

Social Stability Early Warning Study

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Keywords: Feature selection, alert threshold, spirituality, factor analysis

Abstract: This study delves into the construction of an early warning system for social stability, thoroughly analyzing the comprehensive impact of political, economic, and cultural factors on societal stability. The article proposes a holistic early warning model based on feature selection, alert threshold setting, and factor analysis, aimed at accurately predicting and assessing the state of social stability. Through case studies of specific countries or regions, the article validates the practicality and effectiveness of the model, emphasizing the critical role of positive spiritual forces in maintaining social stability during economic challenges. Additionally, the article reviews the economic achievements in the early stages of China's socialist construction, underscoring the central position of Marxist belief in China's social stability and development, as well as historical experiences in the exploration of the socialist path.

1. Introduction

Social stability refers to the normal functioning of the social order, which is the result of the interaction between political, economic, cultural, and other human activities, and is characterized by relativity, regionalism, and dynamism. In a modern society where competition is increasing and crises are frequent, it is not easy to overcome them. We must rely on modern sociometric science and modern social early warning science. Social measurement and social early warning are closely related. To accurately warn of social crises, several factors that affect social stability need to be identified. There are numerous factors contributing to sensitivity, including subsistence security, economic support, and social engagement. These elements are interconnected and mutually influence one another, collectively sustaining societal well-being. Once there is a large fluctuation in one factor, it will directly or indirectly affect other factors in society, which in turn will lead to social unrest or collapse. Multiple factors are supposed to be an organic whole, but once the ratio of forces acting on the factors becomes unbalanced, society will be deformed and social stability will be shaken. It may then be possible to predict and intervene in social stability problems before they become serious so that social risks can be averted in time and unnecessary social unrest can be avoided. Therefore, strengthening the monitoring and early warning analysis of social stability is conducive to identifying and forecasting social instability factors, helping the government to identify and solve problems early, and creating a harmonious and stable social environment.

Without a stable political and social environment, nothing can be achieved and no good plan can be realized. Academics are also paying more and more attention to the study of social risk and social stability. Song Linfei conducted three studies on social risk and social stability in 1989, 1995, and 1999^[1] and proposed and designed an early warning system for social risk in China; in 2003, Deng

Weizhi demonstrated the feasibility of establishing an early warning mechanism for social risk and social stability and proposed a framework and operational concept for an early warning mechanism^[2]; in 2008, Xiao Qunying conducted a study on the role of government information management and information regulation models in crisis warning. In 2008, Xiao Qunying explored the role of government information management and information control mode in crisis early warning and proposed methods to improve the accuracy and time efficiency of early warning prediction^[3]. Although there are abundant research results on social stability monitoring and early warning, there are still some shortcomings in the selection of indicators, weight distribution, and model construction, and most of the research work lacks empirical models, so the application value is not effectively guaranteed. Given this, this paper selects three countries or regions for social stability analysis based on the existing literature as a reference, evaluates social stability and early warning through time series and principal component analysis, and confirms the accuracy and feasibility of the model by combining existing facts.

2. Social warning criteria of 3σ control principle

Early warning criterion is the basis for judging the state of social stability, that is, in what state the society is stable with police and in what state the society is stable without police^[4]. Therefore, it is necessary to reasonably divide the state of socially stable operation.

2.1 Single Indicator Early Warning Guidelines

Let the index X (growth rate) obey the normal distribution: $X \sim N(\mu, \sigma^2)$, and the bandwidth between no warning zones is X_i . Its no warning intervals under the general preference, the general and poor state of social stability are determined according to the majority principle, half principle, and minority principle respectively.

1) When the overall preference of the social stability state is determined according to the majority rule

The interval of $2/3$ years of the indicator X is taken as the no-warning interval and $x_i = 0.97\sigma$ can be obtained from $P\{|X - \mu| < x_i\} = 2/3$, that is, the no-warning interval $(\mu - 0.97\sigma, \mu + 0.97\sigma)$.

2) When the social stability state is generally general, it shall be determined according to the principle of half

The interval of $1/2$ years of the indicator X is taken as the no-warning interval and $x_i = 0.68\sigma$ can be obtained from $P\{|X - \mu| < x_i\} = 1/2$, that is, the no-warning interval $(\mu - 0.68\sigma, \mu + 0.68\sigma)$.

3) When the overall deviation of the social stability state is determined according to the minority principle

The interval of $1/3$ years of the indicator X is taken as the no-warning interval and $x_i = 0.43\sigma$ can be obtained from $P\{|X - \mu| < x_i\} = 1/3$, that is, the no-warning interval $(\mu - 0.43\sigma, \mu + 0.43\sigma)$.

2.2 General Early Warning Guidelines

The early-warning criterion of the single index cannot analyze the overall situation of social stability, so it is necessary to establish the overall early-warning criterion to judge the overall situation of social stability^[2]. Social stability alert is the result of the comprehensive action of every single index. The general practice is to calculate the comprehensive value of each index first and then classify the comprehensive value according to some criteria.

In this paper, the scoring method is adopted to establish the overall warning criterion, that is, 5 points, 4 points, 3 points, 2 points, and 1 point are assigned to the warning interval of each indicator

according to the status of the major alarm, major alarm, medium alarm, light alarm, and no alarm, and the annual score of each indicator is calculated. If the number of indicators is N , the highest score is $5N$ and the lowest score is N ^[6]. The ratio of the index comprehensive score to the highest score is used as the warning criterion, and 80%, 60%, 40%, and 20% of the ratio are specified as the four critical points of the warning criterion, as shown in Table 1. The five intervals divided by the critical points are the overall warning criterion.

2.3 Example analysis

Since our country's economic and social transition is relatively early, various social contradictions are relatively complex. China has always attached great importance to social stability, actively prevented and defused social conflicts^[2], and put in place a long-term mechanism for maintaining social stability. The practice has proved that the measures and exploratory methods adopted by China in maintaining social stability are effective.

2.3.1 Guidelines for single-indicator policing

Table 1: The proportion of the total score to the highest score

The proportion of the total score to the highest score	signal	meaning
$V < 20\%$	Giant policeman	Poor social stability
$20\% \leq V < 40\%$	Heavy alarm	Poor social stability
$40\% \leq V < 60\%$	Intermediate police	Moderate social stability
$60\% \leq V < 80\%$	Minor alarm	Better social stability
$V \geq 80\%$	No alarm	Social stability is very good

According to the social stability monitoring index system determined by cluster analysis in Section 2, relevant statistical data from China from 1979 to 2009 were collected^[4]. The state of each indicator is divided into five categories: extremely unstable, unstable, stable, very stable, and extremely stable. Through the processing of the original data, the no-alarm zone of each indicator is obtained, as shown in Table 2:

Table 2: Non-alarm interval of a single indicator

Index	2/3No alarm in the year	1/2No alarm in the year	1/3No alarm in the year
income	(9.04, 24.29)	(11.32, 22.01)	(13.29, 20.05)
poverty gap	(-1.83, 14.16)	(0.56, 11.77)	(2.62, 9.70)
unemployment rate	(-4.95, 1.29)	(-4.01, 0.36)	(-3.21, -0.45)
inflation	(5.40, 22.46)	(7.95, 19.91)	(10.15, 17.71)
Political corruption	(-9.84, 27.43)	(-4.27, 21.86)	(0.54, 17.05)
Social security	(-0.70, 6.64)	(0.40, 5.54)	(1.34, 4.60)

On this basis, the mean value greater than the index or the upper limit value between no police zones is taken as the lower limit of the very stable state, and the negative principle is used to determine the upper limit of the unstable interval. Finally, the warning criterion of the single index is determined by consulting expert opinions, as shown in Table 3:

Table 3: Single indicator warning criteria

Index	Extremely unstable	unstable	stable	Very stable	Extremely stable
income	$L \leq 7$	$7 < L \leq 15$	$15 < L \leq 21$	$21 < L \leq 30$	$L > 30$
poverty gap	$L > 21$	$13 < L \leq 21$	$6 < L \leq 13$	$0 < L \leq 6$	$L \leq 0$
unemployment rate	$L > 7$	$5 < L \leq 7$	$3 < L \leq 5$	$0 < L \leq 3$	$L \leq 0$
inflation	$L \leq 5$	$5 < L \leq 14$	$14 < L \leq 24$	$24 < L \leq 33$	$L > 33$
Political corruption	$L \leq 0$	$0 < L \leq 4$	$4 < L \leq 8$	$8 < L \leq 12$	$L > 12$
Social security	$L \leq 1$	$1 < L \leq 4$	$4 < L \leq 7$	$8 < L \leq 10$	$L > 10$

2.3.2 Determination of index weight rights

The Delphi method is a common method to determine the weight of indicators. It uses back-to-back communication to consult the opinions of the members of the expert group in the field. After several rounds of consultation, the opinions of the expert group tend to be concentrated. In this paper, the Delphi method is adopted to determine the weight of each index, as shown in Table 4.

Table 4: Weight of each indicator

index	weight
income	0.32
The gap between rich and poor	0.15
Unemployment rate	0.21
inflation	0.13
Political corruption	0.09
Social security	0.1

2.3.3 Prediction of single indicators

Early warning is to predict the future state of social stability. Therefore, based on historical data, the changing trend of six selected social stability monitoring indicators is predicted.

Take income as an example and establish the prediction equation:

$$X = 203.539459 + 1.856194X_{(t-1)} - 0.849013X_{(t-2)} \quad (1)$$

Where, X is the current predicted value, $X_{(t-1)}$ is the value of the previous year, $X_{(t-2)}$ is the value of the previous two years, and the correlation coefficient R , $R = 0.998$, is used to measure the validity of the forecast result^[5]. According to the forecast results, the predicted value of China's per capita income from 2010 to 2015 is 11672, 12643, 15876, 19543, and 22575 respectively. In the same way, you can get the predicted values of the other indices.

2.3.4 Single indicator warning analysis

The historical data and predicted value of each indicator are used to analyze the alarm situation of each year with a single indicator according to the early-warning criterion of a single indicator, as shown in Table 5. Only the data from 2004 to 2015 are intercepted here. See Appendix 1 for the detailed table

Table 5: The data from 2004 to 2015

year	x_1 (%)	x_2 (%)	x_3 (%)	x_4 (%)	x_5 (%)	x_6 (%)
2004	stable	unstable	Very stable	Very stable	Extremely stable	stable
2005	stable	stable	stable	Extremely stable	Very stable	stable
2006	Extremely stable	Extremely stable	stable	Extremely stable	Extremely stable	Extremely stable
2007	unstable	unstable	stable	stable	Very stable	unstable
2008	stable	unstable	stable	unstable	stable	stable
2009	unstable	stable	unstable	stable	stable	stable
2010	stable	unstable	Very stable	Very stable	stable	unstable
2011	unstable	stable	stable	Extremely stable	Very stable	stable
2012	unstable	stable	Extremely unstable	stable	stable	unstable
2013	stable	unstable	Extremely unstable	Very stable	unstable	stable
2014	Very stable	Very stable	stable	Very stable	Extremely stable	stable
2015	Very stable	stable	Very stable	Extremely stable	Very stable	stable

2.4 Overall police situation analysis

The final regression result of the model is shown in the Figure 1 below, which tends to be stable after 12 iterations. It can be seen from the bottom right figure that the social stability of the country fluctuates slightly but is generally stable

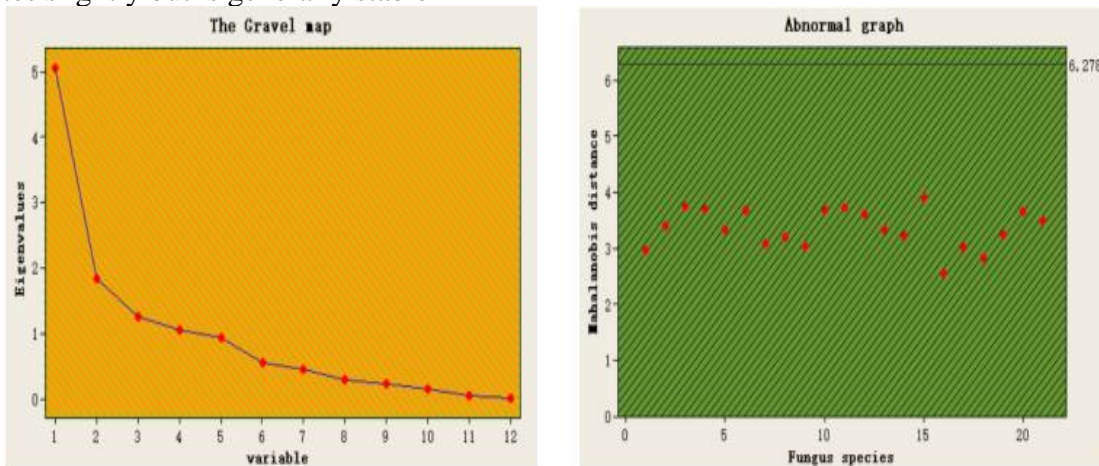


Figure 1: The Gravel map

Then, based on single indicator alarm analysis and weighted processing, the analysis results of the overall alarm state in each year of social stability are obtained, as shown in Table 6. According to the forecast, the social stability in 2023-2028 will be medium^[3], indicating that the social stability will be basically under control in the next 5 years.

Table 6: The next 5 year stats

Year	Social stability value	Threshold value (Table 3)	Result	Warning situation
2023	24.1144	-3.1144	1	Central police
2024	20.1807	0.8193	0	Light police
2025	16.5911	4.4089	0	Light police
2026	23.3373	-2.3373	1	Central police
2027	20.4108	0.5892	0	Light police
2028	17.8035	3.1965	1	Central police

3. Conclusion

This study not only constructs a comprehensive early warning model for social stability but also delves into the effectiveness and necessity of the model in practical applications. Through the analysis of political, economic, cultural, and other multidimensional factors, we recognize that social stability is a complex and dynamic system influenced by a multitude of internal and external factors. Therefore, it is crucial to establish a system capable of comprehensively monitoring and alerting to social risks, which can help governments and policymakers identify potential instability factors in a timely manner and take effective measures to prevent social crises.

Particularly, this article emphasizes the importance of positive spiritual forces in maintaining social stability during economic hardships, as validated in the practices of countries like China, indicating that even under limited material conditions, steadfast beliefs and positive social values can provide a solid foundation for social stability. Additionally, the article reviews the economic achievements in the early stages of China's socialist construction, underscoring the central role of Marxist belief in China's social stability and development, as well as historical experiences in the exploration of the socialist path.

Against the backdrop of globalization and the information age, the challenges to social stability are becoming increasingly complex and varied. Thus, the early warning model proposed in this article is not only applicable to China but also holds universal reference value. It reminds us that, whether in developing or developed countries, it is essential to pay attention to the multidimensional factors of social stability and use scientific methods and models to predict and assess the state of social stability, thereby formulating more precise and effective social management strategies.

Finally, the research findings of this article underscore the importance of maintaining and strengthening the stability of Marxist belief. In China, Marxist belief is not only the source of success in revolution and construction but also the shared choice of the Chinese people. Its stability is related to the construction and ruling status of the Communist Party of China, and even more so to the development of socialism with Chinese characteristics and the construction of ideology. Therefore, we must continue to deepen our research on Marxist theory, constantly enrich and develop its content, and ensure that it still provides a strong theoretical support and spiritual impetus for China's social stability and development in the context of the new era.

In summary, the research in this article not only provides theoretical and practical references for the construction of an early warning system for social stability but also offers valuable insights for social stability research and management practices worldwide. Through continuous research and practice, we can hope to build a more stable and harmonious social environment, contributing to the sustainable development of humanity.

References

- [1] Huang Yongsong, *Research on the comprehensive evaluation system of social stability risk of immigrants in the post-immigrant period [D]*. North China University of Electric Power (Beijing), 2022. DOI: 10.27140/d.cnki. ghbbu.2022.000657
- [2] Wang Siyu, *Design and Implementation of Social Stability Index Evaluation Information System [D]*. Northeast University, 2015
- [3] Du Binhu, *Project social stability risk assessment based on fuzzy evaluation method [D]*. Overseas Chinese University, 2014
- [4] Liu Huanshen, *Research on Lenin's Thought of Russian Development Path before the October Revolution [D]*. Shandong Normal University, 2021. DOI: 10.27280/d.cnki. gods.2021.000023
- [5] Guo Jinyu; Zhang Zhongbin; Sun Qingyun. "Advances in the Stagger Analysis Methodology for Structural Integrity Assessment." *Structural Engineering and Mechanics*, vol. 65, no. 2, Feb. 2017, pp. 213-220. DOI: 10.18282/sem.v0i65.2345
- [6] Wang, Binhui; Li, Xiongying. "A Comparative Investigation into the Robustness of Factor Analysis Techniques in Financial Modeling." *Journal of Quantitative & Technical Economics*, vol. 34, no. 4, Apr. 2017, pp. 78-92. DOI: 10.27110/jqte.2017.v34i4.0102