

# Research on the Issue of EDPs Based on the AHP System Model

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**Abstract.** This paper aims to study issues concerning environmentally displaced persons (EDPs) and immigration policies. The author successfully figured out the number of EDPs, analyzed the cultural risks faced by their nations, formulated a specific immigration policy, evaluated and improved it by using the Analytic Hierarchy Process model (AHP), Long short-term memory (LSTM), Difference-driven algorithm and the combination weighting method.

**Key words:** AHP system model; the resettlement of EDPs; risk assessment.

## 1. Introduction

### 1.1 Background

Imagine the following scenario: You are an indigenous people living in Tuvalu and you're more than eighty years old. You remember that when you were a kid, running from the eastern end of the city to the western end just for a few hours. But now, living in the east of the city, it seems that you can see the westernmost end of the city at a glance. You think that, maybe in the near future, there will be only a step away.

In the context of global warming, sea ice has melted, causing sea levels rising. It has become an irreversible trend. Those island nations with extremely low altitudes, such as The Maldives, Tuvalu, Kiribati, and The Marshall Islands, are in danger of being drowned.

Therefore, how to protect such people and their culture has become a crucial issue at the moment. We will stand on the humanitarian perspective of the United Nations and take full account of the various elements of environmental migration to build our model.

### 1.2 The goal

I am certain to construct a policy model, which includes a set of policy recommendations that will create an efficient immigration plan. To find out the optimal strategies, We need to construct models, run simulations and present the visualized results. Our model should be scalable, multilayered and dynamic.

However, trade-offs should be made if some objectives contradict.

Our tasks are as follows:

Task 1: An analysis of the scope of the issue in terms of both the number of people at risk and the risk of loss of culture.

Task 2: Proposed policies to address EDPs in terms of both human rights (being able to resettle and participate fully in life in their new home) and cultural preservation.

Task 3: A description of the development of a model used to measure the potential impact of proposed policies.

Task 4: An explanation of how your model was used to design and/or improve your proposed policies.

Task 5: An explanation, backed by your analysis, of the importance of implementing your proposed policies.

## 2. Problem assumptions

1. Assume that the data The author use for our models is true and accurate. Also, the source is reliable.
2. It is assumed that in the AHP model, the indicators selected for the standard layer and the scheme layer are independent of each other and do not affect each other.
3. Assume that during the model verification, the EDPs in the migrating country have partially migrated.
4. It is assumed that our subjectively determined indicators are reasonable.

## 3. The analysis on the issue of EDPs

### 3.1 A brief introduction to EDPs

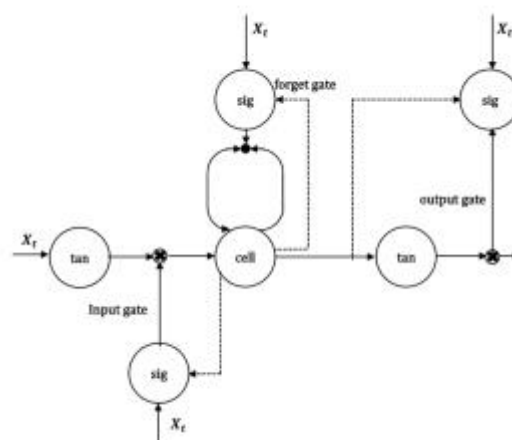
In this article, The author reduces the extension of the concept of EDPs to “people displaced by sea level rise”.

### 3.2 The estimation of EDPs’ number

The number of EDPs at risk is restricted by many factors. The author obtain the number of EDPs from IDMC (International Displacement Monitoring Center) from 2008 to 2018 years, which changes with time and presents a certain regularity.

Long short-term memory (LSTM) is a type of neural network that is suitable for processing time series. The input time series of EDPs is in units of years, so the data of 2008 to 2018 years are used as the input of the neural network, and the prediction data of the migration model for the following year is output and compared with the real value. The specific idea of LSTM is briefly introduced as follows .

As shown in Figure 1, LSTM has three gates in the unit, which is correspond to three calculation processes. Input gate: select the required information to enter the memory cells; output gate: obtain appropriate output results by inputting information and memory cells ; Forget gate: select the unwanted information in the memory cell to kick out. Let input be  $X_t$ ,  $X_t$  is the sample value at time  $t$ ,  $X_t$  passes a sigmoid neural network layer, and gives a quantity of  $0 \sim 1.0$ , the output of forget gate is affected For the cell unit, the inputs continue to process the data and add it to the last result of the previously forgotten gate to get the last updated state of the unit. The updated memory cell and  $X_t$  are processed by the output gate to obtain the output result.



**Figure 1.** Structure of long and short term memory (LSTM) unit

The functions of the three gates are as follows:

Forgotten Gate:

$$Ff(X_t, ht-1) = \sigma(X_t, ht-1)Ct-1 \tag{1}$$

Input gate:

$$Fi(X_t, Ff(X_t, ht-1)) = Ff(X_t, ht-1) + \sigma(X_t) \tan(X_t) \tag{2}$$

Output gate:

$$F0(X_t, Fi(X_t, Ff(X_t, ht-1))) = \sigma(X_t) \tan Fi(X_t, Ff(X_t, ht-1)) \tag{3}$$

Where is the output of the previous cell, the last cell state, and the sigmoid function. The final result obtained by the algorithm is the selective processing of all previous input data. In processing the number of EDPs prediction problem, the migration model for the sixth year is used to predict the data for the sixth year, which has a certain gain effect compared to other methods.

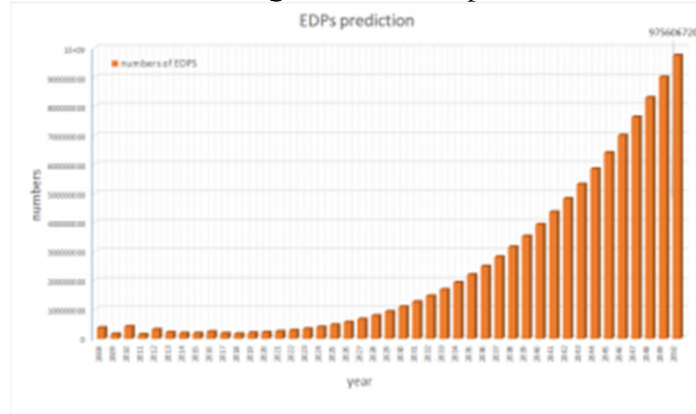


Figure 2. Results Figure of LSTM(EDPs prediction)

### 3.3 The prospection of the risk of disappearance of culture

With the mass migration of native residents, the risk of national culture decline and even extinction are also increasing. Can the international community allow the decline of these EDP cultures and ignore them? The answer, of course, is not. Cultural heritage, not only for the study of the evolution of human civilization, but also for the display of the diversity of the world culture has a unique role, they are the common cultural wealth of mankind. Therefore, from whatever perspective, the international community should work together to protect the common spiritual wealth of mankind.

The author classifies cultural heritage according to the UNESCO Convention for the Protection of World Cultural and Natural Heritage, and the Convention for the Protection of Intangible Cultural Heritage. (As shown in Figure 3) The author divided cultural heritage into material cultural heritage and intangible cultural heritage and analyzed the risk of the loss of culture respectively.

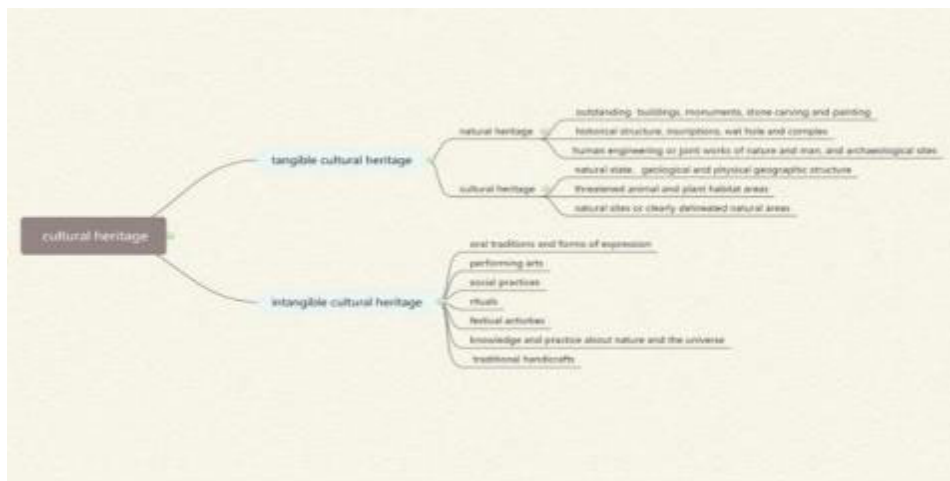


Figure 3. mind Mapping of Tangible cultural heritage

### **3.3.1 Tangible cultural heritage**

Material cultural heritage is divided into natural heritage and cultural heritage.

It can be seen that with the rise of sea level, the disappearance of the immovable and unrepeatable parts of the material and cultural heritage is inevitable. However, the risk of loss of movable material cultural heritage, such as local characteristic plants and animals, is almost zero if it is protected by appropriate means.

### **3.3.2 Intangible cultural heritage**

With the development of modern science and technology, most of the intangible cultural heritage can be preserved in digital form. However, cultural practices related to the geographical location of island countries, such as fishing techniques, are likely to be lost to the waves of history.

The author can know that most of the intangible cultural heritage can be preserved. Cultural heritage, such as fishing techniques, which are closely related to a country's geographical location, is likely to be lost.

## **4. The exposition of our policy**

Based on our models and results, The author offers the following valuable and viable recommendations to the United Nations and hope for the adoption:

### **4.1 The intention of our policy**

In order to implement the Sustainable Development Goals, the International Law Commission, in conjunction with relevant committees, adheres to humanitarian principles, selects sea level rise as the main cause of disasters, and takes the nationals of the affected countries as the main guarantee object. Systematic protection policies for environmentally displaced persons are being explored in practice. In order to ensure the smooth implementation of the system, this plan was formulated.

### **4.2 Basic thoughts**

Considering the actual needs and long-term plans as a whole, focusing on ensuring the safety of people's lives and cultural heritages in the affected countries, establishing a separation, independent legal and political regime created under an agreement on the Recognition, Protection, and Resettlement of EDPs to the United Nations Framework Agreement on Climate Change.

### **4.3 The principle of implementation**

This agreement would operate under five principles [1] .

First, at the core of the agreement must be the objective of a planned and voluntary resettlement and reintegration of affected populations over periods of many years and decades, as opposed to mere emergency response and disaster relief.

Second, environmentally displaced persons must be seen and treated as permanent immigrants to the regions or countries that accept them. environmentally displaced persons cannot return to their homes as political refugees can.

Third, the environmentally displaced persons regime must be tailored not to the needs of individually persecuted people but of entire groups of people.

Fourth, an international regime for environmentally displaced persons will be targeted less toward the protection of persons outside their states than toward the support of governments, local communities, and national agencies to protect people within their territories.

Fifth and finally, the protection of environmentally displaced persons must be seen as a global problem and a global responsibility.

#### **4.4 Mode of operation**

The agreement would provide for an executive committee on the recognition, protection, and resettlement of environmentally displaced persons that would function under the authority of the meeting of the parties (which could meet back to back with the conference of the parties to the climate convention).

#### **4.5 Specific measures**

##### **4.5.1 Strengthen the protection of environmental refugees under international law[2].**

##### **4.5.2 Give full play to the role of international protection agencies.**

Regarding the resettlement of environmental refugees and the protection of their rights, the following institutions are mainly involved.

(1) the office of the United Nations high commissioner for refugees (UNHCR) :this agency is mandated to guide and coordinate international action to protect and resolve refugees worldwide. Its main purpose is to address the resettlement of refugees and protect the rights of refugees. Its specific measures mainly include facilitating the conclusion and ratification of refugee conventions or agreements and supervising their implementation, persuading countries to allow refugees to enter and grant asylum, seeking to coordinate countries to allow refugees to transfer assets, ensuring fair treatment of refugees, and maintaining close contact with relevant governments and intergovernmental organizations UNHCR plays an important organization, coordinating and supervisory role in the protection and assistance of refugees.

(2) the United Nations office for the coordination of humanitarian affairs shall be responsible for humanitarian relief work of various emergencies and natural disasters and provide assistance to the protection of refugees.

(3) the United Nations development programme (UNDP): it is responsible for the central coordination of United Nations development activities and is able to assist refugees with the advantage of having the largest multilateral resources in the world to provide technical assistance for sustainable human development[3].

##### **4.5.3 Give full play to the role of states as the main body of the international community:**

(1) Establish a basic database and information communication mechanism for regional climate change and migration.

(2) promoting adaptation in the field of climate migration[4].

(3) Strengthen intergovernmental cooperation and improve administrative efficiency.

(4) Establishment of refugee fund.

##### **4.5.4 Improve the decision-making participation mechanism of immigrant groups:**

At all stages of immigration, the people's will must be fully respected, and they must be able to fully express their aspirations.

## **5. Model**

### **5.1 The model of receiving immigrant**

Combining theoretical and policy needs, The author will mainly consider the three elements of carbon dioxide emissions, economic level, and per capita land area in the calculation of immigration receiving capacity, excluding secondary factors such as religious differences and migration costs.

Considering the different influences of different factors, The author will weigh the influence of each factor.

For the intended recipient countries of EDPs, a "capacity indicator" Ci is constructed to measure the ability of the candidate recipient countries to receive EDPs.

Let the refugee receiving country  $i$  ( $i = 1, 2 \dots n$ ), where  $n$  is the sample capacity of the candidate EDPs receiving country, The author assume that the total historical CO2 emissions of each receiving country is  $E_i$ , the per capita GDP is  $G_i$ , and the per capita land The area (per capita land area) is  $PL_i$ , which comprehensively measures the capacity of the receiving country and constructs a "capacity indicator"  $C_i$ , as follows:

$$C_i = w_1 \frac{E_i}{\sum_{j=1}^n E_j} + w_2 \frac{G_i}{\sum_{j=1}^n G_j} + w_3 \frac{PL_i}{\sum_{j=1}^n PL_j} \quad (4)$$

The author set  $w_1$ ,  $w_2$ , and  $w_3$  as the weights of CO2 emissions, economic level, and capacity per capita.

According to the internationally recognized common but differentiated responsibilities, The author can take the the weight as  $(w_1, w_2, w_3) = (0.6, 0.3, 0.1)$ . And  $w_1, w_2, w_3$  meet the following constraints:

$$w_1 + w_2 + w_3 = 1 \quad (5)$$

$$w_1, w_2, w_3 > 0 \quad (6)$$

The author sorted the OECD countries and major developing countries in descending order according to the cumulative carbon dioxide emissions (in kilotons) of each country from 1960 to 2018, and selected 32 countries as candidates. That is, in this time,  $n = 32$ .

## 5.2 The Impact Assessment of EDPs Policy Based on Analytic Hierarchy Process

Analytic Hierarchy Process (AHP) is a decision analytical method that solves multi-objective complex problems by combining qualitative analysis and quantitative analysis.

## 5.3 Hierarchical Structure Model

**Table 1.** assess to the impact of EDPs' policy

target layer	standard layer	scheme layer
assess to the impact of EDPs' policy (A)	economy (B1)	per capita GDP (C11)
		industrial structure (C12)
		per capita disposable income (C13)
		unemployment rate (C14)
		consumer price index (C15)
	culture (B2)	language (C21)
		religion (C22)
		education level (C23)
		customs (C24)
		cultural tolerance (C25)
	society (B3)	social security (C31)
		migration costs (C32)
		marginalization of immigrants (C33)
		internal conflict index (C34)
		social mobility (C35)
	politics (B4)	political stability (C41)
		international relations (C42)
		immigration policy (C43)
		legal power intensity index (C44)
		public protection, safety and security (C45)
environmental resources (B5)	energy (C51)	
	water resources (C52)	
	land resources (C53)	
	natural disasters (C54)	
	environmental pollution (C55)	

Based on the above-mentioned EDPs policies and in accordance with the principles of the construction of a hierarchical structure model, the model of the impact assessment of EDPs policies proposed in this paper consists of three layers. They are as follows.

The first layer is the target layer, which is the overall objective A of the model;

The second layer is the criterion layer (B). Its operation target is several subsystems decomposed by (A).

The third layer is the solution layer (C). Its operation target is several groups of constituent elements.

There’s no doubt that The author are supposed to analyze social events from politics, economy, culture and society perspectives.

Based on the above analysis, The author obtained the following hierarchy of impact assessment of EDPs policy:

### 5.4 Hierarchical Total Sort and Its Consistency Check

The comprehensive importance of each factor to the target layer can be calculated from the relative importance of each factor in the same rule layer and the corresponding weight of each rule layer. Assume that there are x factors in the criterion layer  $n_1, n_2, \dots, n_x$ , and the corresponding weights are respectively; there are y factors in the indicator layer. The calculation results are shown in the following table:

**Table 2.** The combined effect coefficient and Ranking of Comprehensive Impact Factor of the immigrant British part of the Maldives population

target layer	standard layer	standard layer risk coefficient	scheme layer	Scheme layer risk factor	The combined effect coefficient ( $w_{ij}$ )	Ranking of Comprehensive Impact Factors
assess to the impact of EDPs' policy (A)	economy (B1)	0.44	per capita GDP (C11)	0.41	0.1804	1
			industrial structure (C12)	0.06	0.0264	11
			per capita disposable income (C13)	0.14	0.0616	5
			unemployment rate (C14)	0.30	0.1320	3
			consumer price index (C15)	0.09	0.0396	7
	culture (B2)	0.16	language (C21)	0.23	0.0368	9
			religion (C22)	0.49	0.0784	4
			education level (C23)	0.14	0.0224	13
			customs (C24)	0.05	0.0080	21
			cultural tolerance (C25)	0.10	0.0160	17
	society (B3)	0.09	social security (C31)	0.41	0.0369	8
			migration cost (C32)	0.25	0.0225	12
			marginalization of immigrants (C33)	0.10	0.0090	20
			internal conflict index (C34)	0.19	0.0170	16
			social mobility (C35)	0.05	0.0045	24
	politics (B4)	0.26	political stability (C41)	0.12	0.0312	10
			international relations (C42)	0.23	0.0598	6
			immigration policy (C43)	0.52	0.1352	2
	environmental resources (B5)	0.05	legal power intensity index (C44)	0.08	0.0208	15
			Public protection, safety and security (C45)	0.05	0.0130	18
			energy (C51)	0.26	0.0130	18
			water resources (C52)	0.42	0.0210	14
			land resources (C53)	0.16	0.0080	21
			natural disasters (C54)	0.06	0.0030	25
			environmental pollution (C55)	0.11	0.0055	23

## 5.5 Model result analysis

From the various risk factors and comprehensive risk factor rankings shown in the table above, The author select Maldives as the country of emigration and the United Kingdom as the country of immigration. By observing the standard layer, The author can see that economic conditions are the key factors restricting the immigration problem. The top five risk factors are GDP per person, immigration policy, unemployment rate, religion, and disposable income per person. Nearly 75% of the risks are caused by the above five factors, as The authorll as international relations, consumption, social security, language, political stability and industrial structure. At the same time, The author noticed that because the risk factor of the resource environment subsystem itself is very small. Therefore, the corresponding indicators, such as land resources, natural disasters and environmental pollution, have no effect on this migration event.

## 6. Suggestions on Optimizing the Policy

In this article, The author have reduced the extension of the concept of EDPs to "people displaced by rising sea levels." Compared to refugees in the general sense, that is, people who displaced for political persecution, religious exclusion, war, ethnic conflict, etc. EDPs have the following significant characteristics.

- At the core of the agreement must be the objective of a planned and voluntary resettlement and reintegration of affected populations over periods of many years and decades, as opposed to mere emergency response and disaster relief.
- Policy formulation needs to be considered from a long-term perspective and stand the test of time. Because EDPs cannot return to their homes like political refugees. EDPs must be considered as permanent immigrants in their region or country.
- Protecting EDPs must be seen as a global issue and global responsibility. Because the generation of EDPs is mainly caused by the carbon emissions of developed countries and major developing countries, not their own faults.

In the establishment of the model and the analysis results, The author obtained the main impacts of resettlement policies through qualitative analysis. In addition, The author calculated the weight of each influencing factor through quantitative calculation.

Based on the above analysis, the authors now propose the following optimization suggestions.

### 6.1 Pay attention to the sustainable development of migrants and meet their economic needs

The permanent and irreversible nature of environmental migrants determines that ecological migrants cannot return to their homes, but live permanently in the place of resettlement. Therefore, The author should pay more attention to the long-term survival and development rights of ecological migrants in the local area.

At the same time, the model's analysis and calculation results clearly show that among the various elements of the standard layer, the influence of economic factors is significantly higher than other factors. And most indicators under the economic factors in the scheme layer also rank high in the forefront.

In summary, the proposed policy should put forward a more operable plan based on the existing basis, which is more conducive to protecting the migrants' integration into the local economic life in the place where they move in. In order to ensure that the immigrants can continue to receive income for a long time, get rid of the assistance and achieve economic independence. Of course, this measure can also reduce the relevant financial pressure of the local government.

### 6.2 Pay attention to the development of immigrant culture and meet its spiritual needs

A prominent problem brought by permanent immigration is the protection and inheritance of indigenous culture. At the same time, The author cannot ignore the problem of cultural conflict caused

by cultural differences. According to the analysis and calculation results of the aforementioned model, it can be seen that religious belief is a more important factor in the impact of immigration policies.

Based on the freedom of belief in the general sense, the proposed policy does not have the right to enforce the cultural practices of immigrants, especially religious beliefs. However, the policy should clarify and actively guide cultural conflicts and cultural protection issues in the immigration process.

### **6.3 Don't neglect the impact of environmental resources brought by immigrants**

Environmental resources are the factors on which human beings depend. The emergence of EDPs is also due to insufficient living resources on account of environmental degradation. During its immigration process, The author should ensure that its relocation does not cause resource constraints and environmental degradation, which leads to a further increase in EDPs. At the same time, it should also ensure that after resettlement, the immigrants have sufficient living resources and a livable living environment.

Based on the above conditions and model analysis, the proposed policy should be relevant to the government in terms of resources and environment, which is operable and consistent with the fair migration policy in the general sense. The international community must not only guarantee the rights of both immigrants and immigrants, but also assume corresponding responsibilities for the environmental protection of global resources.

## **7. The importance of our proposed policies**

Famous climatologist Kamar predicts that the number of EDPs will reach 1 billion by 2050. The author obtained the similar results by using neural network algorithms.

It can be seen that the number of EDPs will increase sharply and the EDPs' problem will also become a global problem that the United Nations and the global people need to solve urgently. Therefore, it is urgent to formulate a reasonable EDPs' policy.

### **7.1 Fully regulate international organizations and institutions and play the role of international law to protect the basic rights of refugees.**

The policy emphasizes the role of international law. This will have a significant positive impact on the better survival and development environment for EDPs. In the AHP model proposed in the article, the impact of economic factors on policy is fully considered (the economic index level risk index is as high as 0.44). Per capita GDP and unemployment index have become important indicators for measuring the comprehensive risk coefficient. This initiative is to enable EDPs to travel to countries with higher economic levels to protect their basic lives.

The policy fully regulates the legal system and international organizations, provides reliable guarantees and safeguards the basic rights of EDPs.

### **7.2 Emphasize on cultural protection and be instructive for maintaining global cultural diversity**

The resettlement of EDPs is essentially a secondary problem caused by the deterioration of resources and environmental shortages. Preventing environmental degradation and shortage of resources is the fundamental solution to the problem of climate refugees.

According to the LSTM model in this paper, the number of EDPs will rise sharply after 2030 and will reach a peak in 2050, which will be a result that is pretty disappointing. The proposed policy focuses on the measures to prevent environmental pollution.

According to the World Bank's global carbon emissions statistics, although the carbon emissions of some major countries have been declining in recent years, environmental problems have become increasingly serious. Let the big carbon-emitting countries take the initiative to take responsibility for environmental protection, energy conservation and emission reduction. The people of the world co-

manage climate and environmental issues and promote common development. The people of the world fully embody the concept of a community of shared future for mankind.

This paper considers the cultural differences between EDPs and their recipient countries. This policy can guarantee the full protection of the culture of environmental migrants under the supervision of the system.

For the religious beliefs, language (in the AHP analysis model, the index level risk index of these two items is as high as 0.49) and other cultural indicators have been given the best solution.

These are of great significance to the cultural protection work and even cultural exchange and integration of refugee countries. Cultural harmony will be an important basis for maintaining a good relationship between immigrants and the host country.

### **7.3 Emphasize on the concept of sustainable development and fully embody the beautiful vision of achieving a community of shared future for mankind**

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## **8. Sensitivity analysis**

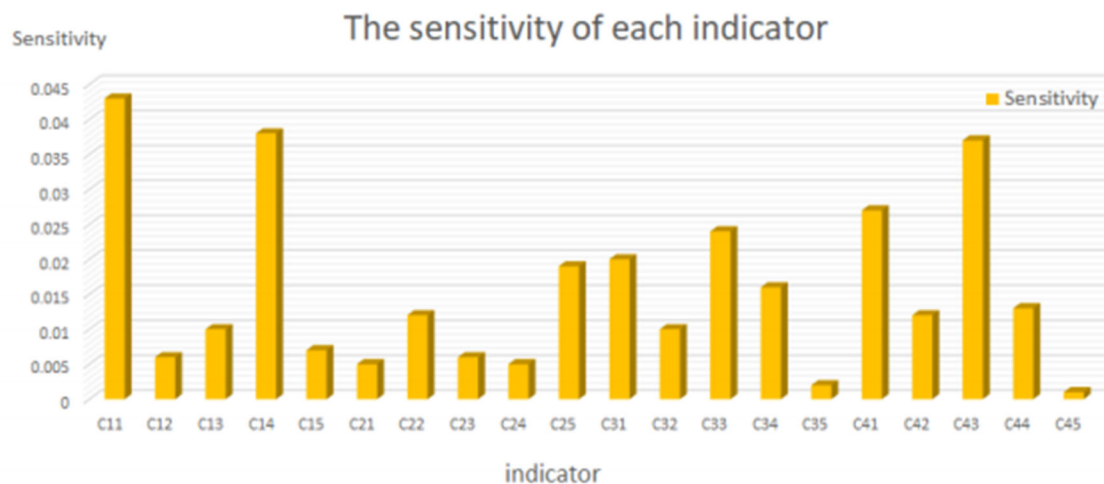
The comprehensive evaluation results obtained by the AHP model are obtained under evaluation indicators, indicator weights (risk coefficients) and indicator values, but some factors have great uncertainty, which may lead to great changes, or the decision makers do not have a good grasp of the data, which will affect the evaluation results.

Therefore, The author need to discuss the stability of the evaluation results through sensitivity analysis . The specific method of sensitivity analysis is to calculate the change degree of evaluation results and its influence on scheme ranking after perturbing single or multiple indexes to a certain extent, and then calculate the sensitivity coefficient and ranking of index factors. Analyzing the allowable change range of a factor under the condition that the decision result is unchanged .

AHP uses the eigenvalues of the judgment matrix to calculate the weight of each index, and the change of the weight depends on the change of the judgment matrix, which can be divided into the following three cases:

- (1)When the judgment matrix of the index layer changes, the evaluation result changes according
- (2)When the judgment matrix of the criterion layer changes, the weight of the index layer and the evaluation results change accordingly, that is, the indexes under the same criterion change in the same direction and proportion .
- (3)When the judgment matrix of criterion layer and index layer changes at the same time, the evaluation result changes accordingly, and the change of weight is complex .

Limited to space, this paper only takes the single-factor sensitivity of the change of single index weight as an example. Assuming that the weight of the criterion layer is unchanged, take  $\Delta w_{ij} = -0.0001$ , and then change each index by  $\Delta w_{ij}$ , and the calculation sensitivity is as follows:



**Figure 4.** The sensitivity of each indicator

From the analysis of the results, The author can see that the per capita GDP, unemployment rate and immigration policy have a great influence on the model.

## 9. Evaluation of the model

### 9.1 Strength

1) When determining the judgment matrix, the two factors need to be compared with each other. The author used a quantitative-qualitative determination method, which is more practical than the traditional subjective determination method.

2) When constructing the AHP model, The author reasonably selected the indicators at the standard layer and the scheme layer, The author comprehensively analyzed the indicators and established a more accurate risk assessment model.

3) The sensitivity analysis module fully considers the difference in the contribution of different index factors to the evaluation model, making our model more complete.

4) The AHP model requires more qualitative judgment than the ordinary quantitative methods.

### 9.2 Weakness

1) When assigning values to risk factors based on the evaluation scale, there is subjective judgment error due to the existence of qualitative data, which is not convincing.

2) The data source in this article is uncertain, which has a certain negative impact on the results of the model.

3) In the process of solving the model, the exact solution of eigenvalues and eigenvectors is a difficult problem. So they have some rounding errors.

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