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Research Article

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Comparison of principal factors affecting CZER (China zero environmental risk) between different periods: Behavior angle

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ABSTRACT

The purpose of this study is to find principal factors affecting CZER (China Zero Environmental Risk) from behavior angle, and compare the above factors between different periods, and the related advice can help people to solve environmental problems. So in this study the factors' selection, contribution and sequence by correlation, regression, principal component analysis, and comparison of the above factors between different periods, etc. were studied from behavior angle, which is different from the present work only studying individual behavior. Especially in this study, emphasis was put on comparison of principal factors affecting CZER between different periods from behavior angle. To make sure this study applicable, data were collected by case study, and such norms as KMO (KMO refers to Kaiser-Meyer-Olkin Measure of Sampling Adequacy), etc. were abided by. By this study, on one hand, there are such aspects in common as production action, living action, production waste disposal, living waste disposal, public management, and market management. On the other hand, they are different in such aspects as natural cause only for CZER during Period 2, and factors have different sequence by contribution for different periods. And the related advice is as follows: first, careful protection of natural environment. Secondly strict surveillance on production of waste from such behaviors as enterprise production and human living action by market management, and public management, etc.. And thirdly great encouragement to arouse interest in technological innovations friendly with the environment in waste disposal, etc..

Keywords: CZER, Principal Factors, Behavior, Comparison, Different periods

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INTRODUCTION

Environmental risk usually refers to such things as groundwater contamination, soil contamination by hazardous substances, air pollution, or even pollution of lakes or streams, etc. If a bad event doesn't happen then the consequences will not be realized, which can be called as zero environmental risk (ZER), so China zero environmental risk can be abbreviated as CZER.

The present studies mainly focus on assessment of environmental risk, precaution measures and emergency response technology [1,2,3,4], etc., and no special studies were found on China zero environmental risk (CZER), let alone on the principal factors affecting CZER. Because of the emphasis on comparison of principal factors affecting CZER (i.e. principal factors preventing China environmental risk from happening) in this study, the present studies of different preventive measures against environmental risks and their influences should be reviewed. Current research mainly focuses on such individual behaviors respectively as less production of waste, waste disposal, and related management, etc.. The examples of the above research are on less production of waste in Potassium Perchlorate producing [5] and Phosphoric Acid producing [6], waste disposal and related policy design [7], hazardous waste policy [8], public participation [9], etc., but no comprehensive studies were found on all the behaviors together, which are against environmental risks. So comprehensive studies should necessarily be carried out, first on all the behaviors together (it can be called behavior angle), and secondly on comparison of principal factors affecting CZER between different periods

from behavior angle. Because principal factors affecting CZER from October 22, 2009 to April 29, 2010 and from May 12, 2011 to August 25, 2011 was studied [10], and principal factors affecting CZER from October 22, 2009 to April 29, 2010 and from May 12, 2011 to October 27, 2011 was also studied [11], so in this study emphasis was especially put on comparison of principal factors affecting CZER from behavior angle between these two periods: the first period is from October 22, 2009 to April 29, 2010 and from May 12, 2011 to August 25, 2011, and the second period is from October 22, 2009 to April 29, 2010 and from May 12, 2011 to October 27, 2011.

EXPERIMENTAL SECTION

2.1. Behavior angle

2.1.1. Definition: To study principal factors, which affect CZER from behavior angle, all the behaviors can be classified into human actions and natural causes. The former refer to such actions as technological innovations, etc., which can prevent environmental risk, and the latter refer to such substances, which don't bring hazard to people in nature, or were thought to be without environmental risk by scientists according to their knowledge [12], etc. Human actions are further classified into production, living, waste disposal, Government surveillance, public management, and market management, etc.. So the variables can be designed as follows.

2.1.2. Dependent variable: China zero environmental risk. Let CZER be China zero environmental risk.

2.1.3. Independent variables: Natural cause: Let hnc1 be natural cause. Production action: Let hp2 be production action. Living action: Let hl3 be living action. Production waste disposal: Let hprd4 be production waste disposal. Living waste disposal: Let hlrd5 be living waste disposal. Government surveillance: Let gg6 be Government surveillance. Public management: Let pg7 be public management. Market management: Let mg8 be market management.

2.2. Data source and variables' scores

Data are collected by case studies mainly through Southern Weekend from these two periods respectively: the first period is from October 22, 2009 to April 29, 2010 and from May 12, 2011 to August 25, 2011 (it can be called Period 1), and the second period is from October 22, 2009 to April 29, 2010 and from May 12, 2011 to October 27, 2011 (it can be called Period 2). Data from May 6, 2010 to May 7, 2011 are missing because there were no detailed reports in Southern Weekend during this period. Period 1 above is further classified into six study periods with two months as one study period, and Period 2 above is further classified into seven study periods with two months as one study period. To reflect the actual happening of CZER (i.e. China environmental risk has been prevented), CZER can equal to 1 for every period. To reflect the influence of each variable, it can equal to 1 if it's in operation, otherwise it can equal to 0.

2.3. Methods

Here, regression analysis is used to find correlations and coefficients between dependent variables and independent variables, principal component analysis is used to find principal factors' contribution and order them in sequence by their contribution, and comparison of the factors is to find similarities and differences between different periods from behavior angle.

For convenience of study, such basic regression model is developed as follows.

$$CZER=\alpha+\alpha_1\times hnc1+\alpha_2\times hp2+\alpha_3\times hl3+\alpha_4\times hprd4+\alpha_5\times hlrd5+\alpha_6\times gg6+\alpha_7\times pg7+\alpha_8\times mg8+\delta \quad (1)$$

Note in the above equation, α is constant, α_i are regression coefficients, and δ is residual term for the model of behaviors.

RESULTS AND DISCUSSION

3.1. Correlations between Dependent Variables and Independent Variables

Table 1. Correlations between CZER and independent variables for behaviors for period 1

	Behaviors	hnc1	hp2	hl3	hprd4	hlrd5	gg6	pg7	mg8
CZER	Pearson correlation	0.167	0.540	0.354	0.548	0.417	0.408	0.167	0.320
	Sig. (2-tailed)	0.721	0.211	0.437	0.203	0.352	0.364	0.721	0.484

Table 2. Correlations between CZER and independent variables for behaviors for period 2

	Behaviors	hnc1	hp2	hl3	hprd4	hlrd5	gg6	pg7	mg8
CZER	Pearson correlation	0.218	0.535	0.293	0.429	0.339	0.427	0.189	0.339
	Sig. (2-tailed)	0.604	0.172	0.482	0.289	0.411	0.291	0.654	0.411

According to Table 1 and Table 2, CZER is positively correlated with all the behaviors.

3.2. Regression Analysis and Selection of Principal Factors

3.2.1. Result of regression for period 1

1) The factors entering the model

Table 3. Behavior variables entered by regression between CZER and independent variables for behaviors

Model [a]	Variables entered	Variables removed	Method
1	mg8		
	hl3		
	hp2		Enter
	pg7		
	hprd4		
	hlrd5[b]		

a. Dependent Variable: CZER. b. Tolerance = .000 limits reached.

According to Table 3, such behaviors as production action (hp2), living action (hl3), production waste disposal (hprd4), living waste disposal (hlrd5), public management (pg7), and market management (mg8) are the factors, which actually affect CZER.

2) The model with the entered factors

Table 4. Coefficients by regression between CZER and independent variables for behaviors

Model [a]		Unstandardised coefficients		Standardised coefficients
		B	Std. Error	Beta
1	Constant	$-6.42E^{-16}$	0.000	
	hp2	0.250	0.000	1.080
	hl3	0.750	0.000	1.061
	hprd4	0.750	0.000	1.369
	hlrd5	-1.250	0.000	-2.500
	pg7	$2.221E^{-16}$	0.000	0.000
	mg8	0.500	0.000	1.041

a. Dependent Variable: CZER.

According to Table 4, the model with the entered factors for behaviors is as follows:

$$CZER = -6.42E^{-16} + 0.25 \times hp2 + 0.75 \times hl3 + 0.75 \times hprd4 - 1.25 \times hlrd5 + 2.221E^{-16} \times pg7 + 0.5 \times mg8 \quad (2)$$

Note in the equation above, CZER is positively correlated with such behaviors as production action, living action, production waste disposal, public management, and market management, but negatively with such behavior as living waste disposal.

3.2.2. Result of regression for period 2

1) The factors entering the model

Table 5. Behavior variables entered by regression between CZER and independent variables for behaviors

Model [a]	Variables entered	Variables removed	Method
1	mg8		
	hl3		
	pg7		
	hp2		Enter
	hprd4		
	hnc1		
	hlrd5[b]		

a. Dependent Variable: CZER. b. Tolerance = .000 limits reached.

According to Table 5, such behaviors as natural cause (hnc1), production action (hp2), living action (hl3), production waste disposal (hprd4), living waste disposal (hlrd5), public management (pg7), and market management (mg8) are the factors, which actually affect CZER.

2) The model with the entered factors

Table 6. Coefficients by regression between CZER and independent variables for behaviors

Model [a]		Unstandardised coefficients		Standardised coefficients
		B	Std. Error	Beta
1	Constant	$-1.97E^{-15}$	0.000	
	hnc1	$9.195E^{-16}$	0.000	0.000
	hp2	0.250	0.000	1.069
	hl3	0.750	0.000	1.098
	hprd4	0.750	0.000	1.500
	hlrd5[f]	-1.250	0.000	-2.631
	pg7	$-3.68E^{-16}$	0.000	0.000
	mg8	0.500	0.000	1.052

a. Dependent Variable: CZER.

According to Table 6, the model with the entered factors for behaviors is as follows:

$$CZER = -1.97E^{-15} + 9.195E^{-16} \times hnc1 + 0.25 \times hp2 + 0.75 \times hl3 + 0.75 \times hprd4 - 1.25 \times hlrd5 - 3.68E^{-16} \times pg7 + 0.5 \times mg8 \quad (3)$$

Note in the equation above, CZER is positively correlated with natural cause (hnc1), production action (hp2), living action (hl3), production waste disposal (hprd4), and market management (mg8), but negatively with living waste disposal (hlrd5) and public management (pg7).

3.2.3. Selection of principal factors

As seen in the above model for the two periods, first, such six factors as production action (hp2), living action (hl3), production waste disposal (hprd4), living waste disposal (hlrd5), public management (pg7), and market management (mg8) are entered for Period 1. And secondly such seven factors as natural cause (hnc1), production action (hp2), living action (hl3), production waste disposal (hprd4), living waste disposal (hlrd5), public management (pg7), and market management (mg8) are entered for Period 2.

3.3. Principal Factors' Contribution and Sequence

3.3.1. Suitability of the variables for component analysis

Table 7. KMO[a] and Bartlett's test on suitability of component analysis between CZER and independent variables for period 1

Kaiser-Meyer-Olkin measure of sampling adequacy		0.702
Bartlett's test of sphericity	Approx. Chi-Square	18.762
	df[b]	15
	Sig. [c]	0.225

Note: in this table, a. KMO refers to Kaiser-Meyer-Olkin Measure of Sampling Adequacy. b. df refers to degree of freedom. c. Sig. refers to significance level.

Table 8. KMO[a] and Bartlett's test on suitability of component analysis between CZER and independent variables for period 2

Kaiser-Meyer-Olkin measure of sampling adequacy		0.546
Bartlett's test of sphericity	Approx. Chi-Square	29.779
	df[b]	21
	Sig. [c]	0.097

Note: in this table, a. KMO refers to Kaiser-Meyer-Olkin Measure of Sampling Adequacy. b. df refers to degree of freedom. c. Sig. refers to significance level.

According to Table 7 and Table 8, Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) is bigger than 0.5, so the variables are suitable for principal component analysis.

3.3.2. Extraction of principal components

Table 9. Total variance explained by component analysis for period 1

Component [a]		1	2	3	4	5	6
Initial eigenvalues	Total	4.116	0.996	0.468	0.195	0.187	0.038
	% of Variance	68.607	16.598	7.794	3.253	3.111	0.638
	Cumulative %	68.607	85.205	92.999	96.252	99.362	100.000
Extraction sums of squared loadings	Total	4.116	0.996	0.468	0.195	0.187	0.038
	% of Variance	68.607	16.598	7.794	3.253	3.111	0.638
	Cumulative %	68.607	85.205	92.999	96.252	99.362	100.000
Rotation sums of squared loadings	Total	1.505	1.270	1.190	1.069	0.913	0.054
	% of Variance	25.083	21.165	19.829	17.812	15.214	0.897
	Cumulative %	25.083	46.248	66.077	83.889	99.103	100.000

a. Extraction Method: Principal Component Analysis.

According to Table 9, the contribution of the first component is 68.607%, the second 16.598%, the third 7.794%, the fourth 3.253%, the fifth 3.111%, and the sixth 0.638%. All the first five components can explain 99.362% of variance, so it's enough to choose these five components to reflect most of the variance.

Table 10. Total variance explained by component analysis for period 2

Component [a]		1	2	3	4	5	6	7
Initial eigenvalues	Total	3.630	2.028	0.741	0.358	0.162	0.057	0.023
	% of Variance	51.856	28.967	10.587	5.119	2.321	0.819	0.332
	Cumulative %	51.856	80.823	91.410	96.528	98.849	99.668	100.000
Extraction sums of squared loadings	Total	3.630	2.028	0.741	0.358	0.162	0.057	0.023
	% of Variance	51.856	28.967	10.587	5.119	2.321	0.819	0.332
	Cumulative %	51.856	80.823	91.410	96.528	98.849	99.668	100.000
Rotation sums of squared loadings	Total	2.461	2.120	1.056	0.875	0.386	0.060	0.041
	% of Variance	35.161	30.281	15.088	12.504	5.518	0.863	0.585
	Cumulative %	35.161	65.442	80.530	93.034	98.552	99.415	100.000

a. Extraction Method: Principal Component Analysis.

According to Table 10, the contribution of the first component is 51.856%, the second 28.967%, the third 10.587%, the fourth 5.119%, the fifth 2.321%, the sixth 0.819%, and the seventh 0.332%. All the first four components can explain 96.528% of variance, so it's enough to choose these four components to reflect most of the variance.

3.3.3. Ordering principal factors by their contributions

Before ordering principal factors by their contributions, Component Matrix and Rotated Component Matrix should first be analyzed.

Table 11. Component matrix by component analysis between CZER and independent variables for period 1

	Component [a]					
	1	2	3	4	5	6
hlrd5	0.944	0.277	0.003	0.012	-0.071	-0.161
mg8	0.922	-0.004	0.206	0.064	-0.310	0.079
hprd4	0.921	0.053	-0.061	-0.370	0.085	0.041
pg7	0.860	-0.157	0.381	0.143	0.264	0.015
hp2	0.825	0.158	-0.502	0.183	0.077	0.050
hl3	-0.326	0.931	0.153	0.011	0.047	0.040

a. Extraction Method: Principal Component Analysis and 6 components extracted.

Table 12. Rotated component matrix by component analysis for period 1

	Component [a]					
	1	2	3	4	5	6
hp2	0.916	0.245	0.187	-0.090	0.239	-0.004
mg8	0.325	0.794	0.403	-0.150	0.278	-0.022
hlrd5	0.558	0.564	0.388	0.079	0.402	0.230
pg7	0.236	0.357	0.844	-0.202	0.253	0.018
hl3	-0.054	-0.065	-0.122	0.987	-0.059	0.005
hprd4	0.436	0.360	0.338	-0.128	0.741	0.010

a. Extraction Method: Principal Component Analysis, Rotation Method: Varimax with Kaiser Normalization, Rotation converged in 6 iterations.

According to Table 11 and Table 12, Component Matrix can reflect principal factors' initial loadings, and Rotated Component Matrix can make us see the difference between their loadings more easily and clearly. The first component (i.e. production component) including production action (hp2) contributes 68.607% (please refer to Table 9). The second component (i.e. living waste disposal and management component) including market management (mg8) and living waste disposal (hlrd5) contributes 16.598% (please refer to Table 9). The third component (i.e. public management component) including public management (pg7) contributes 7.794% (please refer to Table 9). The fourth component (i.e. living action component) including living action (hl3) contributes 3.253% (please refer to Table 9). The fifth component (i.e. production waste disposal component) including production waste disposal (hprd4) contributes 3.111% (please refer to Table 9). And they all contribute 99.362% (please refer to Table 9).

Seen from the analysis above, principal factors can be ordered by contribution as follows: production action (hp2), market management (mg8), living waste disposal (hlrd5), public management (pg7), living action (hl3), and production waste disposal (hprd4).

Table 13. Component matrix by component analysis between CZER and independent variables for period 2

	Component [a]						
	1	2	3	4	5	6	7
mg8	0.926	-0.069	0.084	-0.230	-0.262	0.084	-0.037
hp2	0.819	0.254	-0.011	0.511	-0.037	0.013	-0.031
hlrd5	0.815	0.543	0.097	-0.077	-0.048	-0.125	0.091
hnc1	0.747	-0.599	0.190	-0.088	0.137	-0.123	-0.071
hprd4	0.741	0.569	-0.168	-0.152	0.255	0.102	-0.008
pg7	0.434	-0.841	0.280	0.083	0.073	0.090	0.084
hl3	-0.375	0.524	0.763	0.001	0.030	0.027	-0.023

a. Extraction Method: Principal Component Analysis and 6 components extracted.

Table 14. Rotated component matrix by component analysis for period 2

	Component [a]						
	1	2	3	4	5	6	7
hprd4	0.969	-0.052	-0.085	0.191	-0.004	-0.118	0.011
hlrd5	0.882	0.052	0.105	0.334	0.229	0.207	0.033
mg8	0.609	0.505	-0.162	0.194	0.558	0.013	0.004
pg7	-0.177	0.957	-0.154	0.092	0.058	-0.033	-0.128
hnc1	0.241	0.921	-0.214	0.099	0.106	0.049	0.153
hl3	-0.019	-0.245	0.967	-0.051	-0.042	0.006	-0.001
hp2	0.532	0.187	-0.084	0.818	0.081	0.003	0.002

a. Extraction Method: Principal Component Analysis, Rotation Method: Varimax with Kaiser Normalization, Rotation converged in 6 iterations.

According to Table 13 and Table 14, Component Matrix can reflect principal factors' initial loadings, and Rotated Component Matrix can make us see the difference between their loadings more easily and clearly. The first component (i.e. disposal and management component) including production waste disposal (hprd4), living waste disposal (hlrd5), and market management (mg8) contributes 51.856% (please refer to Table 10). The second component (i.e. public management and natural cause component) including public management (pg7) and natural cause (hnc1) contributes 28.967% (please refer to Table 10). The third component (i.e. living action component) including living action (hl3) contributes 10.587% (please refer to Table 10). The fourth component (i.e. production component) including production action (hp2) contributes 5.119% (please refer to Table 10). And they all contribute 96.528% (please refer to Table 10).

Seen from the analysis above, principal factors can be ordered by contribution as follows: production waste disposal (hprd4), living waste disposal (hlrd5), market management (mg8), public management (pg7), natural cause (hnc1), living action (hl3), and production action (hp2).

3.4. Comparison of Principal Factors between Different Periods and Related Analysis

3.4.1. Comparison of Principal Factors between Different Periods: There are such aspects in common as production action (hp2), living action (hl3), production waste disposal (hprd4), living waste disposal (hlrd5), public management (pg7), and market management (mg8). But they are different in such aspects as natural cause (hnc1) only for CZER during Period 2, and factors have different sequence by contribution for different periods.

3.4.2. Related Analysis for Comparison of Principal Factors between Different Periods: There are such aspects as stated above in common between different periods, main reasons are stated as follows. First, enterprise production, human living action, and related waste disposal are inevitable, decisive and direct powers affecting CZER: more environment-friendly technological innovations, less production of waste, and proper disposal of waste can lead to CZER [13], etc.. Secondly, the public, especially environmental groups, environmentalists, and meetings to discuss environmental issues, etc. all make strict management leading to CZER [9]. Thirdly, the high-efficiency of market-driven solution of pollution, i.e. market-driven transaction of production quota of carbon dioxide, etc. can lead to CZER, etc.. And they are different in such aspects as natural cause (hnc1) only for Period 2, the reason is that natural environment have been improved during Period 2, which can lead to CZER.

3.4.3. Related Analysis for Comparison between Correlation and Regression: From the analysis above, we have known that between correlation analysis and regression analysis most factors' influences are similar, because only the cases leading to the happening of CZER were collected, the positive correlation between dependent variables and independent variables should be without doubt, but there are still some exceptions: e.g. living waste disposal for Period 1 and Period 2, and public management only for Period 2.

Living waste disposal for Period 1 and Period 2. First, it should be positively correlated with CZER because more technological innovations friendly with the environment and higher-efficient disposal of waste should lead to CZER [13]. Secondly perhaps technological innovations not friendly with the environment and improper disposal of waste for other factors deterred living waste disposal's good function [14], so it is negatively correlated with CZER.

Public management only for Period 2. First, management including public management can't affect CZER directly, so it can't have definite effect and definite subject. Secondly it should be positively correlated with CZER because strict management should lead to CZER happening [13]. And thirdly perhaps some people's lack of interest in pollution management, or lack of cooperation from subjects governed in fact, and other factors all deterred public management's proper function [14], so it is negatively correlated with CZER.

3.4.4. Related Analysis for Factors' Different Sequence: Seen from the analysis above, principal factors can be ordered by contribution as follows: production action (hp2), market management (mg8), living waste disposal (hlrd5), public management (pg7), living action (hl3), and production waste disposal (hprd4) for Period 1, and principal factors can be ordered by contribution as follows: production waste disposal (hprd4), living waste disposal (hlrd5), market management (mg8), public management (pg7), natural cause (hnc1), living action (hl3), and production action (hp2) for Period 2. The reason is that these factors have different values, different correlations, and different trend during different periods, which are in fact attributed to both people's different attitude and behaviors (i.e. preventing or causing CER) and changes of natural environment (i.e. changes for the better or worse).

CONCLUSION

By analysis, on one hand, there are such aspects in common as production action (hp2), living action (hl3), production waste disposal (hprd4), living waste disposal (hlrd5), public management (pg7), and market management (mg8). On the other hand, they are different in such aspects as natural cause (hnc1) only for CZER during Period 2, and factors have different sequence by contribution for different periods.

In one word, CZER has been affected mainly by behavior factors. And the related advice is as follows: first, careful protection of natural environment. Secondly strict surveillance on production of waste from such behaviors as enterprise production and human living action by market management, and by public management [9], etc.. And thirdly great encouragement to arouse interest in technological innovations friendly with the environment in waste disposal, etc. [13]. Of course, the following themes still need further study, for example, incongruity of some factors' influences between correlation and regression, and factors have different sequence by contribution for different periods, etc., so that environmental risk can be prevented more effectively and efficiently.

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