Operation Risk of Rural Cooperative Economic Organization Based on Principal Component Analysis

——A Case of Sichuan Province, China

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Abstract Based on the previous research, a total of 10 risk indices are selected according to the specific situation in Sichuan Province, such as natural risk, resource constraint risk, internal management risk, capital risk, technical input and output risk, market risk, contract credit risk, property risk and policy support risk. According to the questionnaire survey by cooperative economic organization of Sichuan Province, principal component analysis is used to analyze the importance and influence degree of the operation risk of rural cooperative economic organization. Result shows that in the operation of cooperative economic organization, management risk has greater influence degree and importance degree, which should be paid special attention to. Capital, property, price fluctuation, and quality of members have great degree of risk and are paid little attention to. The technical input and output risk and the contract credit risk have relatively low impact on the operation risk of cooperative economic organization and their importance is relatively low. Therefore, we should continue to maintain its advantages. Nature, resource constraint and policy support have relatively high risk awareness and low influence degree, belonging to the factors with priority attention which are controlled to some extent. Finally, suggestions are put forward, such as enhancing the management level of cooperative economic organizations, strengthening the farmer's risk awareness, and improving the risk aversion ability of cooperative economic organization.

Key words Type of risk, Influence degree, Principal component analysis, Risk prevention, China

Rural cooperative economic organization, short for cooperative economic organization, has already become an irreplaceable force in the development of rural economy, which has very broad prospect for development[1]. However, after entering the WTO, agriculture faces many contradictions and difficulties due to the competition of domestic and international markets and the scale enlargement of cooperative production, mainly reflected in the short survival time, the small quantity, the unstable development of cooperative organization, the weak participatory competence of peasant household, the slow growth of farmers' income and other greater potential risks caused by scale enlargement. All these are determined by the industrial characteristics of agriculture itself and the operating mechanism, contract relations and technical level of cooperative economic organization. There are a few researches on the operation risk of cooperative economic organization, and related researches are mostly about qualitative description, standardized research with almost few empirical studies[2-9]. As a big agricultural province, Sichuan is one of the provinces in China carrying out agricultural cooperative production at early stage. Cooperative economic organization germinates in the 1990s. With the development of agricultural production in Sichuan, the organizations showed strong growth momentum. Until the end of the year 2007, there are 11 590 rural cooperative economic organizations, which directly help more than 6 600 thousand peasant households, accounting for 33.6%[10]. Of course, cooperative economic organization in Sichuan Province is also facing some risks that can not be ignored and risk research is very necessary. Therefore, operation risk of cooperative economic organization in Sichuan Province, China is analyzed by principal component analysis, in order to offer theoretical reference for the safe operation of cooperative economic organization in Sichuan Province.

1 Index selection, data source and research method

1.1 Index selection According to the related literatures and the specific situation in Sichuan Province, risks in economic organization operation are classified into 10 types, considering the operating environment of agricultural cooperative organizations and the internal and external factors of organization[11-12].

1.1.1 Natural risk(X_1). It mainly refers to the occurrence of natural disasters and the anomalies of natural condition, which lead to the wide fluctuation margin of agricultural production and the unstable income of farmers.

1.1.2 Resource constraint risk(X_2). Resource constraint refers to the effects of insufficient water and land resources on agricultural production.

1.1.3 Internal management risk(X_3). It mainly refers to the adverse effect on agricultural production due to the irregular management within the organization, the unscientific decision, and the great management expenditure. These are caused by the nonstandard constitution, institution and organization of cooperative economic organization, the weak democratic awareness of membership and the unreasonable daily expenditure.

1.1.4 Capital risk(X_4). Due to the natural inferiority of traditional agriculture, there are difficulties in financing support of

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agriculture. Moreover, capital market in Sichuan Province is underdeveloped and the free flow of capital is restricted in trading market, causing insufficient support of capital for agricultural cooperative economic organization.

1.1.5 Technical input and output risk(X_5). The phenomenon of "free rider" is common, because implementation of agricultural technology has strict requirements for the external natural environment and economic environment, and the confidentiality of agricultural technology is poor[13]. Besides, due to the conditional restriction of peasant household, application of modern technology has brought both risk and benefit for the agricultural cooperative management.

1.1.6 Quality risk of members(X_6). It is mainly due to the effects of the members' cultural level, technical capacity, and the lack of experiences on the development of cooperative economic organization.

1.1.7 Price fluctuation risk (X_7). Long-term and periodic agricultural production has affected the supply and price of agricultural products. The lag of reaction and the adjustment lag of the law of value to agricultural production usually lead to the "Divergent Cobweb". Besides, due to the scale effect of cooperative operation, the depth and breadth of price fluctuation are far beyond the capacity of individual rural household.

1.1.8 Contract credit risk(X_8). It is caused mainly by the existence of incomplete contracts and the unsound supervision and management system. In reality, contract is usually incomplete, which leads to the frequent breach of contract. Moreover, since the supervision and management system is imperfect, there is great credit risk.

1.1.9 Property risk(X_9). It mainly refers to the risks caused by unreasonable arrangement of property right system within cooperative economic organization. The undefined property right has dampened the enthusiasm of organizational investment, exacerbated the risk of interest linkage within organization, and indirectly influenced the contractual relationship and management level of organization.

1.1.10 Policy support risk(X_{10}). There exist the lack of government investment in agriculture, and the instable fiscal investment in agriculture. Government at all levels and management departments carry out multi-intervention, causing the disordered management of cooperative economic organization. Moreover, although many preferential polices are formulated, they have not been implemented by governments at all levels or the implementation is not adequate.

1.2 Data source The data are from the questionnaire survey by cooperative economic organization in Sichuan Province. The survey has been carried out since September, 2009, lasted nearly 2 months and covered a total of 23 cooperative economic organizations in eight counties of Sichuan Province, including Yongfeng Edible Mushroom Cooperative of Pi County (V_1), Shengnong Synthesized Operation of Agricultural Machinery Special Cooperative of Pi County (V_2), Fishery Cooperative of Ornamental Fish of Wenjiang District, Chengdu City (V_3), Jinnong Agricultural Machinery Service Special Cooperative in Wenjiang District (V_4), Tangyuan Yellowish Leek Cooperative of Pi County (V_5), Zhicheng Farmer's Specialized Cooperative of Leshan City (V_6), Luyuan Vegetable Farmer Specialized Cooperative of Hanyuan County (V_7), Mouzi Vegetable Cooperative of Leshan City (V_8), Tongji Meat Pigeon Specialized Cooperative of Zhongjiang County, Deyang City (V_9), Huijue Citrus Specialized Cooperative of Luojiang County, Deyang City (V_{10}), Tongji Fruit Specialized Cooperative of Zhongjiang County, Deyang City (V_{11}), Xyyan Grape Specialized Cooperative of Hongguang Town, Pi County (V_{12}), Shigu Town Mushroom Specialized Cooperative of Shifang City (V_{13}), Zihuamu Marketing Cooperative of Wenjiang Town (V_{14}), Yanshan Pepper Farmer's Specialized Cooperative (V_{15}), Chengbian Fruit Specialized Cooperative of Leshan City (V_{16}), Dafeng Shengyuan Huangguogan Specialized Cooperative of Hanyuan County (V_{17}), Luocheng Hui People's Cattle Specialized Cooperative of Leshan City (V_{18}), Luodu Fruit Cooperative of Leshan City (V_{19}), Huaren Winter Jujube Specialized Cooperative of Renshou County (V_{20}), Hongchang Bamboo Weaving Specialized Cooperative of Leshan City (V_{21}), Wenjiang Garlic Specialized Cooperative (V_{22}), Lianhui Flower and Tree Marketing Specialized Cooperative of Chengdu (V_{23}). Among the cooperative economic organizations investigated, industries are mainly distributed in farming, aquaculture and service. And organizations of planting industry account for 70% of the total organizations investigated. A total of 23 cooperative economic organizations have helped more than 90 thousand peasant households. There are in all 230 cooperative economic organizations investigated. 240 questionnaires are sent out and 236 available questionnaires are retrieved, which are about the basic conditions of cooperative economic organization in Sichuan Province. According to the given information, decision objective and evaluation criterion, indices have 5 evaluation grades, such as extremely high risk, relatively high risk, general risk, relatively low risk, and extremely low risk. Quantization of the five grades is carried out: 1, 2, 3, 4 and 5 indicate extremely low, relatively low, general, relatively high, and extremely high risks, respectively. And the mean values of the effects of each risk on peasant households participated in organizations are calculated, which is called influence degree. The greater the mean value is, the bigger the influence degree becomes. Thus, the analysis table of raw data is obtained (Table 1).

Table 1 Risk influence degree of factors on cooperative economic organization

Cooperative economic organization	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
V_1	2.17	2.80	2.91	3.25	2.79	2.80	3.50	2.46	2.80	2.30
V_2	2.59	3.22	3.31	3.45	2.48	2.97	2.80	2.78	3.16	2.70
V_3	2.34	2.67	3.29	3.16	2.88	3.00	3.33	2.60	2.85	2.80
V_4	2.23	2.74	3.15	3.60	2.32	2.90	2.30	2.50	2.43	2.20
V_5	2.55	3.30	3.00	2.80	2.60	2.70	2.75	2.42	2.60	2.00
V_6	2.45	3.00	3.40	3.20	2.83	3.18	2.98	2.68	2.60	2.56
V_7	2.50	3.13	3.20	2.75	2.82	3.07	3.00	2.60	2.60	2.12
V_8	2.30	2.67	3.50	3.30	2.60	3.00	3.00	2.88	2.60	3.00
V_9	2.40	2.87	3.15	3.75	2.71	2.80	2.80	2.58	3.27	3.40

Continued (Table 1)

Cooperative economic organization	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
V_{10}	2.50	3.10	3.35	3.67	3.00	3.00	2.86	2.25	3.14	3.23
V_{11}	2.50	2.95	3.45	3.00	2.50	3.33	3.50	2.50	3.42	2.80
V_{12}	2.50	2.90	3.20	3.44	2.66	2.90	3.12	2.60	3.38	3.00
V_{13}	2.20	2.54	2.90	2.88	2.69	2.80	3.22	2.70	3.32	2.76
V_{14}	2.20	2.53	3.70	3.30	3.01	3.30	2.75	3.00	3.50	2.80
V_{15}	2.20	2.48	2.84	3.50	2.30	2.65	2.78	2.22	3.41	2.50
V_{16}	2.20	3.20	3.30	3.29	3.04	3.04	3.80	2.80	2.80	2.46
V_{17}	2.20	2.86	3.23	3.35	2.90	3.20	2.86	2.78	2.60	2.87
V_{18}	2.20	2.78	2.72	3.65	2.53	2.67	2.80	2.19	2.60	2.60
V_{19}	2.20	3.12	3.15	3.54	2.91	3.00	2.90	2.60	2.95	3.40
V_{20}	2.20	3.00	3.25	3.24	3.00	3.03	2.60	2.80	2.55	2.90
V_{21}	2.20	3.00	3.00	3.76	2.85	2.98	3.60	2.70	2.74	2.73
V_{22}	2.10	2.70	3.00	3.24	2.98	3.00	3.40	2.57	2.34	2.65
V_{23}	2.20	2.67	2.95	2.87	2.80	2.87	3.30	2.33	2.87	2.45

1.3 Research method Principal component analysis is used to analyze the risk indices affecting the cooperative economic organization in Sichuan Province[14].

2 Result and analysis

2.1 Result of principal component analysis

2.1.1 Principal component analysis. Principal component analysis on the index of risk influence degree of cooperative economic organization is analyzed by SPSS statistical analysis software. Table 2 reports the eigenvalue and the contribution of principal components and Table 3 reports the loading matrix of initial factor.

Table 2 Eigenvalue and contribution of principal components

Component	Characteristic root	Contribution rate//%	Accumulative contribution rate //%
1	2.889	28.887	28.887
2	1.802	18.019	46.906
3	1.722	17.220	64.126
4	1.170	11.699	75.826
5	1.066	10.663	86.489

Table 3 Loading matrix of initial factor

Variable	Component				
	1	2	3	4	5
X_1	0.198	0.111	0.923	−0.064	0.184
X_2	0.254	−0.248	0.620	0.554	0.342
X_3	0.889	0.142	0.212	−0.111	−0.236
X_4	−0.068	0.712	−0.222	0.527	0.050
X_5	0.608	−0.305	−0.421	0.295	0.281
X_6	0.886	−0.116	−0.005	−0.099	−0.134
X_7	0.175	−0.434	−0.333	−0.256	0.688
X_8	0.773	−0.094	−0.174	−0.034	−0.318
X_9	0.149	0.622	0.108	−0.611	0.342
X_{10}	0.430	0.715	−0.249	0.181	0.263

According to the principle of the extraction number of principal component, that is, accumulative contribution rate of principal component being greater than 85%, we can conclude from Table 2 that the contribution rates of the accumulative variances of components 1, 2, 3, 4 and 5 have all reached 86.489%, and the five components are major factors. Table 3 indicates that X_3, X_5, X_6 and X_8, which are the internal management risk, the technical input and output risk, the quality risk of members and the contract credit risk, are relatively significant at first principal component, and can be summarized as the operation risk of cooperative economic organization caused by internal factor. X_4, X_9 and X_{10}, which are the capital risk, the property risk and the policy support risk, are relatively significant at the second principal component, and can be classified into the operation risk of cooperative economic organization caused by socioeconomic factor. X_1, the natural risk, is relatively great at the third principal component, reflecting the effects of natural disasters on the operation of cooperative economic organization. X_2, the resource constraint risk, is significant at the fourth principal component, which is caused by the uncertainty of the operation of cooperative economic organization caused by natural resources. X_7, the price fluctuation risk, is relatively significant at the fifth principal component, showing the effects of market risk on the potation of cooperative economic organization.

2.1.2 Index weight. Since the cumulative contribution rate of the top-five principal components is 86.489%, which is greater than 85%, five new variables are extracted to replace the original 10 variables. Then, data in Table 3 are divided by the square root of corresponding eigenvalue. Thus, coefficients of index of the five principal components are obtained:

$$F_1 = 0.116X_1 + 0.149X_2 + 0.523X_3 - 0.040X_4 + 0.358X_5 + 0.521X_6 + 0.103X_7 + 0.455X_8 + 0.088X_9 + 0.253X_{10}$$

$$F_2 = 0.083X_1 - 0.185X_2 + 0.106X_3 + 0.530X_4 - 0.227X_5 - 0.086X_6 - 0.323X_7 - 0.070X_8 + 0.463X_9 + 0.533X_{10}$$

$$F_3 = 0.703X_1 + 0.472X_2 + 0.162X_3 - 0.169X_4 - 0.321X_5 - 0.004X_6 - 0.254X_7 - 0.133X_8 + 0.082X_9 - 0.190X_{10}$$

$$F_4 = -0.059X_1 + 0.512X_2 - 0.103X_3 + 0.487X_4 + 0.273X_5 - 0.092X_6 - 0.237X_7 - 0.031X_8 - 0.565X_9 + 0.167X_{10}$$

$$F_5 = 0.178X_1 + 0.331X_2 - 0.229X_3 + 0.048X_4 + 0.272X_5 - 0.130X_6 + 0.666X_7 - 0.308X_8 + 0.331X_9 + 0.255X_{10}$$

After multiplied by the corresponding contribution rate, coefficient of each index is divided by the sum of contribution rates of five principal components obtained. Then, the comprehensive score model is the sum of the results, where the corresponding coefficient of each index is the weight of the index:

$$Y = 0.210X_1 + 0.216X_2 + 0.187X_3 + 0.135X_4 + 0.079X_5 + 0.127X_6 + 0.031X_7 + 0.069X_8 + 0.107X_9 + 0.212X_{10}$$

2.2 Comparison of the importance of index Weight of the index in comprehensive score model can be regarded as the importance degree of the effects of index on the cooperative economic organization risk, in order to conduct the comparison of the importance of index. Fig. 1 illustrates that resource constraint risk is the most important, while the price fluctuation risk has the lowest importance. Weighted average of the index indicates that importance degrees of X_1, X_2, X_3 and X_{10} are more than average importance, while those of X_4, X_5, X_6, X_7, X_8 and X_9 are all less.

2.3 Comprehensive analysis and evaluation

2.3.1 Influence degree of risk. Table 4 shows that the average

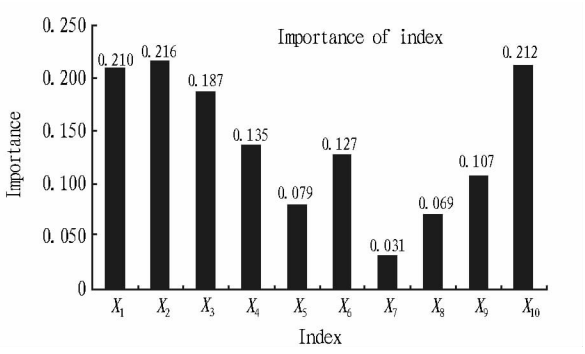


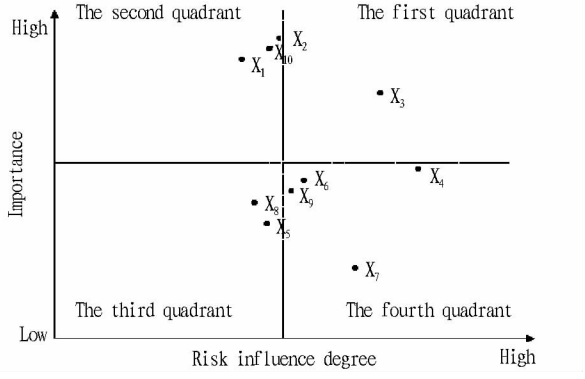
Fig.1 Comparison of the index importance

risk influence degree of indices on the operation of cooperative economic organization can be obtained according to the descriptive analysis of original data in Table 1. Thus, the average risk influence degree is 2.86.

Table 4 Average risk influence degree of indices on the operation of cooperative economic organization

Index	Risk influence degree	Index	Risk influence degree
X_1	2.31	X_6	2.965
X_2	2.88	X_7	3.041
X_3	3.172	X_8	2.589
X_4	3.304	X_9	2.892
X_5	2.748	X_{10}	2.706

2.3.2 Analysis by four-quadrant technique. Influence degree of risk on the operation of cooperative economic organization is analyzed by the four-quadrant technique in marketing. Taking risk influence degree of index as the lateral axis and the index weight (importance degree) as the longitudinal axis, Fig.2 illustrates the quadrant analysis of index, which intuitively shows the importance and influence degree of index in the operation of cooperative economic organization, determines the general orientation of all the risks, clearly presents the advantages and disadvantages of the risk in the operation of cooperative economic organization, and finds out the working emphasis of organization management in order to avoid risks.



Note: The first quadrant is high attention region; the second quadrant is preferential attention region; the third quadrant is relatively stable region; and the fourth quadrant is the region expecting improvement.

Fig.2 Quadrant analysis of index

(1) The first quadrant is the region having high importance and influence degree (high attention region). X_3 (management within the organization) is located in it, indicating that the importance of X_3 is in proportion to the influence degree of risk. In other words, the risk influence degree of cooperative economic organization provided by the peasant households is consistent with the reasonable importance they evaluated. Therefore, index in the first quadrant should be paid high attention to.

(2) The second quadrant is the region having high importance and low influence degree (preferential attention region). X_1 (nature), X_2 (resource constraint), X_{10} (policy support) belong to this region, indicating the strong risk awareness. In other words, the risks of the three indices provided by peasant households are lower than the reasonable importance they evaluated. This might because that government and cooperative economic organization have paid more capital and resources than the importance approved by peasant household. To a certain degree, risk of this quadrant is paid preferential attention to and relevant measures are adopted in order to reduce risk. If possible, organizations should use some of the resources invested in the indices motioned above to solve the problems having great risk influence degree, such as the index in the fourth quadrant.

(3) The third quadrant is a region having low importance and low influence degree (relatively stable region). X_5 (technical input and output) and X_8 (contract credit) are located in this region, indicating that the importance of the two is in proportion to the influence degree of risk, that is, the risk influence degree of cooperative economic organization provided by the peasant households is consistent with the reasonable importance they evaluated. The two indices are relatively stable in a long period of time, and their influence degrees of risk are relatively small. Therefore, organizations should maintain or pay further concerns in the expectation change of peasant households.

(4) The fourth quadrant is a region has low importance and high influence degree (a region expecting improvement). X_4 (capital), X_6 (quality of members), X_7 (price fluctuation) and X_9 (property) belong to this region, indicating that this region has greater opportunities for improvement, and the risk influence degree of cooperative economic organization provided by peasant households is far greater than the reasonable importance they evaluated. Organizations should speed up the improvement of the indices, because the represent significances of the risk of the four indices can all be reduced through resource integration, distinct property, quality improvement of members, and so on.

2.3.3 Comprehensive evaluation. According to the above analysis, during the operation of cooperative economic organization, management risk has great influence and more importance, which should be paid special attention to during the development. Due to the high risk, capita, quality of members, price fluctuation and property are attached low importance, which are the major constraint factors for the development of cooperative economic organization at present. Technical input and output and contract credit have relatively low importance and low impact on the operation risk of cooperative economic organization, which should continue to maintain their advantages. Nature, resource constraint and policy support have relatively high risk awareness and low influence degree, belonging to the factors should paid preferential

attention to and should be controlled to some extent.

3 Countermeasures

3.1 Enhancing the management level of cooperative economic organization Organization and management level has the most significant impact on the risk of cooperative economic organization. Therefore, risk prevention ability of cooperative economic organization should be strengthened by enhancing the organization and management level. For instance, cooperative economic organizations with high risks, including Zihuamu of Wenjiang Town and the Mouzi vegetable of Leshan City, should improve the internal management mechanism, save management cost, strengthen the sense of democracy, establish the democratic decision-making mechanism, reduce the risk within organization, pay attention to the foreign competition and the development of the whole industry chain, and strive for greater interests from parties outside the organization.

3.2 Strengthening the risk awareness of farmers Investigation shows that peasant households have poor awareness of risk and pay little attention to the risks of capital, price, property and quality of members. Therefore, we should reinforce the management of the funds, enlarge the financing channel, encourage peasant household to buy a share, establish financial system and internal control system, negotiate actively with other financial bodies, obtain more channels of financial support, offer production and technology training for members, improve the comprehensive quality of farmers, pay attention to the marketing training of agricultural products, set up specialized market research department, expand the information collection channels to reduce market risk. At the same time, we should also organize the production and sale of peasant household based on the market price and the scientific and rational forecast, clarify the property rights of economic entity in order to prevent the confusion of property rights between the collective and individual, and allocate profits according to the proportion of shares to stimulate the enthusiasm of the members.

3.3 Improving the risk aversion ability of cooperative economic organization Firstly, government at all levels should have the right altitude towards cooperative economic organization and use various ways to develop agricultural cooperative economic organization. For instance, Hanyuan County should pay attention to the development of agricultural cooperative economic organization, increasing the financial subsidies, make full use of the one-to-one assistance policy for post-disaster reconstruction, and develop agriculture by the human, material and other assistance. Secondly, government should pay attention to the pushing effect of research institutions and introduce new technology actively. Cooperative economic organization should take the initiative to cooperate with agricultural universities, introduce advanced research technology, increase investment in technology, led the farmers to become rich and to realize agricultural modernization. Finally, organizations should establish a stable relationship with the members, improve interests connecting mechanism between organization and peasant household, and achieve interest and risk sharing in order to promote the long-term development of cooperative economic organization.

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