Advance Journal of Food Science and Technology 6(4): 552-557, 2014
DOI:10.19026/ajfst.6.72
ISSN: 2042-4868; e-ISSN: 2042-4876

Submitted: January 20, 2014 Accepted: February 10, 2014 Published: April 10, 2014

Research Article

An Empirical Study on Evaluation of Marketing Channel Risk in Agricultural Products via PCA and Cluster Analysis

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Abstract: In order to better guard against the marketing channel risk in agriculture products, it is very important that how to conduct a fair and reasonable quantitative evaluation on marketing channel risk. As an important channel by which the enterprises connect the market and consumers, marketing channels play a very important role on the enterprise operation and development. And the development issue of the "agriculture, rural, farmers" has always been one of the most important problems of Chinese government in recent years. The demand of agricultural products in China has been transmitted from the overall shortage to the relative surplus stage, which leads to increasingly fierce competition on marketing of the agricultural products. To make marketing channel operation of the agricultural products enterprise be healthy and effective, it is necessary to carry out effective risk management of marketing channel. This study builds an evaluation index system on marketing channel risk of agricultural products, which includes 2 first-level indicators, 13 second-level indicators. Then the study uses the statistical data, Principal Component Analysis (PCA) and cluster analysis to evaluate and analyze the marketing channel risk of agricultural products. Finally some corresponding measures and suggestions are put forward to strengthen the risk prevention.

Keywords: Agricultural products, cluster analysis, marketing channel risk, Principal Components Analysis (PCA)

INTRODUCTION

With the development of market economy in China, the circulation system of agricultural products has been rationalized and market economic system of the circulation in agricultural products has been set up, which is mainly controlled by the market regulation and supplemented by the macroeconomic regulation and control of government. At the same time, our marketing channel of agricultural products is not perfect, most of marketing trade efficiency of agricultural products is very low and the contradiction between small-scale production and big market is very outstanding. In recent years, there have been a lot of phenomena that agriculture products sell is difficult and the farmers' income increase is slow, which showed that the barrier of agricultural development of our country has shifted from the production to circulation field.

The marketing channel of agricultural products is different from other forms of products because of its nature characteristics. And marketing enterprises of the agricultural products are in an intense-changing external environment. Changes in the external environment makes the agricultural product marketing enterprises adjust the internal operation mechanism to adapt to such changes. And the business environment is complex and changeable, which results in that business, management and marketing activities always face the risk. But due to the direct the markets and contacting with the market, marketing channel is more vulnerable to the external shock. Therefore, it is more prone to risk. Because the marketing channel in agricultural products is very important and characteristic is difficult to control, it is of great significance to the development to evaluate risk of marketing channel in agriculture products and take corresponding risk avoidance strategies.

With the increasing emerging of the role of agricultural marketing channels, the theoretical circle in the research on marketing channel risk of agricultural product is also increasingly active. A lot of experts and scholars had made some research about the marketing channels risk of agricultural products (Zou, 2007; Zhou *et al*., 2007; PhiliP, 1997; Ethar, 1976; Gaski, 1998; Wang, 2011; Gong, 2012). But most of the existing research is lack of the assessment of the actual data on marketing channel risk of agricultural products and related information and the lack of appropriate research methods, most of research still stay in the simple qualitative description and analysis phase. This shows that the research problems of marketing channel risk on agricultural products have very important theoretical significance. On the basis of it, the study uses Principal Component Analysis (PCA) and cluster analysis to

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evaluate and analyze the marketing channel risk of agricultural products. To better guard against the marketing channel risk in agriculture products, this study uses Principal Component Analysis (PCA) and cluster analysis to evaluate and analyze the marketing channel risk of agricultural products and conducts a fair and reasonable quantitative evaluation on marketing channel risk.

THE CONCEPT AND COMPOSITION OF MARKETING CHANNEL RISK IN AGRICULTURAL PRODUCTS

Marketing channel risk of agricultural products refers to the possibility, variability, uncertainty and change of loss in agricultural products. These losses are the sum of a series of adverse consequences, which result from that the distribution channels of the enterprises cannot perform the distribution responsibility and cannot meet the sales target. As its characteristics nature of agricultural products, most of the agricultural products are not easy to preserve for the time constraints, such as strawberry, Chinese cabbage, tomato. And now people have high quality requirements for fresh vegetable and fruit, which lead to them to have to be consumed in a certain time and range. But the marketing channels of agricultural products are excessive in China. The majority of farmers are the source of channels and then, the local wholesalers go to points of origin to purchase them from the farmers and then wholesale to various market retailers and finally the agricultural products are transferred to the hands of consumers. There are up to 4-5 of the channel length, if one of length appears the problem, agricultural products may deteriorate and have to be discarded. Therefore, it is very important to conduct the research on the marketing channel risk of agricultural products.

Marketing channels of agricultural products can be divided into external and internal channel risks. Internal channels risk refers to the risks which result from the own reasons of manufacturer or channel managers. The risks are coming from the such personnel engaged for the transfer of agricultural products as the farmers and distributors, including: risk from agricultural suppliers, quality safety risk of agricultural products in itself, channel strategy risk, channel conflict risk, channel functions risk, risk of immature marketing channels main of agricultural products, channels cost risk, sales personnel risk. At the same time, external channels risk is the risk caused by factors outside the enterprise channel. It is coming from the national policy by macro economic factors and risk resulting from rival, including: climate risk, political risk, economic environmental risks, competing risks, market price risk of agricultural products.

CONSTRUCTION OF EVALUATON INDEX SYSTEM OF MARKETING CHANNEL RISK IN AGRICULTURAL PRODUCTS

Construction principles of evaluation index system: Evaluation index system of marketing channels risk refers to measure, analyze the relevant parameters of marketing channels risk, to estimate and measure probability of occurrence and scope and intensity of the loss and provide technical data so as to develop the programmers of risk management on marketing channels. Before risk evaluation system is established, the following principles should be guided (Mo, 2004).

Principle of objectivity: Many objective facts on the channel activity should be analyzed and then we can identify sources of risk, correct and pre-control them.

Principle of systematization: As a system, the enterprises consist of several subsystems and marketing management system is an important component and channel risk management is an important component of marketing management. Therefore, construction of marketing risk evaluation system must serve for the enterprise management systems.

Principle of easy maneuverability: As a new evaluation system, it is the basic requirement for easy maneuverability to be applied in practical. Whether or not the channel risk evaluation has practical value, it is one of the most convenient its embodiment to be easy to operate and master.

Principle of precaution: Characteristics of risk evaluation system are to measure and analyze the various indicators of the channel risk, make prediction and assessment of the possible loss and provide information against the channel risk.

Principle of quantitative analysis: There are many factors involved in the marketing channel risk and failure of any links and factors is likely to evolve into a big hidden danger. In these factors, some problems can be directly determined by quantitative assessment method and some problems are difficult to measure the consequences of their actions, but we can build the model by mathematical method which can transform the subjective problem into quantitative description.

To determine the evaluation index system of marketing channel risk: According to classification standard of marketing channels and the designing principle of index system described above, an evaluation indicator system of marketing channels risk in agricultural products can be set up, which includes 2 first-level indicators and 13 second-level indicators shown in Table 1.

Data processing procedure of the questionnaires case: From the Table 1, we can know that marketing

Table 1: The evaluation index system of marketing channel risk in agricultural products

First-level indicators	No	Second-level indicators	No	Connotation of indicators
The external channel risks	U1	Climate risk	W1	It mainly refers to the production risks of agricultural products from climate change.
		Political risk	W2	It mainly refers to the threats to agricultural qualitative production from the political risk.
		Economic environmental risks	W3	It mainly refers to the inflationary risks.
		Competing risks	W4	It mainly refers to the risk of low brand in agricultural products.
		Market price risk of agricultural products	W5	It mainly refers to the risk of fluctuations in the prices of agricultural products.
The internal channel risks	U2	Risk from agricultural suppliers	W6	It mainly refers to the risk of not timely supply, low equipment advanced degree, unqualified quality.
		Quality safety risk of agricultural products in itself	W7	It mainly refers to the risk from growing stage, processing stage, distribution and consumption stage of agricultural products.
		Channel conflict risk	W8	It mainly refers to the conflict risk from channel information, channel behavior, channel relationship.
		Channel functions risk	W9	It mainly refers to the risk from the distribution, transportation, goods recycling.
		Channel strategy risk	W10	It mainly refers to the risk from too long channel structure. The moral and adverse selection for instable channel relation, mismatched rules between channels and markets.
		Risk of immature marketing channels main of agricultural products	W11	It mainly refers to the risk from the producer of low industrialization degree, agricultural products wholesale and retail of small scale and low grade.
		Channels cost risk	W12	It mainly refers to the risk from circulation cost, logistics cost, sales agency cost, time cost of inventory.
		Sales personnel risk	W13	It mainly refers to the moral risk of sales personnel, turnover risk of sales personnel.

channel risk evaluation of agricultural products is a multivariate problem. It is no doubt that too much variable will increase the difficulty of the problem analysis and complexity. And in many practical problems, there is a certain relationship among multiple variables. Based on the study of the relationship among each variable, Principal Component Analysis (PCA) is used to replace the original more variables with fewer new variables and make them less new variables as much as possible to leave the more reflected in the information. From the angle of mathematics, it is a processing technology of dimension reduction.

In this study, corresponding questionnaire has been designed. And 50 copies of questionnaires are issued to the administrative departments of agricultural experts, 43 copies are recycled, 3 invalid questionnaires are eliminated, finally the remaining 40 questionnaires are effective. The statistics analysis software of SPSS17.0 is used for data analysis.

To standardize the raw data: The 40 samples are standardized processing via the software of SPSS to ensure that the data is not affected by various index dimensions:

$$ZX_{ij} = \frac{x_{ij} - \overline{x}_j}{s_j} \quad (1)$$

where,

$$i = 1, 2, \cdots, n; j = 1, 2, \cdots, p$$

$$\overline{x}_j = \frac{\sum_{i=1}^{n} x_{ij}}{n}, s_j^2 = \frac{\sum_{i=1}^{n} \left(x_{ij} - \overline{x}_j\right)^2}{n-1}$$

$ZX_i = \{ZX_{i1}, ZX_{i2}, ZX_{i3}, \cdots ZX_{ij}\}$: The standard matrix.

where,

$$i = 1, 2, 3, \cdots, n; j = 1, 2, 3, \cdots, p$$

To find the correlation coefficient matrix: The correlation coefficient matrix can be easily found via the software of SPSS and indicates the coefficient relation between the variables, which is shown in Table 2.

To take KMO and Bartlett's test of the correlation coefficient matrix: Specific test results are shown in Table 3. And we can know that the result of KMO's Test is 0.563, which is bigger than 0.5 and indicates that the data sample is eligible for factor analysis. And the value of Sig in the Bartlett's test is 0.000, which is smaller than 0.05 and indicates that all variables are not independent (Luo and Yang, 2010).

To extract the main factors via the principal component method: As can be seen from Table 4, the value of the maximum main factor is 3.379; the corresponding variance contribution rate is 25.992%. And the cumulative variance contribution rate of the 5 main factors is up to 71.132%. According to the conditions of that the value of extracting factor eigenvalue must be greater than 1.0, 5 main factors are eventually extracted to replace the original 13

Table 2: Correlation matrix

Correlation	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13
W1	1.000	0.045	-0.218	-0.244	0.172	-0.071	-0.028	-0.233	-0.233	0.069	0.176	0.109	-0.083
W2	0.045	1.000	0.261	-0.172	0.039	-0.374	-0.245	-0.240	-0.064	-0.133	0.231	-0.142	0.193
W3	-0.218	0.261	1.000	0.067	-0.191	-0.195	-0.025	0.130	-0.082	0.031	-0.008	-0.142	0.387
W4	-0.244	-0.172	0.067	1.000	0.230	0.422	0.561	0.230	0.180	0.368	-0.066	0.212	0.321
W5	0.172	0.039	-0.191	0.230	1.000	0.353	0.068	0.122	0.122	0.081	0.435	0.337	0.169
W6	-0.071	-0.374	-0.195	0.422	0.353	1.000	0.428	0.294	0.055	0.364	0.168	0.260	0.272
W7	0.037	-0.245	-0.025	0.561	0.068	0.428	1.000	0.253	-0.066	0.141	-0.052	0.236	0.193
W8	-0.028	-0.240	0.130	0.230	0.122	0.294	0.253	1.000	0.289	0.406	0.082	0.208	0.352
W9	-0.233	-0.064	-0.082	0.180	0.122	0.055	-0.066	0.289	1.000	0.428	0.255	0.267	0.271
W10	0.069	-0.133	0.031	0.368	0.081	0.364	0.141	0.406	0.428	1.000	0.328	0.309	0.417
W11	0.176	0.231	-0.008	-0.066	0.435	0.168	-0.052	0.082	0.255	0.328	1.000	0.385	0.385
W12	0.109	-0.142	-0.142	0.212	0.337	0.260	0.236	0.208	0.267	0.309	0.385	1.000	0.334
W13	-0.083	0.193	0.387	0.321	0.169	0.272	0.193	0.352	0.271	0.417	0.385	0.334	1.000

Table 3: KMO and Bartlett's test

Kaiser-Meyer-Olkin measure of sampling adequacy		0.563
Bartlett's test of sphericity	Approx. chi-square	144.139
	df	78
	Sig.	0.000

Table 4: Total variance explained

	Initial eigenvalues			Extraction S.S. loadings		
Component	Total	% of variance	Cumulative (%)	Total	% of variance	Cumulative (%)
1	3.379	25.992	25.992	3.379	25.992	25.992
2	1.890	14.539	40.532	1.890	14.539	40.532
3	1.722	13.250	53.781	1.722	13.250	53.781
4	1.247	9.589	63.370	1.247	9.589	63.370
5	1.009	7.762	71.132	1.009	7.762	71.132
6	0.748	5.750	76.882			
7	0.685	5.272	82.154			
8	0.633	4.869	87.023			
9	0.489	3.763	90.787			
10	0.410	3.156	93.943			
11	0.360	2.767	96.710			
12	0.260	2.003	98.713			
13	0.167	1.287	100.000			

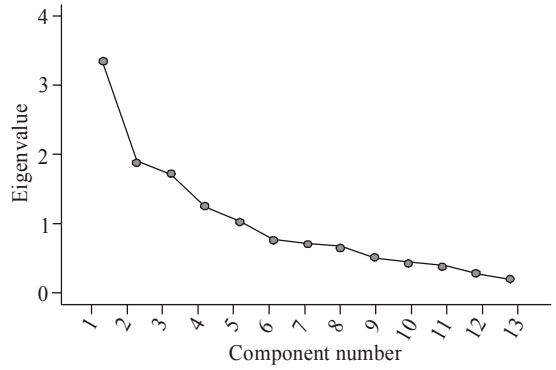

Fig. 1: Screen plot

observation points, which can basically reflect the basic circumstances of the study. The Scree Plot is shown in Fig. 1, where the all eigenvalues are arranged in accordance with value in descending order.

To obtain the component matrix: The component matrix can be obtained, which is shown in Table 5.

To calculate the total score of main factor and explain them: According to the numerical contribution rate in Table 2, the corresponding weight of Y_i (i = 1, 2, 3, 4, 5) were 25.992, 14.539, 13.250, 9.589 and 7.762%, respectively:

Table 5: Component matrix

	Component				
No.	Y1	Y2	Y3	Y4	Y5
W1	-0.041	0.182	-0.608	0.282	0.612
W2	-0.250	0.686	0.187	0.351	-0.187
W3	-0.013	0.285	0.752	0.319	0.163
W4	0.630	-0.376	0.267	0.226	-0.291
W5	0.458	0.226	-0.491	0.226	-0.382
W6	0.671	-0.360	-0.181	0.131	-0.118
W7	0.500	-0.511	0.043	0.453	0.073
W8	0.583	-0.079	0.219	-0.180	0.437
W9	0.468	0.248	0.136	-0.679	-0.181
W10	0.693	0.133	0.100	-0.266	0.302
W11	0.442	0.670	-0.298	0.050	-0.062
W12	0.612	0.165	-0.302	-0.024	-0.017
W13	0.632	0.401	0.387	0.224	0.066

$$S_i = \sum x_i * w_i \quad (2)$$

where,

i = 1, 2, 3, 4, 5

x_i = The standardized score of the evaluation value

w_i = The weight corresponding to the evaluation value

S_i = The comprehensive evaluation value of the evaluation value

Table 6: Principal component score, rank and classification

Company	ZY1	ZY2	ZY3	ZY4	ZY5	S_i	Rank	Classification
Q1	1.144	1.053	-1.347	0.104	-0.303	0.258	1	1
Q2	-1.456	0.468	0.056	0.624	0.707	-0.188	5	3
Q3	-0.416	-1.482	1.459	1.144	0.959	0.054	2	1
Q4	0.624	0.468	0.056	-1.456	-1.565	-0.023	3	2
Q5	0.104	-0.507	-0.224	-0.416	0.202	-0.101	4	3

As can be seen from the Table 5, the loads of the first principal component in W4, W6, W10, W12, W13 is larger, which mainly reflects the competing risks, risk from agricultural suppliers, channel strategy risk, channels cost risk and sales personnel risk; the feedback of the W1, W2 and W3 is negative. The loads of the second principal component in W2, W11 is larger, which mainly reflects the political risk and risk of immature marketing channels main of agricultural products; the feedback of the W4, W6, W7 and W8 is negative. The loads of the third principal component in W3 are larger, which mainly reflects the economic environmental risks; the feedback of the W1, W5, W6, W11 and W12 is negative. The loads of the fourth principal component in W7 are larger, which mainly reflects the quality safety risk of agricultural products in itself; the feedback of the W8, W9, W10 and W12 is negative. The loads of the fifth principal component in W1 and W8 are larger, which mainly reflects the climate risk and channel conflict risk; the feedback of the W2, W4, W5, W6, W9, W11 and W12 is negative.

To make the cluster analysis and evaluation via K-means clustering method: In order to verify whether the result is consistent with the actual or not, this study rates five sales companies engaged in agricultural product in Henan Province on the basis of expert opinion, the five companies were respectively named Q1, Q2, Q3, Q4, Q5. After the scoring is standardized, the comprehensive evaluation value of S_i can be calculated according to the formula (2) and the results are ranked in descending order, which are shown in Table 6. According to the factor scores of each enterprise, cluster analysis can be made the by the means of K-means clustering method in SPSS software. When the clustering analysis is conducted, it is supposed that the cluster number is 3 and the convergence criteria value is 0.03, the final results of classification on standardized variation ZY_i (i = 1, 2, 3, 4, 5) will be shown in the last column of Table 6. Results of ordination and classification show that comprehensive evaluation result is satisfactory and the evaluation system achieves the desired effect.

CONCLUSION

Marketing channel risk in agricultural products is affected by many factors and it is difficult to have a comprehensive, accurate and quantitative evaluation. In this study, a comprehensive evaluation index system on marketing channel risk in agriculture is established, which combines the advantages the advantage of PCA and cluster analysis method. To a certain extent, this system provides a method to solve the complicate problem on the evaluation of marketing channel risk.

According to the actual results of calculation of a case study including five enterprises, the system proves to be valid. And four countermeasures and suggestions have been made to guard against the risk.

SOME COUNTERMEASURES AND RECOMMENDATIONS

To establish the early warning system and dispatch center: On the base of the early warning system and dispatch center of marketing channels, all aspects of the marketing channels in agricultural products will in real-time monitoring. If there is a problem happening, it must be timely feedback to the dispatch center and processed uniformly by the dispatch center. Then all problems that appear can be solved timely, effectively, accurately in the marketing channel, so as to prevent risks from happening and minimize the loss for maximum interests.

To shorten the channel length and put an end to channel conflict: As the agricultural product itself is not easy to preserve, channel length should not be too long. The farmers can produce products and make sales on their own to solve the problem. Farmers can take their own crops grown or unite with several farmers to concentrate all products to transport to the nearest city, sell them directly to the final consumers. Or in a country a sales representative is recommended to specialize in selling the products to the farmers' markets or supermarkets or secondary agent in cities and towns.

To strengthen the construction of the brand and establish a good image: Nowadays, agricultural products have complex category and their quality is uneven. To do a better marketing, we must let the consumer be different from other similar products, which require us to build loyalty of brand and strengthen the construction of the brand in agricultural products. At present, brand development of agricultural products is not yet perfect and the consumer market has a great demand. After the integration of agricultural products to packaging, we will attach a unified identity, coupled with the safety certification of QS quality, which not only can perfect the brand construction, but

also enhance the confidence of consumers and improve the loyalty of consumers.

To realize the network marketing of agricultural products: Due to the advent of the era of Internet, the network marketing has penetrated into every household, but the network marketing of agricultural product is very few. Deterioration of agricultural products in logistics process is the key influence factors. To prevent the emergence of this situation, network marketing of agricultural product should be sold in the same city or near city. At the same time, we should develop the logistics technology and preservation technology of cold fresh to solve the fatal restriction of the logistics service length. Network can also make the farmers, wholesalers, retailers and other channels principals share information, less can reduce the risk of marketing channel inside.

ACKNOWLEDGMENT

The authors are very grateful to the reviewers for their detailed comments and suggestions that improved the quality and presentation of this study.

The study is supported by the Outstanding Youth Science and Technology Innovation Team funded projects of Hubei Polytechnic University under Grant No. 13xtr03 and the Laboratory Open Foundation of the 2013 Hubei Polytechnic University Grant No. 201343.

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