social welfare theory and prospect theory.

The above literature reviews lay the foundation for evaluating the effect of electric universal service from the perspective of equalization. To the best of our knowledge, electric universal service evaluation from the perspective of equalization has rarely been studied. Therefore, conducting an appropriate equalization evaluation model to estimate the effect of electric universal service is quite necessary, which can fill the research gap. Meanwhile, the evaluation result about electric universal service can provide some reference for the administrative departments to make policy related to electric universal service.

Considering the differences of supply and benefit of electric service, this paper proposes a comprehensive evaluation model for the electricity equalization by employing variation coefficient method and prospect theory from the supply equalization and benefit equalization. This paper is organized as follows: Section 2 introduces the meaning of electric universal service in China and electricity equalization. Section 3 conducts the electric supply equalization evaluation model based on entropy weight and variation

coefficient method. Section 4 establishes the electric benefit equalization evaluation model through AHP weight and prospect theory. Section 5 estimates the electricity equalization in rural areas of Southwest China and analyzes the electric universal service effect from the perspective of equalization. Section 6 concludes this paper.

2. Electric Universal Service and Electric Equalization in Southwest China

2.1 Electric Universal Service

Electric Universal Service is a government funded project, aiming to insure people living in remote areas can consume the sustainable and reliable electricity at affordable prices. The driving mechanism of electric universal service implementation is to raise the energy equalization level and promote economic growth and living quality by means of the positive externality of the electric power grid [11]. The electric universal service holds some characteristics as other public services, which are:(1) Scope of universal service should cover all residents, especially in rural areas; (2) all the recipients should have equal access to basic electricity service; (3) the universal service price should be affordable for the recipients; (4) electric universal service standards should change periodically with the economic and social development.

Electric universal service in China is still in the primary stage. There are some people who have no access to electricity. As the agricultural region, Southwest China has the rural population of 58.9% accounting for the total population. The regional economy development is in low level. The rural people are living in poverty. The electricity-free problem has restricted the development in rural area of Southwest China, according to "China's Energy Policy (2012)". In 2013, the electricity cover ratio of Southwest China has been promoted to 99.61%, but the electricity service level is still low.

2.2 Electric Equalization

Electric universal service is a basic public service in the energy sector. Electric equalization degree reveals the social fairness and justice to a certain extent. It includes electric supply equalization which means that electric infrastructure supplies should be roughly the same, and electric benefit equalization which means citizens can enjoy the electric power service equally.

Electric supply equalization provides the equal opportunities for all citizens to enjoy basic electricity, which is macro. The core of electric supply equalization is the general equal supply of basic electric services in all regions. According to electric universal service, electric supply equalization pays more attention to the electric power investment and electric service in rural areas. Electric benefit equalization embodies the similar effect of using electric power for all citizens, which is micro. The core of electric benefit equalization is the equal welfare improvement from the basic electric service. Electric benefit equalization focuses on the actual individual welfare level and the equalization degree of welfare improvement from electric universal service. Electric supply equalization is the premise and foundation of electric benefit equalization. Electric benefit equalization is consistent with the goal of electric universal service implementation.

3. Electric Supply Equalization Evaluation Model

3.1 Indicator System of Electric Supply Equalization in Rural Areas

Electric supply equalization is the main performance of electric power investment equalization and electric service equalization in rural areas. Per capita electricity

investment and its share in infrastructure investment reflect how much the regional government emphasizes rural electric power investment. The more electric power investment is, the higher the electric supply equalization degree is. The per capita electricity generation reflects the construction of power facilities in rural areas. Electricity cover ratio is the proportion of people who can use electricity in the general population, which is an important evaluation indicator of electric universal service. Per capita electricity consumption reflects the overall level of electricity for living and production. In order to enhance the rural electric supply capacity, the government and electricity utilities carry out the rural power grid renovation project actively in China. The degree of the rural power grid renovation can reflect the electric service degree in rural areas to a certain extent. The index system of electric supply equalization is shown in Table 1.

Table 1. Index System of Electric Supply Equalization

Object	First-grade indicator	Second-grade indicator
Electric supply equalization , X_1	Electric power investment, A_1	Per capita electricity investment, B_1
		Per capita electric power generation, B_2
		The share of rural electric investment in infrastructure investment, B_3
	Electric power service, A_2	Electricity cover ratio, B_4
		Per capita electricity consumption, B_5
		The degree of the rural power grid renovation, B_6

3.2 Weight of the Electric Supply Equalization Indicator

Objective fixed weight methods, which is based on the inherent information of indictors to calculate the weight, can eliminate the man-made disturbances and be close to facts. According to information theory, the entropy is used to measure the disorder degree and the amount of information. The small entropy value represents the indicator with much information and the small disorder degree.[12] We employ the entropy weight method to determine the weight of electric supply equalization indicator, which is as follows.

Supposing there are *m* pieces of indicators and *n* regions in the indicator system, r'_{ij} is the value of indicator *i* in the region *j*. In order to eliminate the influence of indicator dimension on incommensurability, we should standardize indicators by using the extreme value method. The calculation formula is as follows:

$$r_{ij} = \frac{r'_{ij} - \min r'_{ij}}{\max r'_{ij} - \min r'_{ij}} \quad (1)$$

$$r_{ij} = \frac{\max r'_{ij} - r'_{ij}}{\max r'_{ij} - \min r'_{ij}} \quad (2)$$

Where r_{ij} represents the standardized value of indicator *i* and region *j*; eq(1) uses for the benefit indicators; eq(2) uses for the cost indicators, $i = 1, \cdots, m$, $j = 1, \cdots, n$

According to the definition of entropy, the entropy value of indicator r_i is calculated by Equation (3).

$$h_i = -\frac{\sum_{j=1}^{n} f_{ij} \ln f_{ij}}{\ln n} \quad (3)$$

Wherein:

$$f_{ij} = r_{ij} \Big/ \sum_{j=1}^{n} r_{ij} \tag{4}$$

And if $f_{ij} = 0$, $f_{ij} \ln f_{ij} = 0$

So the entropy weight can be calculated by Equation (5).

$$w_i = \frac{1 - h_i}{m - \sum_{i=1}^{m} h_i} \tag{5}$$

Where w_i represents the weight of indicator *i*.

3.3 Electric Supply Equalization Index in Rural Areas

Electric supply equalization means the equal electricity supply without the regional differences. We will establish the electric supply equalization index to measure the electric supply equalization degree in rural areas based on variation coefficient method.

Variation coefficient can measure the data dispersion in the evaluation index system, which is employed to measure the electric supply equalization degree.[13] The larger the variation coefficient value is, the more obvious the data dispersion is, and the lower the electric supply equalization degree is. We consider the variation coefficient of electric supply equalization indicator system as the electric supply equalization index.

According to the variation coefficient method, electric supply equalization index of region *j* can be calculated by Equation (6).

$$S_j = \frac{\sigma_j}{\overline{z}_j} \tag{6}$$

Wherein:

$$\overline{z}_j = \frac{\sum_{i=1}^{m} w_i \times r_{ij}}{m} \qquad i = 1 \cdots m,\ j = 1 \cdots n \tag{7}$$

$$\sigma_j = \sqrt{\frac{\sum_{i=1}^{m} (z_{ij} - \overline{z}_j)^2}{m - 1}} \tag{8}$$

Where S_j is the electric supply equalization index of the region *j*; $\overline{z}_j$ is the average indicator value of region *j*; σ_j is the standard deviation.

4. Electric Benefit Equalization Evaluation Model

4.1 Indicator System of Electric Benefit Equalization in Rural Areas

Electric benefit equalization focuses on the equality of individual welfare improvement from electric universal service. The welfare improvement mainly comes from the economic situation, residential electricity level and living quality. Effective implementation of electric universal service can improve the economic development in rural areas, such as increasing the per capita net income, improving the consumption level, purchasing electrical appliances, etc. Rural residential electricity level is promoted with

the implementation of electric universal service, which is shown to increase living electricity consumption and reduce the electricity bills. The improvement of electric power service satisfaction degree also reflects electric service level. As electric power is a kind of clean energy, rural residents can improve their living environment by increasing the electricity consumption to reduce the usage of coal and straw to some extent. The popularity of television and mobile phones can reduce the Engel coefficient values and illiteracy quantity in rural areas by the increasing exchange opportunities with the outside world in a certain extent. The index system of electric benefit equalization in rural areas is shown in Table 2.

Table 2. Index System of Electric Benefit Equalization in Rural Areas

Object	First-grade indicator	Second-grade indicator
Electric benefit equalization , X_2	Economic situation, A_3	The per capita net income,B_7
		Color TV ownership,B_8
		Mobile phone ownership,B_9
		Per capita consumption level,B_{10}
	Residential electricity level, A_4	The share of electricity consumption in per capita consumption,B_{11}
		Per capita living electricity consumption,B_{12}
		Electric power service satisfaction degree,B_{13}
	Living quality, A_5	Engel coefficient,B_{14}
		Living environment satisfaction degree,B_{15}
		Illiteracy rate,B_{16}

4.2 Weight of the Electric Benefit Equalization Indicator

The analytic hierarchy process (AHP) method is a multiple criteria decision-making approach created to solve complex multiple criteria problems involving qualitative decisions [14]. The electric benefit equalization indicator system has a multi-level hierarchy structure, and there is a certain relationship between the indicators. So we apply the AHP method to calculate electric benefit equalization indicator weights.

According to AHP method, at first we need to analyze the relationship between the electric benefit equalization indicators and conduct the hierarchy structure. Then we compare the relative importance between every two indicators in the same layer and construct the judgment matrix based on 1-9 scale method, where 1 represents that the two indicators are of the same importance and 9 represents that the former is much more important than the latter. Finally we calculate the weights of each indicator layer by Super Decisions 1.6.0 and test the consistency of judge matrix. If the consistency indicator value is less than 0.1, the indicator weight should be accepted, if not, the judgment matrix should be modified.

4.3 Electric Benefit Equalization Index in Rural Areas

Electric benefit equalization means the equal welfare improvement of rural residents, who are recipients of electric universal service. We will construct the electric benefit equalization index to measure the welfare change and electric benefit equalization degree.

Prospect theory is resulted from connecting cognitive psychology and behavioral science with rich experimental verification.[15] It can truly reflect the decision-making

behavior in the uncertain environment. According to the prospect theory, people make decisions with limited rationality and have a higher sensitivity about losses rather than caring about gains from the selected reference point. [16] The welfare improvement inducted by the rural residents is subjective and uncertain, which is consistent with the limited rationality. Applying prospect theory into the issue of electric benefit equalization index, we found out that the individual welfare has changed relatively to the reference point after the implementation of electric universal service. Then we choose the initial indicator values before electric universal service as the reference point of the indicators.

According to the prospect theory, individuals will feel the gain when the actual indicator value is higher than the reference point, or they will feel the loss when the actual indicator value is lower than the reference point. Individuals have a higher sensitivity about the welfare loss rather than detecting welfare gain, which conforms to the actual situation.

Supposing there are M pieces of indicators and n regions in the indicator system, the welfare change caused by indicator k can be measured by Equation (9).

$$\Delta U_{kj} = \begin{cases} -\lambda\ (r_k^* - r_{kj})^{\beta} & r_{kj} < r_k^* \\ (r_{kj} - r_k^*)^{\alpha} & r_{kj} \geq r_k^* \end{cases} \quad (9)$$

Where ΔU_{kj} represents the welfare change of region j caused by indicator k; r_k^* represents the reference point value of indicator k; r_{kj} represents the standardized value of indicator k and region j; λ represents the loss aversion coefficient; α and β represents the value adjustment coefficient. $k = 1 \cdots M$, $j = 1 \cdots n$.

Therefore, the electric benefit equalization index can be measured by Equation (10).

$$B_j = \sum_{k=1}^{l} w_k U_{kj} \quad (10)$$

Where B_j represents the electric benefit equalization index of region j.

5. Electric Equalization and Electric Universal Service Effect in Rural Areas of Southwest China

5.1 Data Sources and Standardization

For estimating the effect of electric universal service in Southwest China, this paper employs the related data of the rural area in Chongqing Municipality, Sichuan Province, Guizhou Province, Yunnan Province and Tibet Autonomous Region through 2006 to 2013 to calculate the electric equalization. This paper also uses the relevant nationwide data from 2006 to 2013 as the comparison object. We obtain the related date of the five administrative divisions through consulting the relevant statistical materials and issuing the questionnaires. The relevant statistical materials include China Statistical Yearbook (2007-2014), China Rural Statistical Yearbook (2007-2014), China Yearbook of Household Survey (2007-2014) etc.

In order to eliminate the influence of indicator dimension on incommensurability, we standardize the data by the extreme value method. B11 B14 B16, as the cost indicators, should be standardized by Equation (2), and others should be standardized by Equation (1).

5.2 Electric Supply Equalization

The first step of electric supply equalization calculation is to determine the indicator weight. According to Equation (2)-(5), the weights of electric supply equalization indicators can be measured, which is listed in Table 3.

Table 3. The Weights of Electric Supply Equalization Indicators

Indicator	A_1	A_2	B_1	B_2	B_3	B_4	B_5	B_6
Weight	0.4756	0.5244	0.1439	0.1598	0.1719	0.1889	0.152	0.1835

According to Equation (6)-(8), the electric supply equalization index in rural areas from 2006 to 2013 can be evaluated, as shown in Table 4.

Table 4. The Electric Supply Equalization Index in Rural Areas of Southwest China

Year	**China**	**Chongqing**	**Sichuan**	**Guizhou**	**Yunnan**	**Tibet**
2006	1.1108	1.3495	1.3011	1.6499	1.6914	1.8361
2007	0.9969	1.2709	1.1375	1.4135	1.2144	1.3588
2008	0.8609	0.8958	0.9849	1.2395	0.8856	1.2905
2009	0.7726	0.803	0.7773	1.3161	0.9151	0.8739
2010	0.7154	0.7276	0.7566	1.1103	0.9646	1.1001
2011	0.6914	0.6892	0.7317	1.0838	0.9009	0.7415
2012	0.6509	0.5757	0.7241	1.0118	0.8453	0.7243
2013	0.6346	0.4887	0.6617	0.9303	0.8138	0.6504

The smaller the electric supply equalization index value is, the higher the electric supply equalization degree is. According to the trend of electric supply equalization (as shown in Figure 1), the electric supply equalization degree in this five administrative divisions is increasing year by year with decreasing index values. The electric supply equalization degree of Chongqing is better than the national average since 2011. The electric supply equalization degree of Sichuan and Tibet are close to the national average in 2013. The electric supply equalization degree of Yunnan is lower than these of Chongqing, Sichuan and Tibet after 2011, and maintains small change after 2010. Guizhou has the lowest electric supply equalization degree in rural areas of Southwest China after 2009.

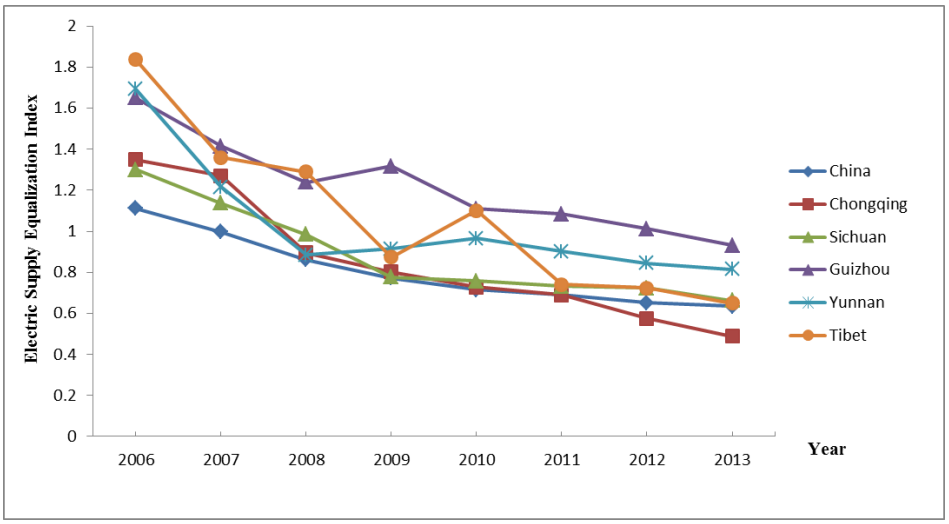

Figure 1.The Trend of Electric Supply Equalization

5.3 Electric Benefit Equalization

The weights of electric benefit equalization indicators should be calculated according to AHP method. We conduct the judgment matrixes and then employ the Super Decisions 1.6.0 to measure the weights. The consistency indicator CR of first-grade indicator equals 0.0279 and the consistency indicators CR of second-grade indicator equal 0.0077, 0.0176 and 0.0176, respectively, which shows that the judgment matrixes is consistent. Thus, the weight of electric benefit equalization indicators are calculated, which is listed in Table 5.

Table 5. The Weight of Electric Benefit Equalization Indicators

Indicator	A_3	A_4	A_5	B_7	B_8	B_9	B_{10}
Weight	0.5336	0.3164	0.1500	0.2590	0.0581	0.0581	0.1584
Indicator	B_{11}	B_{12}	B_{13}	B_{14}	B_{15}	B_{16}	
Weight	0.1767	0.1011	0.0386	0.0937	0.0358	0.0205	

According to Equation (9)-(10), the electric benefit equalization index of national rural areas in 2006 is chosen as the reference point, and then the electric benefit equalization index in rural areas of Southwest China from 2006 to 2013 can be evaluated, as shown in Table 6.

Table 6. The Electric Benefit Equalization Index in Rural Areas of Southwest China

Year	**China**	**Chongqing**	**Sichuan**	**Guizhou**	**Yunnan**	**Tibet**
2006	0	-0.5186	-0.3758	-0.6577	-0.4114	-0.5628
2007	0.063	-0.3385	-0.2135	-0.5454	-0.2936	-0.4854
2008	0.0869	-0.1679	-0.1299	-0.4647	-0.1597	-0.3886
2009	0.1871	-0.1012	0.0568	-0.3006	-0.0824	-0.2902
2010	0.2385	-0.0046	0.055	-0.1607	0.0397	-0.1769
2011	0.3862	0.1435	0.2232	-0.0152	0.1638	-0.0055
2012	0.4752	0.2917	0.3127	0.1098	0.2539	0.0928
2013	0.5345	0.324	0.385	0.1228	0.2248	0.1411

In Table 6, positive values represent the electric benefit equalization degree of the administrative division in the year is higher than the national average level in 2006, and negative values represent the opposite situation. The higher the electric benefit equalization index value is, the higher the electric benefit equalization degree is. According to the trend of electric benefit equalization (as shown in Figure 2), the electric benefit equalization index values of this five administrative divisions are increasing year by year, but still lower than the national average level. Sichuan's electric benefit equalization is the highest in rural areas of Southwest China, which shows that the rural residents living in Sichuan gain the more consistent welfare from the electric universal service than those living in other administrative divisions of Southwest China. Chongqing and Yunnan have a relatively medium degree of electric benefit equalization. The electric benefit equalization of Tibet and Guizhou are lower, which means these rural residents can't enjoy fully benefit from electric universal service.

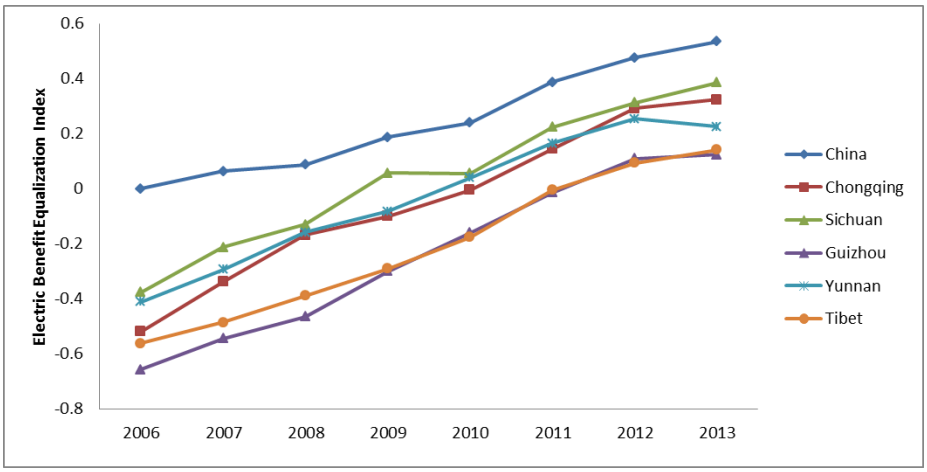

Figure 2. The Trend of Electric Benefit Equalization

5.4 Electric Universal Service Effect in Rural Areas of Southwest China

The electric equalization degree in Southwest China is increasing year by year, which is consistent with the purpose of electric universal service. We analyze the electric universal service effect by deeply researching electric equalization index and the reasons for electric inequality.

We employ the entropy weight and variation coefficient method to establish the electric power investment index and electric power service index, as is shown in Figure 3 and Figure 4. According to Figure 3, the five administrative divisions in rural areas of Southwest China have lower electric power investment equalization degrees than nation. Sichuan and Chongqing have the greatest electric power investment equalization degrees in rural areas of Southwest China, close to the national average degree, following by Guizhou and Tibet. Electric power investment equalization of Yunnan is the least. According to Figure 4, the electric power service equalization degree of the five administrative divisions is increasing year by year but still obviously lower than the national average. Government agencies and electricity utilities in Southwest China should increase investment and promote electric power service level through carrying out household electrical engineering and rural power grid renovation projects.

We employ the prospect theory to establish the economic situation index, residential electricity level index and living quality index, as is shown in Figure 5, Figure 6 and Figure 7. According to Figure 5, the economic situation equalization degrees of five administrative divisions are increasing year by year, but still lower than the national

average level. Chongqing's and Sichuan's economic situation equalization degrees are the best and similar, following by Yunnan's. Guizhou and Tibet have the lowest economic situation equalization degrees in rural areas of Southwest China. According to Figure 6, the residential electricity level equalization degrees of Yunnan and Tibet are close to the national average level. The residential electricity level equalization degrees of Guizhou is lowest in rural areas of Southwest China. According to Figure 7, the living quality equalization degree in rural areas of Southwest China is obviously lower than the national average level. Tibet's living quality equalization degree is the lowest in Southwest China. There are some other factors to influence the rural living quality, such as the age, education level, cognitive ability, etc. Even using electricity, it is very difficult to change living habits for rural residents in short term, which restricts the improvement of living quality.

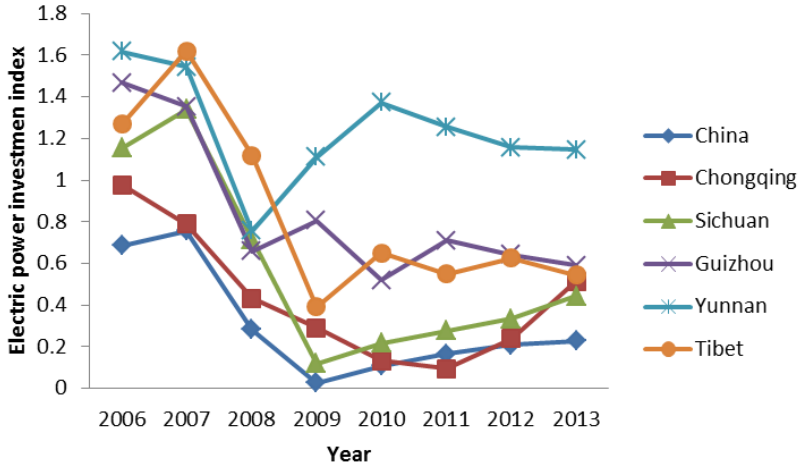

Figure 3. The Electric Power Investment Index and the Trend

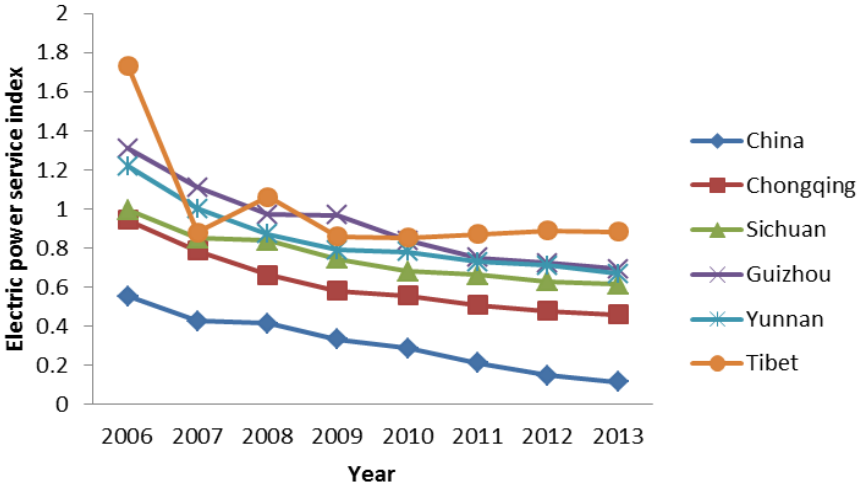

Figure 4. The Electric Power Service Index and the Trend

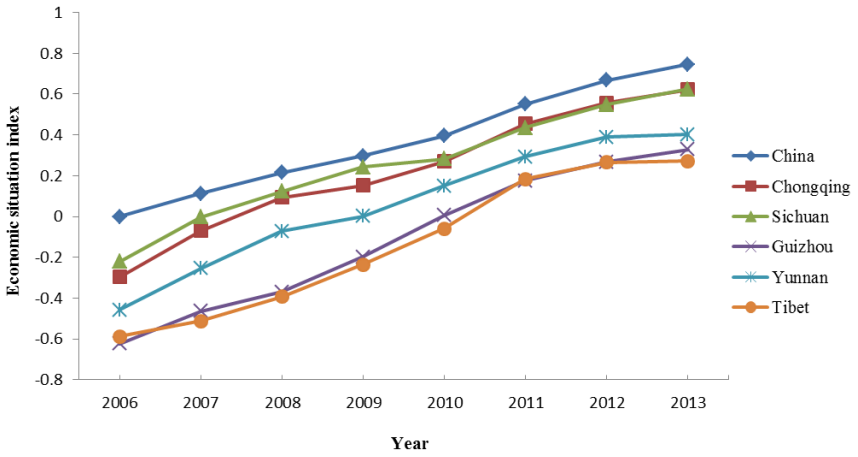

Figure 5. The Economic Situation Service Index and the Trend

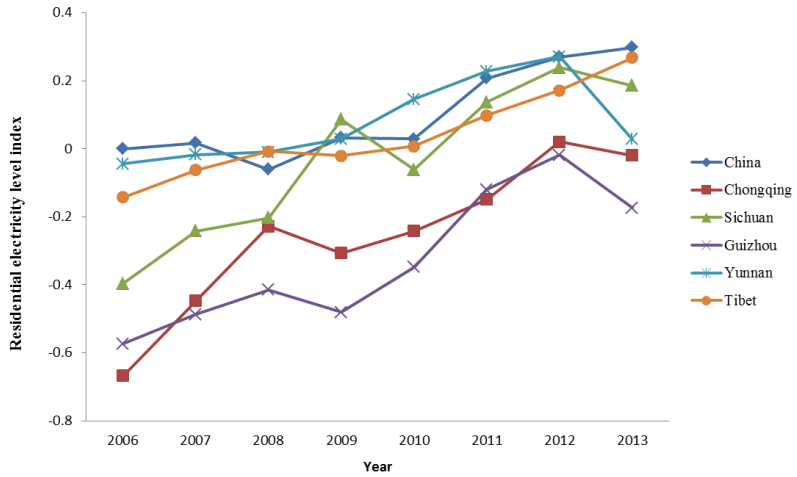

Figure 6. The Residential Electricity Level Index and the Trend

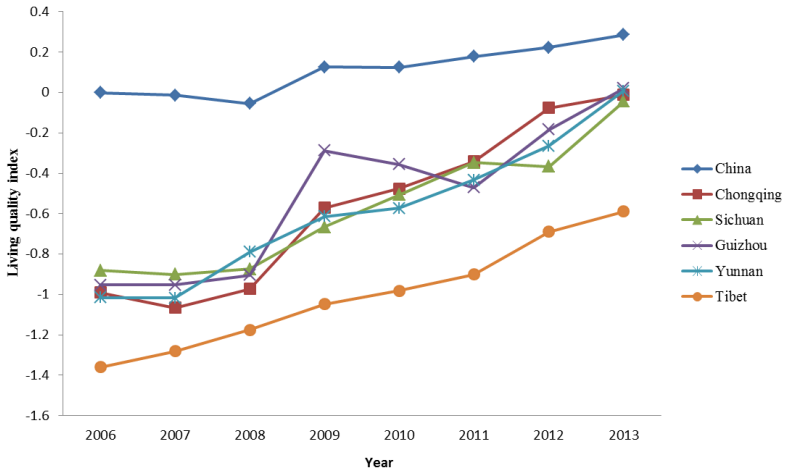

Figure 7. The Living Quality Index and the Trend

The electric universal service in Southwest China has shown a certain effect in promoting the electric supply equalization and electric benefit equalization. Based on the above analysis, we put forward the following suggestions for the implementation of electric universal service in the rural areas of Southwest China. For Chongqing City, the government and the electricity utilities should take measures to enhance the level of rural electricity service and encourage rural residents to consume electricity. For Sichuan Province, the administrative authorities should continue to carry out electric universal service from the perspective of improving the living quality. For Yunnan Province, the administrant should increase the investment of rural electricity infrastructure and motivate electricity utilities to provide better electric service for rural areas through the policy means. For Guizhou Province, local government and electricity utilities should formulate complete measures for electric universal service to improve the rural electric equalization degree, including increasing investment of rural electricity infrastructure, reducing rural electricity price and carrying out household electrical engineering and rural power grid renovation project continuously. For Tibet Autonomous Region, the administrants should make clear the relationship between electricity and economy in rural areas and propose the electric universal service implementation strategies to promote regional economic growth and improve electric service level.

6. Conclusions

Being a public service project, electric universal service is an important part of promoting the coordinated development of regional economy and the social equity and justice. Electric universal service has been implemented for many years in rural areas of Southwest China. Effective implementation of electric universal service can improve the electric equalization degree and increase social welfare to some extent. The research on the electric equalization evaluation model can provide a theoretical method for analyzing the electric equalization degree and the effect of electric universal service. The proposed evaluation model in this paper based on variation coefficient method and prospect theory from the perspective of electric equalization can fill the current research blank related to electric universal service.

According to the proposed electric equalization evaluation model and the analysis of electric universal service effect in rural areas of Southwest China, we can safely draw the following conclusions:

(1)The electric equalization evaluation model of electric universal service proposed in this paper not only includes the supply equalization, but also considers the benefit equalization. When evaluating the supply equalization, we pay more attention to the electric power investment and the electric power service in rural areas and conduct the electric supply equalization index based on entropy weight and variation coefficient method. Meanwhile, we establish the electric benefit equalization index from the perspective of individual welfare improvement by using the prospect theory.

(2)The empirical analysis of electric equalization shows that the electric equalization degree in rural areas of Southwest China is increasing year by year and the implementation effect of electric universal service is satisfactory. The electric supply equalization index and the electric benefit equalization index show the same upward trend from 2006 to 2013 in the rural areas in the five administrative divisions, but still lower than the national level to different extent.

(3) The analysis results of electric universal service effect indicate that the different implementation effect of electric universal service in rural areas of Southwest China is caused by the different equalization degrees of electric power investment, electric power service, economic situation, residential electricity level and living quality. Different administrative divisions have the different implementation levels of electric universal

service and the different improvement strategies which we put forward in the paper.

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