Research on the Global Equlty Index Model

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Abstract: In the current situation, the earth ' s resources will be exhausted one day. There are tens of thousands of asteroids in the universe. According to the current scientific research, the asteroid mining industry has its advantages. However, how to mine and in what proportion to distribute mining profits in various countries is the key to promoting global equity. Therefore, based on the reality of different levels of development in various countries, our goal is to establish a Global Fair Index to measure the degree of equity, and use this index as a standard to realize the practical problem of asteroid mining promoting global equity. First of all, we define global equity as that low-score weak countries have more opportunities to reach the average level, and advantageous countries should allocate economic resources to low-score countries to achieve global equity. To measure global equity, we introduce typical countries and regions with different levels of development (countries and regions included in the G20) to establish standard world models. Through the theory of hierarchy need, global equity is divided into Sanitation & Safety, Economic development, social equity, Education & Technology, Sustainable development, Five dimensions. Secondly, we develop a Global Fair Index Model to measure the degree of global equity. Combined with Five Demand Level, through the Entropy Weight Method, the weight of different levels is calculated, and then the Entropy Weight Method and TOPSIS Evaluation Model are used to calculate the satisfaction score of the Five Demands Level of each country. By calculating the average score of each country's demand satisfaction, the Global Fair Standard Point (0.025862938) is obtained. Each country can compare with the Global Fair Standard Point to understand its position in the global average demand level, that is, the definition of low-score weak countries and advantageous countries. Then, drawing on the standard deviation formula, we calculate the composite score reflecting the degree of satisfaction of countries ' needs over a period of time (point) on the discreteness of the global equity standard point, that is, the Global Fair Index. (The lower the Global Fair Index, the smaller the international differences, which means that the world is more equitable.)

Keywords: Global Fair Index; Fair Standard Point; Five Demand Level; Fair Guarantee Funds

1. Introduction

With the development of science and technology and the gradual depletion of Earth resources, most countries have signed the United Nations Treaty on Outer Space, agreeing to explore and utilize outer planets and recognizing them as human territory. Up to now, people have observed that the nearest galaxy to us is 13 billion light years. That is to say, if a beam of light is emitted from the galaxy at a speed of 300,000 km per second, it will take 13 billion years to reach the earth. The distance of 13 billion light years is the universe we know today. The universe is so large that the resources that can be used by human beings in the universe are also infinite. In 2010, scientists found a celestial body 50 light years away from us, and its core was all composed of diamonds. The preliminary judgment was 1034 carats, far beyond the range that human beings can understand. Therefore, almost every country is actively exploring how to obtain more resources in the universe.

The barriers to technology, the high costs and the economic benefits that should be enjoyed when acquiring space resources. These problems may arise from mining on asteroids. How to define global fairness, how asteroid mining will affect fairness, how it will affect fairness, and what policies the United Nations can formulate to balance fairness are the primary tasks to ensure the reasonable progress of asteroid mining.

2. Global Equity Index Model

2.1. Definition of Global Equity

Based on the purposes of the United Nations and the "United Nations Regulations on Outer Space,"

we define global equity as a trend that countries can move closer to a global equilibrium point through the current allocation of resources and opportunities.

We believe that global equity is made up of equity in the five broad categories of demand satisfaction in the world. The satisfaction degree of various needs is an obvious manifestation of opportunity and resource allocation.

In the reality that there are countries in a dominant position and relatively weak countries in the world, we advocate those weak countries have more opportunities to reach the average level. Countries in a dominant position should allocate economic resources to weak countries so as to achieve global fairness.

2.2. Quantitative analysis:

1) Comparison of the average score of fair use between countries and the global equity benchmark.

2) Global equity can be quantified by calculating variances between countries ' scores and global equity benchmarks, leading to global equity trends in time dimensions.

To this end, we established the Global Equity Index Model to evaluate equity in the spatial (inter-country) and temporal (historical) dimensions.

2.3. Global Equity Index Model

2.3.1. Index numerical pretreatment

- **Harmonization of indicators**

Due to the different nature of different indicators, the content expressed is not consistent. According to their own attributes, indicators can be divided into positive indicators, reverse indicators and moderate indicators. The larger the positive index value is, the better the performance of the index is; the smaller the reverse index value is, the better the performance of the index is; neither too large nor too small the moderate index value is good, and it is in the middle. There are many indexes selected in the essay, including positive indexes, reverse indexes and moderate indexes. If the index attributes are not unified, the final evaluation results can't be judged.

Therefore, before the comprehensive evaluation of the satisfaction degree of the five needs of each country, it is necessary to deal with the consistency of the evaluation indexes, and transform the indexes of different attributes into the indexes of unified attributes. In this paper, the indexes are unified into positive indexes. The method of index transformation is as follows:

a) Reverse indicator transformation

If index X is a reverse index, the following formula can be used to transform into a positive index, where M is the maximum value in the range of index X.

$$X' = M - x \tag{1}$$

Or for reverse indicator X, take its reciprocal and turn it into a positive indicator:

$$X' = \frac{1}{x} \tag{2}$$

b) Moderate indicator conversion

If the index X is a moderate index, the following formula can be used to transform into a positive index, where m and M are the maximum and minimum values in the range of index X, respectively.

$$X' = \begin{cases} \frac{2 \times (x-m)}{M-m}, & m \leq x \leq \frac{m+M}{2} \\ \frac{2 \times (M-x)}{M-m}, & \frac{m+M}{2} \leq x \leq M \end{cases} \tag{3}$$

Or convert X into reverse index according to the following formula, and convert it into positive index by using formula (1) or (2).

$$X' = \left| x - \frac{M+m}{2} \right| \tag{4}$$

- **Non-dimensionalities of indicators**

Since the units of different indicators are different, they cannot be compared, so before the evaluation,

all indicators need to be dimensionless to eliminate the impact of different dimensions and make the data comparable. The global equity index evaluation system constructed in this paper has many indicators, some indicators are in percentage, such as the proportion of R & D expenditure in GDP; some indicators are in square kilometers per people, such as per capita land area; some indicators are in units such as life expectancy at birth. Therefore, in order to ensure the accuracy of the evaluation results, before the comprehensive performance evaluation of Jiangxi power grid, all evaluation indexes need to be dimensionless.

There are many methods for dimensionless processing of indicators. At present, the commonly used methods include: linear ratio method, extreme value method, standardization method, vector normalization method and so on. In this paper, the extreme value method is selected as the dimensionless method of the global equity index evaluation system. The characteristics of the extreme value method are that all the index values are transformed into 0-1 intervals, the minimum is 0 and the maximum is 1. In addition, in order to make data processing meaningful, all dimensionless indexes can be translated into a minimum unit value to meet the operation requirements. The formula of extreme value method is as follows:

(1) For positive indicators, the following formula can be used:

$$X_j = \frac{x_{ij} - m_j}{M_j - m_j} \tag{5}$$

Where M_j is the maximum of X_{ij} and m is the minimum of X_{ij}.

(2) For the reverse index, it can be treated as follows:

$$X_j = \frac{M_j - x_{ij}}{M_j - m_j} \tag{6}$$

2.3.2. Entropy Weight Method

This paper uses the entropy method as the weighting method of the global equity index model to calculate the final performance score, so that the evaluation results are more accurate.

'Entropy' was first proposed as the concept of thermodynamics, and then was introduced into the information theory to show the degree of confusion in the system. The smaller the entropy value is, the more useful information it provides and the more important the index is; the larger the entropy value is, the less useful information the index provides, and the less important the index is.

Assuming that n countries are selected as samples and m evaluation indexes are designed, X represents the jth index value of the ith country ($i = 1,2,3,......$ n; $j = 1,2,3,......$ m). The application steps of entropy method are as follows:

(1) Undimensionalize the original data, eliminate the influence of physical quantity, calculate the characteristic proportion or contribution of the ith enterprise under the jth index.

$$p_{ij} = \frac{x'_{ij}}{\sum_{i=1}^{n} x_{ij}} \tag{7}$$

The results of the dimensionless treatment of the average G20 national equity indicators over the past decade. In order to make the data processing meaningful, it is necessary to eliminate the zero and negative values. Therefore, it is necessary to carry out the overall translation of the dimensionless data, *i. e.*, $X_{ij} = X_{ij} + \alpha$. However, in order not to destroy the inherent law of the original data and retain the original data to the maximum extent, the value of a must be as small as possible, *i. e.*, the closest minimum value. In this paper, $\alpha = 0.0001$.

(2) Entropy calculation. Calculate the entropy of jth item.

$$e_j = -\frac{1}{\ln n} \sum_{i=1}^{n} p_{ij \ln(p_{ij})}, 0 \le e_j \le 1 \tag{8}$$

(3) Difference coefficient calculation.

$$g_i = 1 - e_j \tag{9}$$

(4) Determine the weight of the evaluation index w, calculate the enterprise comprehensive score.

$$W_j = \frac{g_i}{\sum_{i=1}^{m} g_i}, j=1,2,3……m \tag{10}$$

Table 1: Entropy, Difference and Weight of Global Equity Evaluation Index

	Entropy e_j	Diversity factor g_j	Weight w_j
Per capita land possession area	0.6486	0.3514	0.3486
GDP	0.8084	0.1916	0.1901
Carbon dioxide emissions	0.9783	0.0217	0.0215
Gini Coefficient	0.8666	0.1334	0.1324
Per capita disposable income growth rate	0.9617	0.0383	0.0380
Life expectancy at birth	0.9675	0.0325	0.0322
Duration of compulsory education	0.9111	0.0889	0.0882
Total rent of natural resources	0.9798	0.0202	0.0200
R & D expenditure	0.8700	0.1300	0.1290

Table 1 shows the entropy, difference index and weight of each evaluation index of the global equity index in the past decade, which provides the basis for the comprehensive evaluation of global equity (using entropy method and analytic hierarchy process respectively below).

(5) Calculate the scores of the nine indicators for each country. The calculation formula and results are as follows:

$$s_{ij} = w_j \times p_{ij} \tag{11}$$

(6) Calculate the satisfaction degree of each country's five demand level.

For each country ' s data, the average value of n indicators corresponding to each demand are calculated, and five data are obtained, which is recorded as the degree of satisfaction from each demand. The part expressed by gray shadow is the score of each country ' s demand satisfaction. The results are as follows:

(7) Calculation of comprehensive scores of five country demands satisfaction

The index weight w_j is multiplied by the ratio p_{ij} of the first evaluated object on the j evaluation index to obtain the comprehensive performance score of each evaluation object, and then the ranking comparison is carried out according to the score. The calculation formula of comprehensive score S is as follows:

$$S = \sum_{j=1}^{m} w_{j \times p_{ij}} \tag{12}$$

In order to evaluate the fairness of countries around the world more comprehensively and effectively, this paper calculates the scores and comprehensive scores of G20 countries (in which the EU belongs to regional organizations) in various aspects in the past ten years according to the above formula (the score is a relative number, which is only applicable to the comparison between different countries in the same year, and the score of the same country is different in different years).

In the model, we believe that the fairness of all countries in the world should be composed of the fairness of the five demands of people. Therefore, the scores of the five demands of all countries are added to obtain the comprehensive scores of the five demands of the country.

3. Sensitivity Analysis

In this paper, TOPSIS method and entropy weight method are used to calculate the comprehensive score of G20 countries ' demand satisfaction, so as to verify and supplement each other. When calculating the final score results, this paper takes the average value of the two, that is, the weight is 0.5. For sensitivity analysis, we assign different weights to the two methods and recalculate the results.

If the score weight calculated by TOPSIS is w_1, the score weight calculated by entropy weight is $1 - w_1$. Let $w_1 = 0.2, 0.3, 0.5, 0.7, 0.8$, and the five calculation results are shown as follows:
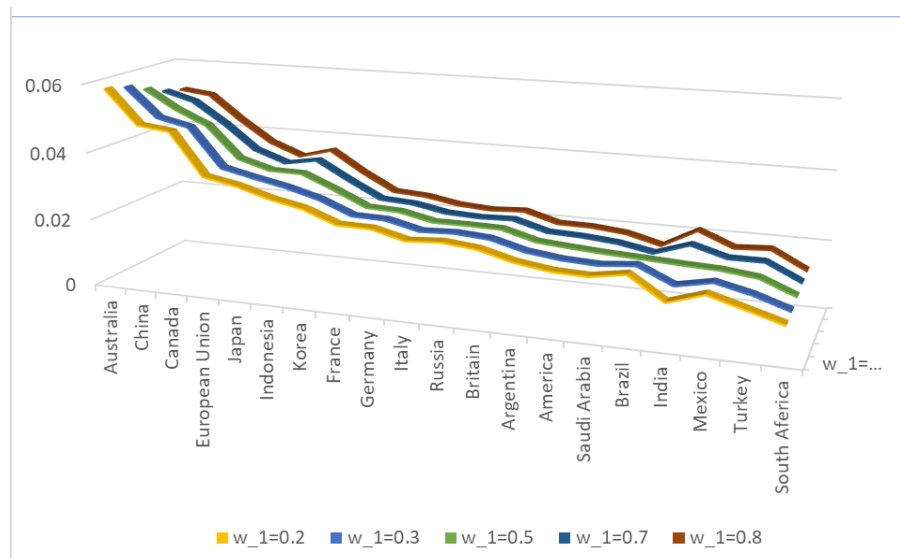
Figure 1: Trend of the comprehensive scores of G20 countries

We find that, as shown in the Figure 1, the trend of the comprehensive scores of G20 countries calculated under different weights is roughly the same. Therefore, it is reasonable to believe that the comprehensive scores of countries calculated by entropy method and TOPSIS verification are true and reliable. In addition, the relative level between countries is stable.

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