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Application of Fuzzy Comprehensive Evaluation in the Loss Risk of Tariff Source

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Abstract: This paper analyzes the main risks of Tariff source, put forward a method of risk fuzzy comprehensive evaluation based on fuzzy set theory, explains the specific steps of the method. In order to deal with the uncertainty in the risk assessment of the Loss risk of tariff source, we propose an approach with factor analysis method and fuzzy comprehensive evaluation integrated together. Due to the complexity in uncertainties of factors, the method of factor analysis is applied to determine the weights of each factor, and the fuzzy sets theory is adopted to calculate the membership degrees of each factor.
Keywords: fuzzy comprehensive evaluation, fuzzy set theory, risks of tariff source

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1. BACKGROUND

Tariff is an important source of Finance in China, the most Protective measures in transition period for accession to the WTO have been expiration. China economy and its management mode are faced with the challenge and challenge from the global competition. Tariff measures are still the main means of protecting the fair competition of domestic industries and the interests in the future. Approved by the China State Council, the implementation of the< 2015 China tariff plan >was implemented in January 1, 2015. According to the the< 2015 China tariff plan >,2015 China's tariff level will remain at 9.8%. In 2015, a total of 749 items of goods which implement provisional import tariff rate, the average tax rate is 4.4%. Relative to the most favored nation tax rate, the discount rate is 60%. In 2015, China further lowered the tax rate of some commodities with originating in ASEAN, Chile, New Zealand, Peru, Costa Rica, Switzerland, Iceland, Hongkong and Macao.

"Actual transaction price" highly regarded by "WTO valuation agreement", in objective requirements the importer to exercise the right in an honest and friendly manner, performance obligations. Customs Valuation according to the principle of uniform, fair and neutral, so as to achieve the purpose of stable and harmonious development of international trade. But China Customs is currently facing serious price deception, which seriously damaged the country's tax

interests and damage the fair competition market mechanism. According to China Customs statistics, in recent years, China customs retroactive taxes in more than 2 billion yuan a year.

Especially after the strengthening of the sea and land border smuggling efforts in China, price fraud became one of the main ways of illegal tax evasion. So, In the case of the external environment is not clean and China customs valuation connecting the practice of international customs valuation being imperative under the situation, China Customs will take a huge tax risk.

2. INTRODUCTION

This paper argues that risk loss evaluation of tariff sources is of fuzziness, so this paper conducts a comprehensive judgment with combination of fuzzy comprehensive evaluation[1] and factor analysis method. In risk loss evaluation of tariff sources, because of existence of many uncertain factors and different hierarchies between factors, it can't be easy to use a score to evaluate.

This paper mainly studies the influence of the inspection and decision factor of the China customs for the entry and exit of the trade. Many studies have analyzed the tariff reductions (Baier, SL; Bergstrand, JH 2001, GRUBERT, H, MUTTI,1991, ANDERSON, JE; NEARY,JP,1992, Ketterer Tobias D., Bernhofen Daniel M., Milner Chris, 2015),levels of risk management, importance of information of customs system (Bardhi, Ejona, 2015), customs administrative capacity(경윤범; 한상필,2010), risk and risk management in customs administration, structure of institutions in charge of risk management, and the process of risk management in Korea and the bloc (경윤범,한상필,2014). There is no relevant literature report about the loss model of tariff source in government departments.

With the development of social economy and the increase of complexity, all kinds of risks facing the economic entities are increasing, which is urgent to study the technical methods of risk loss of tariff source.

3. METHOD

This paper proposes a comprehensive evaluation algorithm based on factors and fuzzy theory. This algorithm adopts factor analysis method[2] to solve weights of all factor indexes and fuzzy comprehensive evaluation to determine attribute values of schemes. It applies this algorithm to comprehensive evaluation of tariff source risk, and has achieved feasible comprehensive evaluation results, which verifies practicability of this algorithm in fuzzy comprehensive evaluation.

[1] P.Z. Wang,Fuzzy Sets Theory and its Applications, Shanghai Scientific and Technical Publishers, Shanghai (1983), pp. 91–94

[2] Harman, Harry H., Modern factor analysis, Oxford, England: Univ. of Chicago Press Modern factor analysis. (1960). xvi 469 pp.

3.1 Risk Loss Measurement of Tariff Sources

This paper believes that factors which have negative influence on tariff sources are risk factors, and tariff source risk can be expressed by the following function:

$$TAX(R_e)=F(M_e, S_e) \quad (1)$$

In the equation (1),$TAX(R_e)$ refers to tariff source risk under specific environment; M_e is macro factor variable under specific environment; S_e is micro factor variable under specific environment. Magnitude of tariff source risk is influenced jointly by macro factors and micro factors, while the two are closely related to the environment the customhouse is located in. Only under specific environment, there will be increasing number of factors which induce tariff source risk incidents, and it's necessary to conduct risk management only when the risk is as high as to an extent which influences function fulfillment of the customhouse.

Set tariff source risk equivalent as R, G is risk factor as stated above, and W is the corresponding weight.

$$TAX(R_e)=w_1G_1+ w_2G_2+ w_3G_3+\ldots w_nG_n \quad (2)$$

In the equation (2), factor analysis is used in all weight determinations, total tariff source risk equivalent R can be expressed as layer-by-layer weighted sum of indexes, specific monitoring only needs to collect truth value of the index at the most basic level, and lay-by-layer substitute into the equation, then we can acquire $TAX(R_e)$.

3.2 Fuzzy Comprehensive Judgment of Tariff Source Risk Factors

Tariff source risk system is a kind of complicated multi-factor system, it's difficult to accurately measure interactive relationships between its internal factors as well as influencing degrees of all factors on system function in quantity, that's to say, the system is of "fuzzy" characteristics; secondly, tariff source risk system is also a compound system including a number of different production levels (0r a number of subsystems), and its system function is a kind of comprehensive function on the whole which is of "multi-attribute" characteristic. The evaluator is required to select proper evaluation model and method according to property, objective and requirement of evaluated problem, and fuzzy comprehensive evaluation model and factor analysis provide us an effective method.

For tariff source risk factor analysis, factor analysis method is used to determine weight sets, and the basic idea of this method is: adopt factor analysis method to analyze structural relationship between variables which have been screened out, through the law of relatively independent factor dominance, then use measured values of all indexes to indirectly determine states of all factors and to determine contribution rates of all variables, then we can respectively

acquire evaluation decision matrix single factors in subsets, synthetic evaluation mathematic model of Major Factor Dominating[3] $M(\blacksquare, v)$ was used, credibility of weighted set analyzed with weighting logic.

$$b_j = \max\{(a_i \cdot p_{ij})1 \leq i \leq n(j = 1,2,\cdots,m)\} \tag{3}$$

In the equation (3), P_{ij} represents the degree of membership of the program X at the j level of the i of the target, Set Wi is the weight coefficient of the target i, then the weight coefficient vector:

$$A = (W_1,\ W_2,\ \cdots, W_n)$$

Fuzzy evaluation vector B is obtained by using matrix fuzzy multiplication, B=A⊙P.

4. EMPIRICAL ANALYSIS

4.1 Evaluation Factors

The macro factors that affect the customs revenue are gross domestic product(GDP), consumer price index of urban residents(CPI), gross import(IM), tariff on the last year(TAX_{n-1}), tariff leve(RATE), exchange rate of RMB(EX), disposable income of urban residents(DPI).

The micro factors that affect the customs revenue are persons at the entry and exit number(PEO), inbound and outbound cargo weight(GOOD), number of inbound and outbound mail(EMS), amount of tax reduction(FT), quantity of customs declaration (DEC), smuggling case(SM), the value of tax(OT). The evaluation factors set:

$$U_i = \{u_m, u_s\},\ U_i(i=2)$$

Each subset:

$$u_m = \{u_{GDP}, u_{CPI}, u_{IM}, u_{TAX_{n-1}}, u_{RATE}, u_{Ex}, u_{DPI}\}$$
$$u_s = \{u_{PEO,} u_{good}, u_{EMS}, u_{FT}, u_{DEC}, u_{SM}, u_{OT}\}$$

[3] Daniel Stufflebeam, Evaluation Models, New Directions for Evaluation, Special Issue: Evaluation Models, Volume 2001, Issue 89, pages 7–98, Spring 2001

4.2 Determination of Evaluative Factor Weight Subsets

Common methods which determine weight coefficients have: Subjective experience judgment method[4];Expert investigation or expert consultation[5]; Panel of experts to discuss the voting method of collective discussion[6]. In order to guarantee objectivity, fairness and scientificity of determined weight coefficients, this paper, by virtue of analysis method, uses variance maximum rotation factor to analyze and evaluate the influence of relevant economic variables on tariff sources and uses SAS[7] software to realize model analysis.

Measurement indexes have X1, X2, …, Xm, and their standardized indexes are xi=(Xi-Xi)/Si(i=1, 2, …, m), all indexes are dominated by p(p<m)common factors. In the meantime, each index is also restricted by one special factor, set $X=(x_1,\cdots,x_P)T$(T is transposition symbol) as a normalized and standardized random vector (P≥2), R as correlation coefficient matrix, order ® = r(r is number of nonzero latent roots of R), set eigenvalues of R as $\lambda_1, \lambda_2, \cdots, \lambda_r, 0$, $\lambda_1 \geq \lambda_2 \geq \cdots \geq \lambda_r > 0$, then this model:

$$\begin{cases} x_1 = a_{11}F_1 + a_{12}F_2 + \cdots + a_{1m}F_{1n} + e_1 \\ x_2 = a_{21}F_1 + a_{22}F_2 + \cdots + a_{m2}F_{2n} + e_2 \\ x_m = a_{m1}F_m + a_{m2}F_m + \cdots + a_{mn}F_{mn} + e_m \end{cases}$$

For the convenience of naming and explaining of all variables by common factors, conduct maximum variance cross rotation of initial factor loading matrix, making factor loading differentiate to 0-1, then rotated factor loading matrix will be acquired. Rotation of factor loading matrix will enhance explanatory ability of common factors. Rotate from common factor F to common factor G, namely:

$$\begin{cases} F_1 = G_{11}X_1 + G_{12}X_2 + \cdots + G_{1m}X_m \\ \cdots\cdots \\ F_m = G_{m1}X_m + G_{m2}X_2 + \cdots G_{mn}X_n \end{cases}$$

This paper uses the SAS9.2 system for statistical analysis, which can be carried out factor analysis and factor rotation. The factor model can be used in orthogonal rotation and skew rotation. The regression method is used to calculate the score coefficient, and the results are as follows:

[4]G Crawford, C Williams, A note on the analysis of subjective judgment matrices, Journal of mathematical psychology, 1985, Elsevier

[5] CA Kulikowski, SM Weiss, Representation of expert knowledge for consultation: the CASNET and EXPERT projects, Artificial Intelligence in medicine, 1982 - groups.csail.mit.edu

[6] Siddhartha Dalala,Dmitry Khodyakova, Ramesh Srinivasana, Susan Strausa, John Adamsa, ExpertLens: A system for eliciting opinions from a large pool of non-collocated experts with diverse knowledge, Technological Forecasting and Social Change, Volume 78, Issue 8, October 2011, Pages 1426–1444

[7] N O'Rourke, R Psych, L Hatcher,A step-by-step approach to using SAS for factor analysis and structural equation modeling, books.google.com,2013

Table 1 The macro factors correlation coefficient table

Pearson H0: Rho=0, Prob > |r|							
	X1	X2	X3	X4	X5	X6	X7
X1	1.00000	-0.09621	0.09071	0.61625	0.60675	0.79836	0.43468
		0.6195	0.6398	0.0002	0.0003	<.0001	0.0145
X2	-0.09621	1.00000	-0.07381	-0.24747	-0.24730	-0.25991	-0.31847
	0.6195		0.7036	0.1956	0.1959	0.1733	0.0922
X3	0.09071	-0.07381	1.00000	0.15788	0.21906	0.20354	0.19761
	0.6398	0.7036		0.4134	0.2536	0.2896	0.3042
X4	0.61625	-0.24747	0.15788	1.00000	0.10420	0.54974	0.53433
	0.0002	0.1956	0.4134		0.5769	0.0014	0.0020
X5	0.60675	-0.24730	0.21906	0.10420	1.00000	0.87266	0.72855
	0.0003	0.1959	0.2536	0.5769		<.0001	<.0001
X6	0.79836	-0.25991	0.20354	0.54974	0.87266	1.00000	0.82680
	<.0001	0.1733	0.2896	0.0014	<.0001		<.0001
X7	0.43468	-0.31847	0.19761	0.53433	0.72855	0.82680	1.00000
	0.0145	0.0922	0.3042	0.0020	<.0001	<.0001	

Table 2 The micro factors correlation coefficient table

Pearson, N = 33 H0: Rho=0, Prob > |r|							
	X1	X2	X3	X4	X5	X6	X7
X1	1.00000	0.83802	0.91146	0.94327	0.94845	0.26154	0.95053
		<.0001	<.0001	<.0001	<.0001	0.1415	<.0001
X2	0.83802	1.00000	0.98499	0.96127	0.93370	0.63367	0.94802
	<.0001		<.0001	<.0001	<.0001	<.0001	<.0001
X3	0.91146	0.98499	1.00000	0.98929	0.96781	0.55409	0.97989
	<.0001	<.0001		<.0001	<.0001	0.0008	<.0001
X4	0.94327	0.96127	0.98929	1.00000	0.98135	0.48348	0.98981
	<.0001	<.0001	<.0001		<.0001	0.0044	<.0001
X5	0.94845	0.93370	0.96781	0.98135	1.00000	0.43031	0.99102
	<.0001	<.0001	<.0001	<.0001		0.0124	<.0001
X6	0.26154	0.63367	0.55409	0.48348	0.43031	1.00000	0.44747
	0.1415	<.0001	0.0008	0.0044	0.0124		0.0090
X7	0.95053	0.94802	0.97989	0.98981	0.99102	0.44747	1.00000
	<.0001	<.0001	<.0001	<.0001	<.0001	0.0090	

In order to make factors have practical meaning, we can conduct factor rotation of results of initial regression.

Table 3 Analysis of macro factor maximum rotation of principal component factor

Final Communality Estimates: Total = 6.421495						
X1	X2	X3	X4	X5	X6	X7
0.784118	0.934474	0.98684	0.99369	0.98619	0.97781	0.75834
Standardized Scoring Coefficients						
		Factor1	Factor2	Factor3		
	X1	0.26540	0.26317	-0.12849		
	X2	0.12235	0.92925	0.06258		
	X3	-0.08031	0.06043	0.99413		
	X4	0.24584	0.03915	-0.05621		
	X5	0.22634	0.00243	0.02452		
	X6	0.22943	0.00584	0.00136		
	X7	0.13589	-0.22554	0.07001		

Table 4 Analysis of micro factor maximum rotation of principal component factor

Final Communality Estimates: Total = 6.954036						
X1	X2	X3	X4	X5	X6	X7
0.99458	0.99675	0.99496731	0.99321	0.98214	0.99995	0.99242
Scoring Coefficients Estimated by Regression						
Squared Multiple Correlations of the Variables with Each Factor						
Standardized Scoring Coefficients						
		Factor1	Factor2	Factor3		
	X1	0.42728989	-0.0062337	-2.5282092		
	X2	-0.0409176	-0.0447472	2.27473191		
	X3	0.09497762	-0.0174203	0.87683084		
	X4	0.17258018	-0.040365	0.20420346		
	X5	0.22093449	-0.0612311	-0.208788		
	X6	-0.2017886	1.09530097	-1.2710053		
	X7	0.19933871	-0.0698717	0.04849109		

According to the above analysis results, the factors and the factors which have negative effect on the analysis of the macro factors and micro factors are analyzed. Analysis on tariff leve(RATE), amount of tax reduction(FT),smuggling case(SM), establish comprehensive identification model:

$$TAX(R_e)=F(M_e, S_e)$$

$$M_e=W_1(RATE) \quad S_e=W_2(SM)+W_3(FT)$$

$$TAX(R_e)=F\ \{\ W_1(RATE), W_2(SM)+W_3(FT)\ \}$$

$$R_eW = \begin{bmatrix} -0.08 & 0.06 & 0.99 \\ -0.04 & -0.04 & 2.27 \\ -0.21 & 1.09 & -1.27 \end{bmatrix}$$

According to practical situation of tariff source risks, divide judgment grading standards into three grades: “100%-75% risk”, “75%-50% risk” and “50%-25% risk”. Take mid-values in intervals as grading parameters, then this parameter list vector as$\mu = (0.875, 0.625, 37.5)^T$, adopt matrix multiplication, after compositional operation, to acquire fuzzy evaluation matrix as:

$$B = A \cdot P = [-0.8475\ 0.2975\ 1.56]$$

Results show that negative influence of tariff rate growth on tariff sources is the greatest, and positive influence of tax relief (FT) on tariff sources is the greatest.

5. CONCLUSION

This paper firstly determines risk weights of indexes according to factor analysis method, then it uses fuzzy comprehensive judgment method to conduct a comprehensive evaluation of tariff source risks. Advantages of this method lie in:

Directing at problems about comprehensive multi-factor evaluation, it effectively solves limitation when AHP is solving weight values of schemes, and the limitation is that consistency check of judgment matrix is hard to pass.

Risk judgment of factor analysis method of factors is more accurate and scientific than that expert analysis method, and it effectively rejects non-critical factors with more convenient operation.

Fuzzy comprehensive judgment of tariff source risks in this paper is based on mutual independence of risks and factors within risks, and many risks in the system are interactional, mutually offsetting and mutually promotive, independent risks rarely exist in reality, features of any risk is not only decided by item characteristics but also influenced by other risks within the system to a great extent. For this, the author will further discuss and perfect this method in future work and study.

REFERENCES

[1] Zuo, Renguang; Cheng, Qiuming; Agterberg, Frederik P., Application of a hybrid method combining multilevel fuzzy comprehensive evaluation with asymmetric fuzzy relation analysis to mapping prospectivity, ORE GEOLOGY REVIEWS,Volume: 35,Issue: 1,Pages: 101-108,Published: MAR 2009

[2] G Crawford, C Williams, A note on the analysis of subjective judgment matrices, Journal of mathematical psychology, 1985, Elsevier

[3] CA Kulikowski, SM Weiss, Representation of expert knowledge for consultation: the CASNET and EXPERT projects, Artificial Intelligence in medicine, 1982 - groups.csail.mit.edu

[4] Siddhartha Dalala,Dmitry Khodyakova, Ramesh Srinivasana, Susan Strausa, John Adamsa, ExpertLens: A system for eliciting opinions from a large pool of non-collocated experts with diverse knowledge, Technological Forecasting and Social Change, Volume 78, Issue 8, October 2011, Pages 1426–1444

[5] 5.N O'Rourke,R Psych, L Hatcher, A step-by-step approach to using SAS for factor analysis and structural equation modeling, 2013, books.google.com

[6] Daniel Stufflebeam, Evaluation Models, New Directions for Evaluation, Special Issue: Evaluation Models, Volume 2001, Issue 89, pages 7–98, Spring 2001

[7] Harman, Harry H., Modern factor analysis, Oxford, England: Univ. of Chicago Press Modern factor analysis. (1960). xvi 469 pp.

[8] Bardhi, Ejona, Customs Risk Management in Albania. An important Step towards Integration in the European Union, EUROPEAN JOURNAL OF SUSTAINABLE DEVELOPMENT, Volume:4, Issue: 2, Pages:155-164, 2015

[9] JUNG, Hongjoo, A Comparative Case Study on Risk Management System of Customs Administration, Korea Trade Review, Volume:39Issue: 5 Pages:301-328, 2014

[10] 김태인, An Empirical Study on the Customs Risk Management and Measurement of Food Industry, The Journal of International Trade & Commerce, Volume:5, Issue:2, Pages:111-137, 2009

[11] SL Baier, JH Bergstrand, The growth of world trade: tariffs, transport costs, and income similarity, Journal of international Economics, Volume 53, Issue 1, Pages 1–27, February 2001

[12] Harry Grubert, John Mutti, Taxes, Tariffs and Transfer Pricing in Multinational Corporate Decision Making, The Review of Economics and Statistics,Vol.73, No.2, Pages: 285-293, May, 1991

[13] James E. Anderson, J. Peter Neary, Trade Reform with Quotas, Partial Rent Retention, and Tariffs, Econometrica, Vol.60,No.1, Pages:57-76, Jan., 1992

[14] Tobias D. Ketterera, Daniel M. Bernhofenb, Chris Milner, The impact of trade preferences on multilateral tariff cuts: Evidence for Japan, Journal of the Japanese and International Economies, Volume 38, Pages: 31–51, December 2015