"How to avoid World War III?"
Nachuan li

Abstract (A)

The resources beneath our feet have been unfairly taken away, and we cannot allow it to perpetuate over our heads.

Asteroids are currently considered a potential source of resources that could ameliorate many of the woes facing the world. But in **the distribution and utilization of resources**, it will cause many disputes about **global equity**, and even lead to the third world war. In order to study the impact of asteroid mining on global fairness and formulate corresponding improvement policies to prevent the outbreak of war, we have established **an indicator model for evaluating global equity, a predictive model for evaluating the impact of asteroid mining on Earth, and a forecast for future resource allocation model**. We also used a number of **data visualizations** to make the results more intuitive.

Aiming at the poor living conditions and the uneven distribution of the earth's resources that people in underdeveloped areas are enduring, we selected **7 raw data from 9 representative countries** in the world, and used **AHP** to weight and merge to obtain a global The data were standardized using **the Z-score standardization method**, and then three main factors were obtained using the factor analysis method, and **Global Equity Indicator(GEI)** was finally calculated to evaluate the current level of global equity.

We made predictions about the impact of asteroid mining on resources on Earth in the future, and obtained the changes brought about by the development of asteroid mining on **oil prices and mineral prices**. Combined with the status quo that only a few countries have asteroid mining capabilities, combined with the fair model The depressing conclusion that global equity **will worsen** in the future if resources are not allocated.

In response to such a conclusion, we propose **three feasible future resource allocation models** — mining company (enterprise)-led, national government-led (dictatorship or oligarchy is not excluded), or international organization-led. We creatively use **the minority game in reinforcement learning** to predict the future resource allocation, combined with the global equity model, the final conclusion obtained is similar to our expectation — **relying on international organizations to maintain global equity.**

Finally, we assess the reality of these policies, as well as **the difficulties and limitations** of implementing them. We also made comments on the update and refinement of the Space Treaty. Our model system and method may have some value in the real-world European acceptance of refugees and climate change.

Keywords: Global equity, Asteroid mining, AHP, FAM, Policies, Outer Space Treaty

Contents

1 Introduction

1.1 Background

In recent years, with the gradual maturity of technology, space activities have become increasingly frequent, the economic attributes of space activities have been constantly enhanced, and the main body of space activities has become increasingly diversified. The exploitation of asteroid resources is becoming feasible, among which asteroid mining has also attracted the attention of all parties.

However, the exploitation of resources is bound to bring challenges to the subject of global equity.[1] The United States and Luxembourg have promulgated laws on the exploitation and utilization of outer space resources, which have also aroused certain controversies. In these circumstances, it is imperative to review the Outer Space Treaty.

1.2 Our works

In order to deal with the situation, we have completed the following tasks:

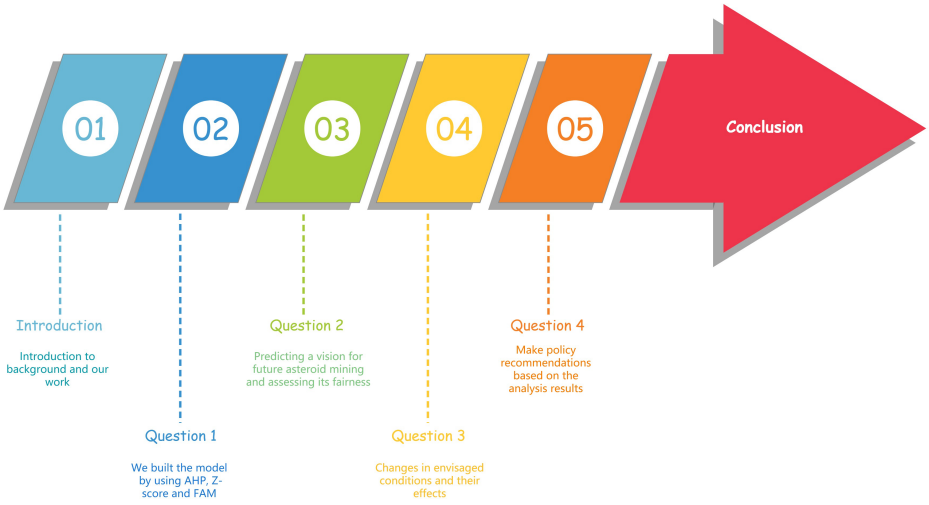

Figure 1: Our mind map

- We give a definition of global equity, and build a model to evaluate global equity (GEI) by combining historical and regional analysis. In this model, we use analytic hierarchy process to get the weights of each indicator, and then use factor analysis method to calculate GEI.
- We describe possible visions of future asteroid mining and use the model we have developed to assess the impact that asteroid mining might have on global equity, as well as to analyse the impact of that change on global equity when the asteroid mining landscape changes.

- We developed and implemented an analytical method —- Q-learning to explore how changes in the asteroid mining sector and the conditions that define the vision will affect global equity in different ways.
- Based on the results of the model, we propose some reasonable suggestions for the improvement of the OUTER Space Treaty, so as to promote global equity and benefit all mankind.

2 General Assumption and Symbol Explanation

2.1 General Assumption

In order to make the model accurately reflect global equity, the following assumptions are made:

1. The statistics we collect from the website are practical and reliable.

2. Global equity is only relevant to our evaluation indicators.

3. In a certain period of time, some indicators will not be affected by policy implementation and can be regarded as constants.

4. A relatively stable international environment means that there will be no natural disasters such as major earthquakes, wars, economic crises, terrorist attacks and other man-made destruction.[2]

2.2 Symbol Explanation

Symbols	Definitions
GEI	Global Equity Index
CR	Consistency ratio
W	Eigenvectors of A
S	The Standard Deviation of The Sequence $\{x\}$
C	Load Matrix
B	Coefficient Matrix

Table 1: Symbols & Definitions

3 Main Factors and Data Selection of Global Equity

3.1 Definition of Global Equity

Considering fairness definition with the vision of sustainable development goals, considering the universal declaration of human rights of appeal and the preface of the charter mentioned UNESCO "human dignity, equality and mutual respect for democratic principles", the world's fair will focus on developing countries and less developed areas

to improve the quality of life and the environment quality, So that the serious social problems that afflict them can be solved, so that they can have dignity, decent work, and enjoy the same standard of living and prosperity as developed countries - no discrimination, fair trade, and equal international status.

3.2 Main Factors

In today's world, the problems of unbalanced development make the residents of some countries suffer poorer conditions and have shorter life spans. In 2000, the United Nations proposed the Millennium Development Plan to further promote sustainable development of regions and countries around the world. Our group believes that achieving "global equity" is crucial to achieving Rational allocation of resources, which will not only improve the environment of countries suffering from energy pollution, but also ease the ecological contradiction on the earth. The 17 Sustainable Development Goals (SDGs) proposed in 2015 are also some ways to improve the earth's environment and achieve global equity. So, in measuring global equity, we look to the Millennium Development Plan and the 17 SDGs to quantify "global equity".[3]

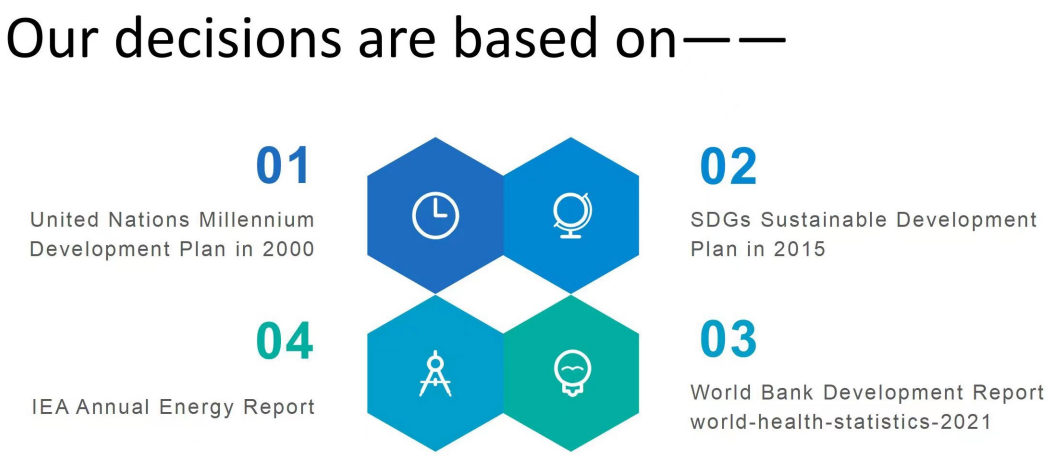

Figure 2: Decision-making basis

Of course, we collected nine radically different countries for our analysis: developed, developing and less developed. The world's leading United States, Japan at the heart of natural conflict, Refugee-plagued Germany in Europe, developing China and India, energy powerhouse the United Arab Emirates, Gambia, one of the most backward places on earth, South Africa in turmoil, and the Pacific island nation of Kiribati. A "fairness index" that measures their place in the world. And, of course, here we have the world index over the years.

As stated above, we believe that the definition of global equity is that all countries enjoy equal social well-being, technological level and high life expectancy, independent of energy issues, interference from other countries and trade. We recognize that some Nordic countries have high social welfare, but it does not mean that all countries in the

world need to achieve such welfare to be called global equity. Again, this stable expectation does not take the same form in every country; it can be skewed or even radically different from one country to another.

Figure 3: Factors affecting global equity

Our team determined the factors shown above by combining data collection and searching of relevant literature.

3.3 Index Selection

Trade

The prosperity of trade also means the creation of more wealth, which helps to bind the country closely to the economic globalization, allowing advanced resources and technology to flow into the development of the region, providing a better environment.

Education

According to a report released by UNESCO, eliminating illiteracy is a daunting task for the less developed regions. If equality is about equal access to education for students from different countries and personal development, then the elimination of illiteracy is the fundamental guarantee of Equity. The fairness of education will also get the sharpest and truest embodiment from this aspect.

Energy

The disparity in oil use is also a measure of equity. Energy, represented by oil, provides heat and light for human survival, and energy inequality is a challenging factor in determining global equity. Because once the energy shortage is solved, especially the use of clean energy, the environmental contradiction will be greatly alleviated, and the environment in areas deeply polluted by fossil fuels will be improved, and the average life expectancy will be prolonged with the improvement of the environment and the reduction of pollutants. If we are asked to predict the most direct way to solve the problem of inequity, we believe that increasing the energy resources on the planet is a key factor.

Science and technology innovation

Abundant resources and energy bring possibilities to the development of science and

technology. Advanced science and technology can change the disadvantage of regional backwardness and disease treatment.

Health

We chose the average life expectancy as the measurement index. The World Health Organization has taken the local ecological environment and the role of peace into great consideration in the calculation and research process, which is an extremely authoritative indicator to measure equity, and this consideration is obviously mentioned in our definition of equity.

Income

We recognize that the national income of different countries in today's world is wide, and this is also reflected in their quality of life, purchasing power, ability to cope with risks and other indicators. Therefore, the narrowing of income gap is also an indicator that cannot be ignored to measure global equity.

Social

The gap between the rich and the poor is a measure of the realization of national equity within a country. Although it is foreseeable that the Gini coefficient will exist for a long time due to the development of capitalism, its reduction also contributes to global equity.

Indicator	**Quantification**	**DS**
Trade	Trade Sentiment Index	WTO
Education	Illiteracy	UNESCO
Energy	Oil Use Per Capita	World Bank
Technological Innovation	Technological Innovation Index	WIPO-GII
Health	Life Expectancy	WHO
Income level	Rating Index	WIPO-GII
Society	Gini Coefficient	World Bank

Table 2: Indexes

4 The Model for Global Equity

Since the object we want to evaluate is **global equity**. Therefore, it is not representative to analyze only the data of a single country or the data of a certain year.

Based on this, we collected seven indicators from nine countries over the five-year period **2016-2020** to support our modelling. We found a total of 9 countries with different levels of development in the world. The United States, Japan, Germany, China, India, South Africa, the United Arab Emirates, Kiribati and the Gambia. We divide these 9 countries according to the table below.

In order to reflect the imbalance between countries, we will calculate the variance of

each indicator in each year with the above four groups of countries as the most original data.

Worldwide	**Developed**	**Sub-developed**	**Backward**
All Nine Countries	United States Japan Germany	China India United Arab Emirates	South Africa Kiribati Gambia

Table 3: Countries Grouping

However, these raw data still need further processing to obtain a single indicator that can reflect the fairness of the world, so we consider weighting four categories of raw data.

Specifically, for the four determined indicators $\{a_i\}$, assuming that we have obtained a set of appropriate weights $\{w_i\}$, we can obtain an indicator that can represent the current time and this indicator accordingly. **Global Equity Indicator** P.

$$P = \sum_{i=1}^{4} w_i \cdot a_i$$

4.1 Determination of indicator weights

First of all, we give weight to every index by using **Analytic Hierarchy Process(AHP)**.

Step1: Build layers

The indicators are divided into four components: the variance of the worldwide, the variance of developed countries, the variance of sub-developed countries and the variance of backward countries.

Step2: Establishment of the **comparison matrix**

Construct a comparison matrix for each primary and secondary indicator:

$$A = \begin{pmatrix} 1 & 3 & 2 & 3 \\ \frac{1}{3} & 1 & 1 & 1 \\ \frac{1}{2} & 1 & 1 & 2 \\ \frac{1}{4} & 1 & \frac{1}{3} & 1 \end{pmatrix} \begin{matrix} Worldwide \\ Developed \\ Sub-developed \\ Backward \end{matrix}$$

Step3: Consistency check

For each comparison matrix we perform the following method to judge its consistency.

Due to space limitations, we omit the specific process here. The consistency of the matrix is considered acceptable if $CR < 0.1$.

Step4: Calculate the weights

Let the vector W satisfy:

$$AW = \lambda_{max} W$$

Then according to the above inference, the $W = (w_1 \dots w_n)^T$ will satisfy the following conditions:

$$a_{ij} = \frac{w_i}{w_j}$$

From this we get:

w_1	w_2	w_3	w_4
0.4690	0.1758	0.2283	0.1269

Table 4: Group Weight

This is exactly what we need to satisfy the weights of the comparison matrix. According to the above formula, we can get the **indicator** representing global equity.

4.2 Data Normalization

Considering that the sizes of these metrics are **not same**, we normalize and forward them, and we use the $Z - score$ normalization method.

$Z - score$ normalization The normalization method is suitable for the case of outlier data that exceeds the value range. Our variance is a kind of data of these characteristics. By applying this normalization method, we can finally normalize all the data, that is, make the processed data obey the positive The state distribution $N(0, 1)$. Let $f(x)$ be the normalized value of x, and $\{x_i\}$ be the original data sequence. We stipulate:

$$\overline{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

$$S = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \overline{x})^2}{n-1}}$$

$$f(x) = \frac{x_i - \overline{x}}{S}$$

This leads to our normalized metric.

However, when we get global equity indicators for different indicators in different years and normalize them, we find that there are still a full seven indicators to consider.

4.3 Data dimension reduction

In view of the mutual influence and effect of many indicators, we use **factor analysis method (FAM)** to reduce and reduce the number of indicators, and weight each factor obtained by it.

Assuming there are n samples and m indicators, then we can form a sample indicator matrix of size $n \times m$:

$$X = (x_{ij})_{n\times p} = (x_1 \dots x_p)^T$$

We need to find a mapping $(x_1 \cdots x_p)^T \to (f_1 \cdots f_m)^T (m \le p)$ and make this mapping satisfy:

$$\begin{cases} x_1 = \quad \mu_1 + \varepsilon_1 + \sum_{i=1}^{m} a_{1i} f_i \\ \quad \vdots \\ x_p = \quad \mu_p + \varepsilon_p + \sum_{i=1}^{m} a_{pi} f_i \end{cases}$$

Where $f_1,\ f_2,\ \cdots,\ f_m$ are called **regression factors**, $\varepsilon_1,\ \varepsilon_2,\ \cdots,\ \varepsilon_m$ are special factors, and the linear combination of each factor can form the original index, And $A = (a_{ij})_{p\times m}$ is the load matrix, and μ_i is the mean of the i item. Then we write the system of equations as:

$$X = \mu + \varepsilon + Af$$

Each element in A is the covariance between the original variable x_i and the common factor f_j, that is: $a_{ij} = cov(x_i, f_j)$. According to A we calculate the contribution of the common factor f to the original indicator x. [Cumulative Contribution Rate Chart] When our cumulative contribution rate reaches 90 and above, it means that our main factor can explain the information of the original index 90% and above. Therefore we chose 3 main factors.

Next we need to calculate the factor scores. Consider finding the matrix $B = (b_{ij})_{m\times p}$ so that it satisfies:

$$\begin{cases} f_1 = \quad \sum_{i=1}^{p} b_{1i} x_i \\ \quad \vdots \\ f_m = \quad \sum_{i=1}^{p} b_{pi} x_i \end{cases}$$

After we find the coefficient matrix B, we can get the factor score formula:

$$\begin{cases} f_1 = 0.904x_1 + 0.597x_2 - 1.957x_3 + 0.431x_4 - 0.187x_5 + 0.166x_6 - 0.335x_7 \\ f_2 = 6.115x_1 + 4.538x_2 - 6.136x_3 - 0.886x_4 - 1.586x_5 - 0.710x_6 - 0.738x_7 \\ f_3 = 0.200x_1 - 0.291x_2 + 0.225x_3 + 0.254x_4 + 1.115x_5 + 0.398x_6 - 0.083x_7 \end{cases}$$

After the normalization of the factor scores, the weight w_i corresponding to each factor can be obtained as follows:

Factor1	Factor2	Factor3
0.4258	0.4225	0.1517

Table 5: Normalized Index

Then the factor index is calculated according to the original index and the coefficient matrix B, and then multiplied by the factor weight to get our final coefficient. The final global fairness calculation formula is as follows:

$$GEI = 0.4258F_1 + 0.4225F_2 + 0.1517F_3$$

The pie circle graph of country grouping weights and factor weights is shown below:

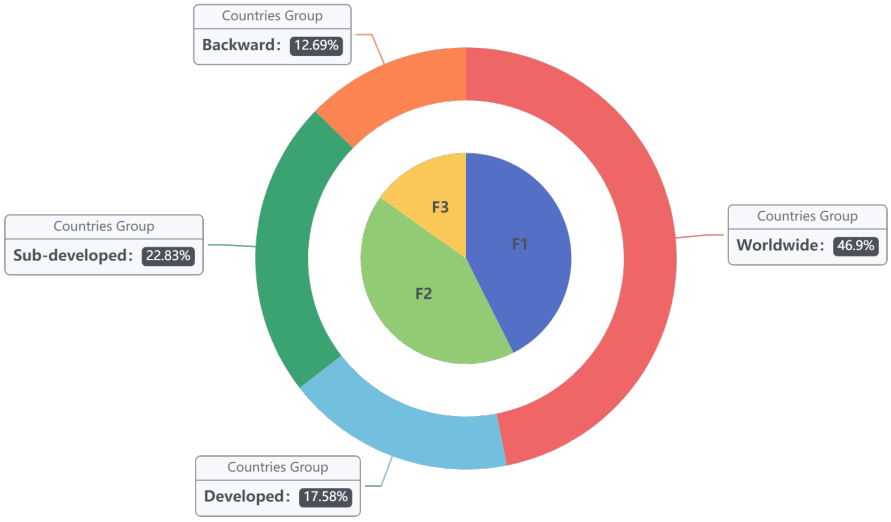

Figure 4: Country grouping weights and factor weights

The **final calculation** results for 2016-2020 are as follows:

Year	2016	2017	2018	2019	2020
GEI	1.9635	1.4020	1.8038	1.3132	2.1708

Table 6: GEI Score

The **smaller** the GEI, the **greater** the global equity in the year.

5 A Vision for the Future of Asteroid Mining

The development and utilization of space resources is a new frontier in the game between great powers and the commanding height of scientific and technological competition. It bears the hope of sustainable development of human civilization in the future, and is also a major strategic issue concerning the future development of all countries. We build a global vision of asteroid mining based on the current status of space mining, as well as the development of Antarctic and ocean mining, and use our model to analyze how asteroid mining will affect global equity. Ball fair contribution.[4]

5.1 The description of our vision

1.Coexistence of cooperation and competition

In our vision, 3-10 space organizations will be established to conduct space exploration and development, and the most likely ones are east Asian, North American, European Union, CIS, African, Arab, South American and other space development organizations. At the same time, private companies mining asteroids of all kinds will have some serious competition. Scientific research institutes are also attached to some national government organizations or private companies for research needs, while the national government will also provide investment to some private companies. The result will be a landscape of cooperation and competition to promote space exploration and resource exploitation.

2.Resources are first come, first served

Whoever establishes the space base first will have the right to develop the surrounding resources. It is forbidden to carve up undeveloped areas by agreement without actually having a space base. Space resources must be on a "first come, first served" basis.[5]

Space exploration is a difficult undertaking, and mankind should encourage and promote it, not limit it. There are only a handful of countries with space exploration capability. It is meaningless to restrict it. After 100 years, 95% of countries still do not have space exploration capability. A few countries are destined to lead humanity, and any unreasonable restrictions on space exploration are unacceptable.

3.Establish the International Organization for the Exploration of Minor Planets

The Legal Subcommittee should study the establishment of an international mechanism for the exploitation and exploitation of natural resources in outer space, and may re-examine the Space Agreement and consider the feasibility of establishing an international mechanism. In order to promote global equity and the well-being of mankind, the exploitation of natural resources in outer space should be carried out through multilateral means and international cooperation.

According to the organization, a zone of 50 kilometers around each space base is an exclusive economic zone. During the period of operation of the space base, the owner country (organization) of the base has the exclusive right to develop the area. If the base is abandoned, the exclusive economic zone will also be cancelled, and other countries

(organization) can take over the development.

4.Relevant national legislation

Limiting private companies to no more than 20 percent of the country's total asteroid mining, and requiring them to pay a tax of 7 percent to the state. The state restricts the export of asteroid mining products and the circulation of domestic asteroid mining products.

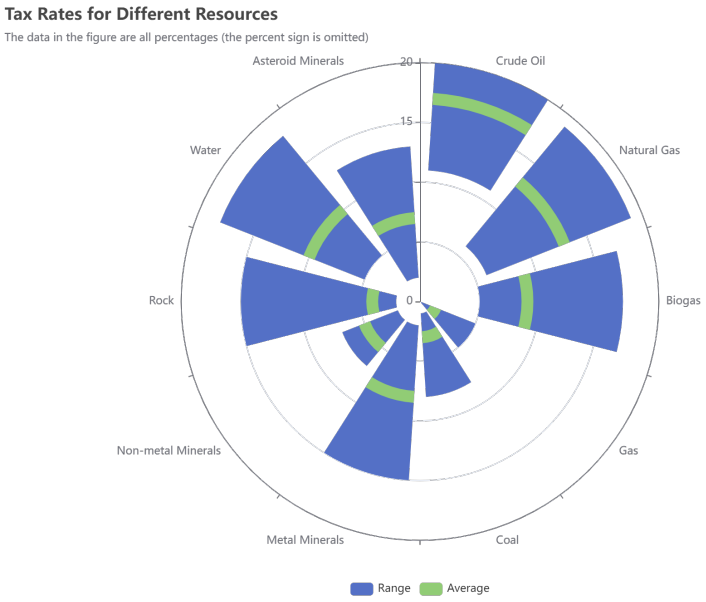

Figure 5: Tax rates for different resources

5.Distribution of benefits

Profits earned by private companies are distributed according to internal decisions. The resources collected by the national government shall be distributed by the national government. Profits from the research institute are used for the educational development of the institute.

5.2 The application of the model

According to our policy vision, asteroid mining will bring more energy and resources to earth – some asteroids are known to contain significant amounts of combustible ice, as is already the case with missions to Mars. The acquisition of resources focuses on metal materials and high-performance nonmetals. We mentioned in our initial hypothesis that such exploitation is profitable, so we can understand that such action brings more resources and energy to the earth, especially clean energy.

We assume that asteroid mining is a gradual process, with mining acquisition increasing over time but not increasing after a peak as resource depletion is realized. It's like drilling for oil. Let's say this is a logistic curve. At present, humanity consumes nearly 5 billion tons of oil per year, and total energy consumption remains relatively constant.

Assuming that 1% of oil demand is obtained in the early stage and 5% of oil demand is obtained in the long term. In the process of acquiring quantity changes, oil price changes according to short-term elasticity of 0.05, long-term elasticity of 0.30 and price elasticity formula, as shown in the figure.

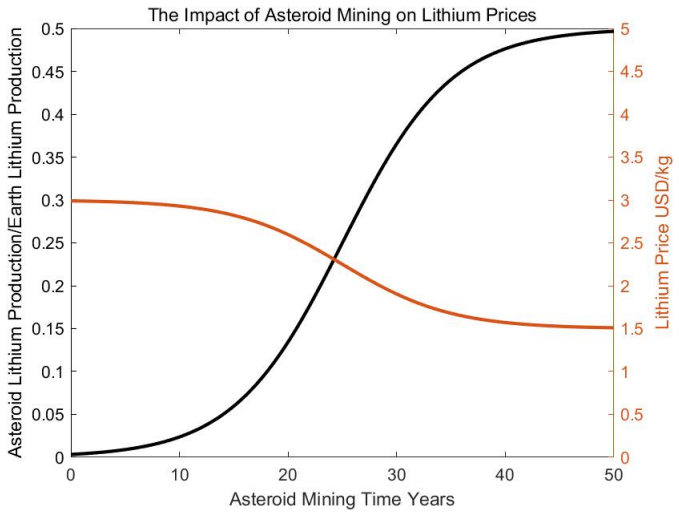

Figure 6: The impact of Asteroid Mining on Lithium Prices

So even if the cost of mining an asteroid were to sell at the same price as oil, the two prices would fall. Of course, we assume that the cost of extraction is equal to that of oil.

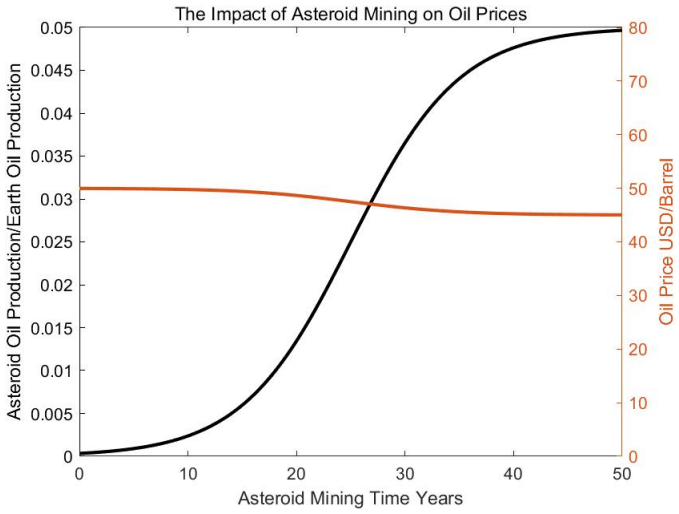

Figure 7: The impact of Asteroid Mining on Oil Prices

For behavior on the asteroid mining mineral resources, because it cannot quantify its output, but the foreseeable that trade sentiment will rise, as dependent on precious metals electronics and information costs down, the per capita income will rise, assuming that for each country's per capita income has increased, and the mineral resources to alleviate contradictions, predictably, Just as asteroid energy has hit oil prices, precious metals are also facing a fall. Here we use the price of lithium metal as a forecast.

World lithium production in 2020 is 83,600 tons, the price is about $300,000 a ton. Given the abundance of lithium produced in asteroids, it is assumed that 10-50% of lithium could be replaced each year. The price elasticity is 0.04 in the near term and 0.20 in the long term.

5.3 The impact of mining on global equity

We factor in the benefits of mining into the model proposed in our first question. Cheaper energy increases per capita oil use by 4%, and the boom in cheaper minerals increases the trade index by 4%, we can get a graph of the change of decision factor with years, and then calculate the year-by-year change of the fairness coefficient.

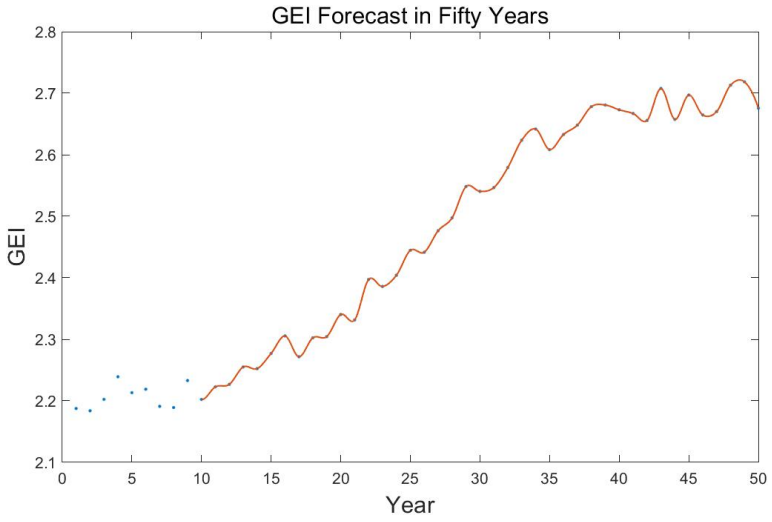

Figure 8: GEI forecast

When considering the gains obtained by different countries, we use the technology level as a weight to calculate the weight. Under such circumstances, Kiribati and The Gambia received meager resources, while developed countries received considerable resources.

According to our indicator calculations, when there is no certain policy implementation, the minerals mined in space will only be owned by countries that have the ability to go to space, which will only exacerbate inequity. Certain scientific interventions and policies are necessary, and this part of the content will be elaborated in Section 6.

6 The Analysis of Condition Changes

Our vision for asteroid mining is described above, but a distant vision has too much uncertainty, so there are parts of it that can be adjusted artificially.

6.1 A statement on the view that "space resources belong to all mankind"

The Outer Space Treaty of 1967 stipulates that all countries shall not use or occupy outer space including the moon and other celestial bodies for their own use by means of national sovereignty requirements.

When the resources of outer space become available, we believe that space resources belong to all mankind, and this proposition is also conducive to "global equity". However, in the actual mining process, mining enterprises and mining organizations in some countries are more inclined to take the resources they have obtained as their own. In order to achieve global equity, we propose that all mining in outer space should be supervised by an organization independent of other countries, and that most of its profits should benefit all other countries. Since every natural person is the owner of space resources, the distribution of profits is also based on "reaching the level of global equity".[6]

We admit that it is very difficult to do this, and in 6.2 we will calculate this idea and principle accurately.

6.2 Level of government, business, and international involvement

To evaluate the impact of different mining schemes on mining results, we introduce multi-agent clusters in reinforcement learning to reflect changes in resource allocation. We use varying learning rate (α) and discount factor (γ) to study resource allocation under different policies. The larger the discount factor (γ), the more forward-looking considerations are in mining and distribution. The larger the learning rate (α), the more consideration will be given to the interests of the minority when resource allocation is made, and the allocation can be scientifically allocated according to our preset "space resources belong to all mankind". The specific allocation method will be in 6.3 mentioned in.

After mining, resource allocation is prioritized according to its wishes:

- **Mining is led by enterprises and assisted by the government.**

  We assume that the distribution decided by enterprises will pay more attention to short-term interests, while the number of individuals who do not participate in the game will gradually decrease.

  α=0.3 γ=0.3 ε=0.02

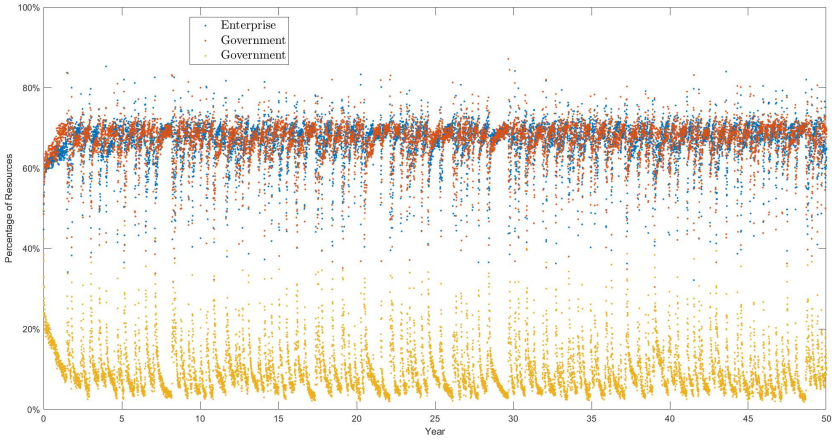

Figure 9: Situation 1

It can be seen that the government and enterprises have occupied most of the profits, while the international organizations (underdeveloped and incapable places) have only a small part of the profits left.

- **Mining is led by the government and assisted by enterprises.**

  α=0.3 γ=0.9 ε=0.02

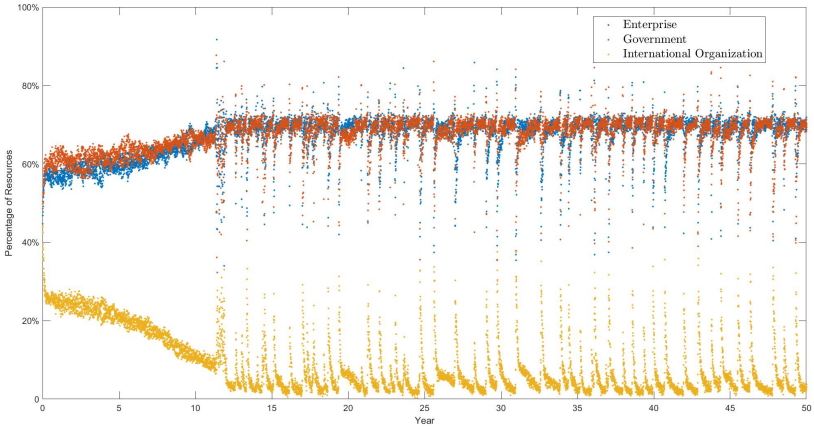

Figure 10: Situation 2

Thus, in the early stage of government-led mining and distribution, international organizations (underdeveloped and incapable places) can occupy some resources, but as time goes by, the government and enterprises still occupy most resources and profits, forming a monopoly. This result is still not conducive to global fairness.

- **International organizations occupy the decision-making power of resource allocation in mining.**

  Because the participation of international organizations in resource allocation makes resource allocation more equitable, we let α=0.9.

  α=0.9 γ=0.3 ε=0.02

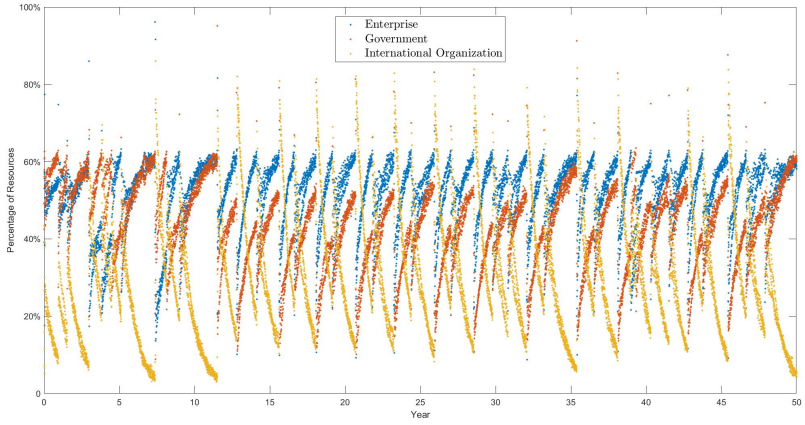

Figure 11: Situation 3-1

α=0.9 γ=0.9 ε=0.02

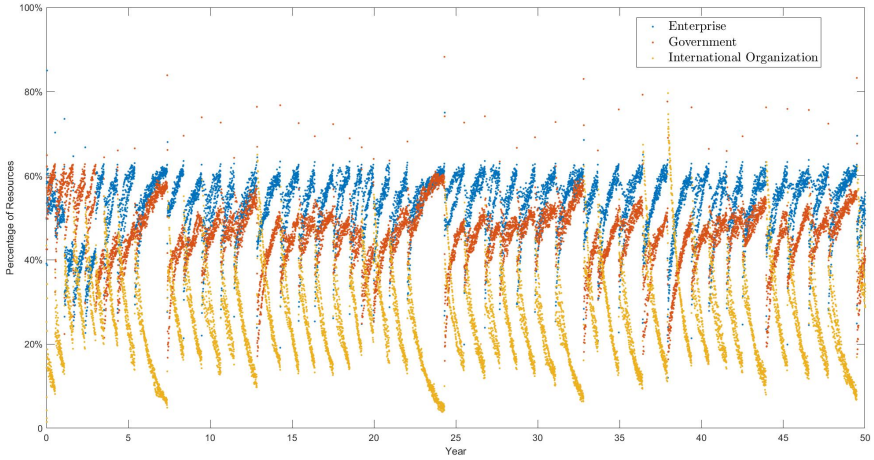

Figure 12: Situation 3-2

After international organizations join the game, the distribution of resources becomes even, and international organizations can also win more benefits for underdeveloped areas. Such resources and benefits also promote our ultimate goal—-global fairness.

6.3 How to achieve the fairest distribution-the only way to solve global fairness

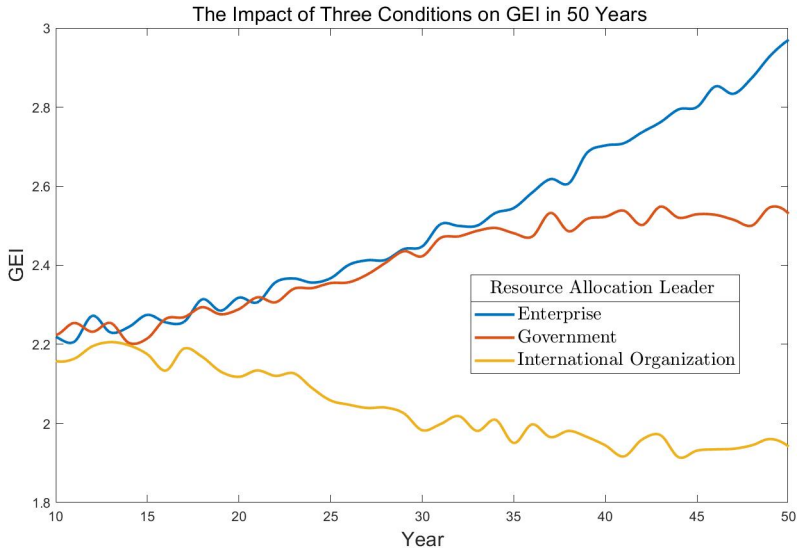

Figure 13: The impact of three conditions on GEI in 50 years

A fair distribution of distributed profits according to population is our answer. Because space resources are jointly owned by all mankind, less developed regions can't use

precious metals acquired in space. They only need money. Obviously, with the development of science and technology and the increase of purchasing power brought by money, less developed regions have the ability to transform their living conditions-this is actually another form of international assistance.

We must admit that it is extremely difficult to improve global equity through asteroid mining itself, but once it is admitted that the resources in space belong to all mankind, all natural persons should make profits from it, and the underdeveloped areas can enjoy higher progress and better life expectancy-this is a very positive impact on global equity. And substitute our above profits into the previous measurement model of global equity, we can get a new development curve about global equity

It can be seen that the establishment of new or existing international organizations to distribute the benefits after asteroid mining can have a positive impact on global equity.

7 Policies of Asteroid Mining

According to the above analysis, the best way to resolve the conflict is to establish an international organization for the exploitation of asteroid resources. We believe that it should have both the function of developing and promoting global equity.

7.1 Principles of policy making

International mechanism generally includes three functions: incentive, sharing and cooperation. International cooperation can balance the interests of all parties, divide clear rights and obligations to share risks and avoid vicious competition.

The idea that space resources belong to all mankind is also good for "global equity". But in practice, mining companies and mining organizations in some countries tend to keep their resources for themselves. International cooperation is to ensure that "every natural person is the owner of space resources and the distribution of profits is based on achieving equitable global distribution".

Of course, all our data also point to the need for international cooperation.

7.2 Policies suggestions of asteroid mining

Allow companies or individuals with mature technology and sufficient capital to conduct mining activities under the supervision of international organizations

At present, the global process of outer space exploration is still in its preliminary stage. Promoting the development and utilization of space resources and solving global energy problems are the main tasks in the initial stage. International organizations issue licenses to eligible subjects. At the same time, it also opens up the possibility of active competition in space mining.

Encourage developing countries to conduct asteroid mining and promote global cooperation

Due to the difficulty of asteroid development and higher requirements for technology

and capital, especially under the UN system, it is difficult for developing countries to approve the establishment of relevant space resource development mechanism. Countries currently engaged in lunar exploration and development naturally have a say in outer space, so international cooperation is needed in the development process. Of course, international cooperation is also the only way to equitable distribution.

Improve relevant legislation and national responsibility systems of various countries, establish a "space court"

With legislation from Congress making it legal for companies to explore and exploit space resources, the right incentives would attract more companies to asteroid mining. Legislation is as important to asteroid mining as a horse in a carriage. States, in turn, should assume international responsibility for "national activities" carried out on the lunar asteroid and in accordance with the relevant provisions of the international space treaties involved. The establishment of a "space court" can effectively supervise and maintain stable order.[2]

Those who violate fair distribution of profits shall be punished

Once again, we reaffirm our core proposition that space resources belong to all humanity. But in practice, mining companies and mining organizations in some countries tend to keep their resources for themselves. The purpose of international organizations is to monitor and regulate, and such deterrence is essential, as is the case with tax evasion.[7]

Limited exploitation

Asteroid minerals are limited, and excessive exploitation on earth has led to many environmental problems, so we should avoid unreasonable exploitation and excessive abuse at the source of asteroid mining. Supervision by international organizations is a key means of policy implementation.

8 Sensitivity Analysis

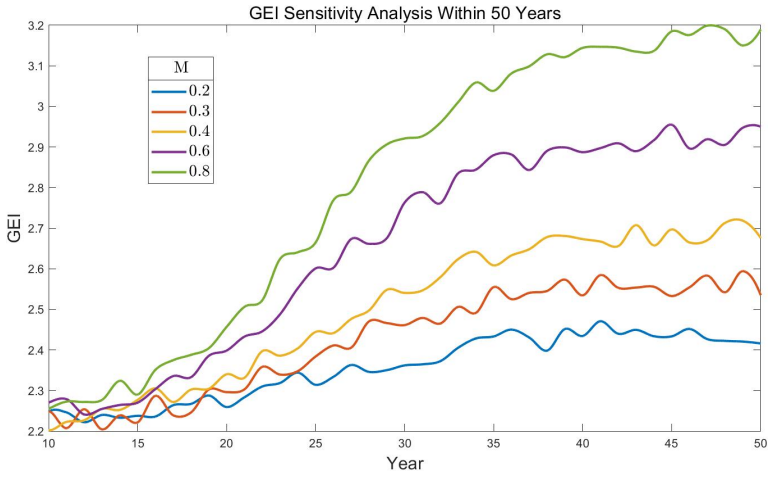

Figure 14: Sensitivity Analysis

For the model simulating GEI in 50 years, we adjusted the upper bound of variance change value of each indicator M, conducted sensitivity analysis, and obtained the following figure.

It can be found that for different index change values, our model can well adapt to the change of GEI in 50 years. GEI goes up as the variance of the indicator goes up. When the variance of the indicator goes down, GEI goes down.

9 Strengths and weaknesses

9.1 Strengths

- **Complete and representative data**

  We have selected enough data from countries and regions at different levels of development, and they come from authoritative organizations such as the World Bank, the World Health Organization and the United Nations, and the data is of reference value. By the way, Kiribati's data is really hard to find. ...

- **Set a reasonable vision**

  When setting a future vision for asteroid mining, we did not set blindly at random, but chose the South Pole, ocean, and moon with similar environments and conditions to asteroids as reference targets for setting the vision. This method is more objective and avoids subjective speculation from the outside world.[8]

- **Innovative methods were adopted**

  We introduced the resource allocation of reinforcement learning in the study of different factors to the global fair game, which is also a brand new innovation. When we were at a loss, we found a reasonable and self-explanatory methodological study, which also met our expected expectations.

9.2 Weaknesses

- **The model does not take into account the impact of sudden factors**

  According to Assumption 4, the environment of the world is relatively stable, so we do not consider the disturbance of sudden influence factors when applying the model. The international environment is generally stable, and sudden influence factors have little impact on the model results, so our model results are still accurate and well-founded. Of course, taking into account individual emergencies such as the impact of a pandemic, rising sea levels, or World War 3, etc., will make our models more accurate —- if you don't mind if we go up to 200 pages or more.

- **The prediction of change is subjective and limited**

  We have assumed many conditions, and many variables are based on subjective predictions and literature. To a large extent, our results can only make a qualitative prediction of the future, but not specific to the data of policy effectiveness-of course,

this is a virtual future after all, and our prediction is at least more convincing than the future described by Greek mythology.

10 Conclusion (A)

—— We emphasize the necessity of **international organizations** in mining, not because they are easy, but because they are hard.

Based on our analytical model of global equity, and the prediction of falling oil and mineral prices caused by the development of asteroid mining, combined with the fact that only a few countries have the capacity to mine asteroids, the disturbing conclusion is that without human intervention, global equity will worsen in the future.

For three different resource allocation policies, we predict that if only mining enterprises allocate resources by themselves, global fairness will deteriorate rapidly, and if resources are handled among governments, global unfairness will be aggravated. **Only with the intervention of international organizations** (most international organizations compensate the underdeveloped areas for economic or goods in the form of relief or assistance, assuming that they will distribute the benefits from space fairly according to our vision) can global equity be promoted.

Our policy also revolves around the intervention and rational distribution of international organizations. The practicalities of those policies have led to an exhilarating declining curve in our equity model, which portends better global equity.

Here, we reiterate our core proposition: the resources in space belong to the common ownership of all mankind, and the profits from space exploitation should be fairly distributed to every citizen of the earth. The resources under our feet have been unfairly occupied, and we can't let this phenomenon continue over our heads.

Here we reaffirm our core belief that the resources of space belong to all mankind, and that the profits from space exploitation should be equally distributed to every citizen of the earth. Resources have been unfairly taken from under our feet, and we cannot allow that to continue over our heads. The loss of fairness ultimately means the outbreak of war and the humiliation of civilization.

Powerful profit-sharing institutions could emerge, perhaps in the form of an armed United Nations, perhaps in the form of a new international organization. Of course, the distribution of profits must be difficult, as you would have to sacrifice a lot to take the meat out of the crocodile's mouth, but we expect it than anytime before.

Save those struggling to survive! We don't want a World War III!

11 A request delivered to the United Nations

Six decades ago, President J.F.K. announced to the world from Rice that 'For space science, like nuclear science and all technology, has no conscience of its own. Whether it will become a force for good or ill depends on man.'

In the same way, the good we can do is to fight for a ray of hope that asteroid mining brings to the uncertain and challenging world. That ray of hope is global equity – enabling people in poor areas to live rich and healthy lives.

We calculate the global impacts of asteroid mining, including falling resource prices and widening inequality, and predict a grim future in which global equity will worsen without intervention. For the United Nations, it is necessary to avoid further widening of the gap between the rich and the poor, so that the benefits brought by new resources can be utilized to the maximum extent of the population in poor areas.

And the indices we have analysed for global equity in recent years show that it has also been getting worse: life expectancy has been rising in the developed world and stagnating in the less developed. With 50 percent of Gambia's population likely to die before the age of 60, Kiribati's annual per capita income cannot afford the most basic food costs in the United States.

In amending the Space Act, we sincerely recommend that the United Nations devote more international influence to the distribution of profits from asteroid mining, as the intervene of international organizations is necessary in the short term to promote global equity.

Give people in less developed areas their share back. This is not a huge sum of money, but it is enough to improve the poor living standards and awful medical conditions of people in underdeveloped areas . At the same time, we recommend that the United Nations impose restrictions on asteroid mining to prevent future depletion of resources and another human descent into a situation like the 1973 oil crisis, or even a worldwide war.

So, therefore, as we set sail we ask God's blessing on the greatest equity promotion on which man has ever carried on.

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Data:

`https://www.wipo.int/global_innovation_index/en/index.html`

`https://data.worldbank.org/en/`

`https://www.who.int/collaboratingcentres/database/en/`

`https://www.opec.org/opec_web/en/publications/338.html`

Appendices

Appendix A Codes

A.1 Code for AHP

```
RI=[0,0,0.58,0.9,1.12,1.24,1.32,1.41,1.45,1.49,1.52,1.54,1.56,1.58,1.59];
Comp=[
    1   3   2   3
    1/3 1   1   1
    1/2 1   1   2
```

```
    1/4 1   1/3 1
    ];
[n,m]=size(Comp);
[V,D]=eig(Comp);
Max_Lambda=max(max(D));
CI=(Max_Lambda-n)/(n-1);
fprintf("Max_Lambda=%f\nCI=%f\nRI=%f\n",Max_Lambda,CI,RI(n));
if n>2
    if(CI/RI(n)<0.1)
        fprintf("True");
    else
        fprintf("False");
    end
else
    fprintf("True");
end
Weight=zeros(n,1);
Max_Lambda_Vector=V(:,find(D(1,:)==Max_Lambda));
for i=1:n
    Weight(i)=Max_Lambda_Vector(i)/sum(Max_Lambda_Vector);
end
Weight
```

A.2 Code for FAM

```
[n,m]=size(P);
X=P(:,1:m);
X=zscore(X);
R=cov(X);
[V,W,C]=pcacov(R);
CU=cumsum(C);
cnt=1;
for i=2:m
    if CU(i)>90
        cnt=i;
        break;
    else
        continue;
    end
end
V=V.*repmat(sign(sum(V)),size(V,1),1);
V=V.*repmat(sqrt(W)',size(V,1),1);
A=V(:,1:cnt);
[B,tmp]=rotatefactors(A,'method','varimax');
Bext=[B,V(:,cnt+1:end)];
Weight=sum(Bext.^2);
Rate=Weight(1:cnt)/sum(Weight);
S=X*coef';
Weight=Rate/sum(Rate)
coef'*Weight'
Ans=S*Weight';
```