Simulation Research of the Loss of Decision-making of Customs Tax Risk

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Abstract: In this paper, by using computer simulation technology a customs tax risk model simulation environment, then on the basis of tariff tax risk model defined by the game situation and economic environment assumptions to establish the simulation model of the system. This article combines complex systems and copulas connect function used for explaining economic problems such as complex phenomena and problems in complex adaptive system, has the vital significance and application prospect.
Keywords: Tax Risk; Simulation; Decision- making; Complex Adaptive system

1. INTRODUCTION

This paper mainly studies the influence of the inspection and decision factor of the China customs for the entry and exit of the trade. Laeven and Goovaerts (2004) got a model based on minimum residual risk is obtained. It is a new way of economic research by using the theory of complex adaptive system of economic management, introduced function of Copula to solve the optimal allocation model of economic capital. Chia-Lin Chang, Juan-Angel Jimenez-Madrid, Teodosio P é rez - Amaral(2011) examines the risk estimates of these models are used to determine capital requirements and associated capital costs of ADIs, depending in part on the number of previous violations, whereby realised losses exceed the estimated VaroPatrick Bolton, Hui Chen and Neng Wang(2011) highlight the central importance of the endogenous marginal value of liquidity (cash and credit line) for corporate decisions. Righi MB, Ceretta PS(2013) through marginal and Pair Copula Construction models, predict daily Value at Risk for each market and for the portfolio composed by them. Individual risk predictions are correctly simulated.

In the reality, the distribution of the risk of tax tariff is not all obey normal distribution, it is very difficult to estimate the total risk distribution function directly. Based on the previous research, the risk measurement function is applied to the tariff tax risk management, try to risk decision of economic management complex adaptive system to make quantitative assessment and analysis. The design of tariff source risk loss decision-making simulation model according to the risk decision theory and decision of tariff source requirement.

2. Decision Simulation

Postulated the actual price of imported crude oil is P0,declare price is T0,when the P0 ¹ T0, then cause damage, The greater| P0- T0|,the greater the loss. The loss of crude oil import tariff source is L，if L has second derivative at P0=T0, according to the Taylor formula, we have:

$$L = L + \frac{L^{'}}{1!}(P0 - T0) + \frac{L''}{2!}(P0 - T0)^2 + \ ?$$

(1)

Set P0=T0,L=0, because there is a minimum value at P0=T0, so L^'=0, spent more than two order of higher order items, we have:

$$L = K(P0 - T0)^2 \qquad (2)$$

If there are n times of crude oil imports declaration, the actual transaction price respectively ,the average tariff tax loss of the n products was:

$$\bar{L} = K[\frac{1}{n}\sum_{i=1}^{n}(Pi - Ti)^2] \qquad (3)$$

Set L as random variable, xs as inspection measures cost, ξas price tax, w as unknown tariff source loss.Simulation program1, 0 inspection measure, loss function:

$$I(E) = L + wl \qquad (4)$$

w1 is the unknown loss of the program 1, we have loss utility function:

$$u(E) = u(E) \qquad (5)$$

Simulation program 2, 5.5% inspection measure, loss function:

$$l(E) = L + \xi + 5.5\% xs + w_3 - \xi \quad (6)$$

w_3 is the unknown loss of the program 2, we have loss utility function:

$$u(E) = (E + 5.5\% xs - \xi \quad (7)$$

Simulation program 3, 8% inspection measure, loss function:

$$l(E) = L + \xi + 8\% xs + w4 - \xi \quad (8)$$

w4 is the unknown loss of the program 3, loss utility function:

$u\left(E\right) = (E+8\%xs-\xi)$ （9）

Simulation program 4, 10% inspection measure, loss utility function:

$l\left(E\right) = \xi+10\%xs$ （10）

The unknown loss of the program 4 is 0, loss utility function:

$u\left(E\right) = \left(\xi+10\%xs\right)$ (11)

The loss caused by the inspection cost fluctuations of the inspection cost with proportional to the T0 deviation square or deviation mean square. Low price will cause damage, even no low price also cause damage. The best risk decision is risk factors and decision costs are stable in the target value. E to express the expected loss:

$$E(L) = K\{D(P0)+[E(P0)-T0-xs]^2\}$$
$$= K\{\sigma^2+E(P0)-T0-xs]^2\} (12)$$
$$= K(\sigma^2+(\mu-T0-xs)^2$$

Can be seen from the above equation, to reduce the tariff tax risk, we must make (variance) and $\delta = |(\mu-T0-xs)|$ (deviation) little more. Because (variance) has been determined, only efforts to reduce the (deviation). It means mainly depend on improving risk decision-making ability to improve inspection efficiency make the utility loss as close to 0 as possible.

$$E(\delta) = \min E(\delta) = \min E\left|(u-T0-xs)\right| \quad (13)$$

loss expectation function of each program is:

$$E(\delta) = \int_X^{\infty} (L-x)\cdot\varphi(L)dL + w_n + xs \quad (14)$$

Set probability density function φ(ξ) of risk accident loss degree ξ, probability distribution function F(x):

$$\int_{x^{(1)n}}^{x^{(2)1}} L\cdot\varphi(L)dL + x^{(2)}[F(x^{(2)})-F(x^{(1)})] \geq 0 \quad (15)$$

Set the parameters set for the N Group,

$$\left\{(x,xD)\,|\,\left(x^{(1)},x^{(1)}D\right),\left(x^{(2)},x^{(2)}D\right),\ldots \left(x^{(n)},x^{(n)}D\right)\right\}$$

Sort the decision result:

$$DN = \min\{d_1, d_2(x^*), d_3(x^*), d_4(x^*)\} \quad (16)$$

Find out the tariff loss expectation or loss expectation utility risk decision scheme with minimum decision results from decision result as optimal risk decision scheme.

3. Model Establishment

Assuming the tariff source risk combination include n risk factors, $X_i\left(i=1,2,\ldots n\right)$ risk random variable, $Z = \sum_{i=1}^{n} X_i$ as random variable of overall risk.

According to the tariff source risk decision scheme, tariff tax risk decision utility loss mainly from the inspection costs. To better represent the loss characte--ristics, using Copula method solving empirical distribution of loss failure.Set α as confidence level （0<α <1）.

$$VAR_\alpha[X] = \inf[x\in R|F(x)\geq\alpha] = \inf[x\in R|P(X\leq x)\geq\alpha] \quad (17)$$

Set distribution of decision cost and utility loss are continuous, the distribution of the corresponding is unique. In the condition of the joint distribution Fxi and the loss of utility known, the objective function is:

$$Min(E[\sum_{i=1}^{n}(X_i-u_i)]), u = \sum_{i=1}^{n} u_i, u_i \geq 0 \quad (18)$$

Set state variable ξk express expected tax amount of risk decision scheme, decision variable φs express amount of damage, state transfer equation is:

$$\xi k+1 = \xi k - \varphi s \quad (19)$$

The equation set is:

$$D_k(\xi_k) = \{\varphi s_k\,|0 \leq \varphi s_k \leq \xi_k\} \quad (20)$$

The first derivative:

$$K\left(t\right) = P(C\left(u,\right)\leq t) = t - \varphi\left(t\right)/\varphi'\left(t\right) \quad (21)$$

Estimation of distribution Copula function:

$$K\left(t\right) = P(C\left(u,v\right)\leq t) = P(H\left(X,Y\right)\leq t), ? \in\left(0,1\right) \quad (22)$$

Simulation of the standard logarithmic marginal distribution risk:

$$F_i(x) = n_u^1 / n(1+\sigma_i^1\left|x-u_i^1\right|/\beta_i^1)^{\frac{1}{\sigma_i^1}} \quad (23)$$

Define random variables:

$$\wp_i = \hat{H}(x_i, y_i) = \frac{1}{n-1}\sum_{j=1}^{n} sign((x_j\langle x_i)(y_j\langle x_i)) \quad (24)$$

n is sample capacity, is distribution of H empirical estimates, non parameter estimation of K(t) is:

$$\hat{K}(t) = \frac{1}{n}\sum_{i=1}^{n} sign(\wp_i \leq t), t\in[0,1] \quad (25)$$

By estimating rank correlation coefficient, parameters that can be obtained from the Copula function.

4 Empirical Analysis

4.1 Study samples and data sources

The minimum value of loss function, the decision making scheme is the optimal decision. This paper selects 3 variables to select decision scheme, customs inspection quantity (CY), price tax（PT）, reporting unit price（IMOP. (ξ) is uncontrolled risk loss.

4.2 Model selection

To test the expected loss of each scheme by kstest, jbtest. According to the test results U(E) is for non normal distribution. we choose the t-copula model to model(see Table 1) .

Table 1 kstest, jbtest

	kstest	jbtest	Skewness	Kurtosis
U(E)	0	0	-0.201	2.3859

4.3 Model Calculation

Convert inspection rate and loss expectation to uniform distribution on 【0,1】. The loss of each scheme is expected to focus on the diagonal. There is a strong correlation between the 2 variables(see

Figure 1) .

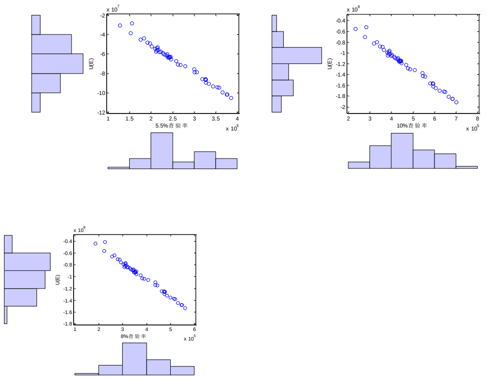

Figure 1 Inspection rate U(E) Scatter diagram

Convert data into estimates of a Kernel cumulative distribution function in related scale. Free t random samples(see Figure 2) .

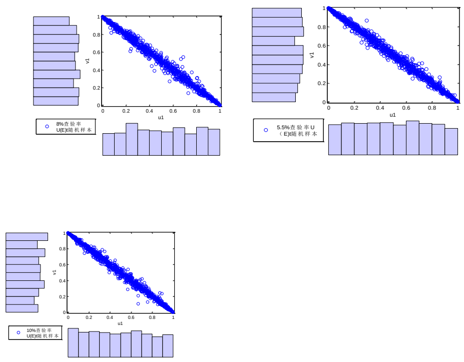

Figure 2 Cumulative distribution function of the transformed kernel

Using spline interpolation method to find the empirical distribution function of the original sample points,.Using the ksdensity function to calculate the nuclear distribution of the original sample(see Figure 3).

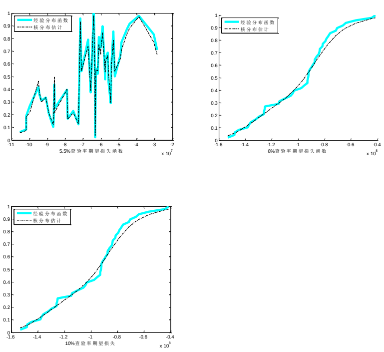

Figure 3 Empirical distribution of the expected loss of the

inspection rate and the estimation of nuclear distribution

Calculate the density function and distribution function of the two element t-Copula (see Figure 4 and Table 2).

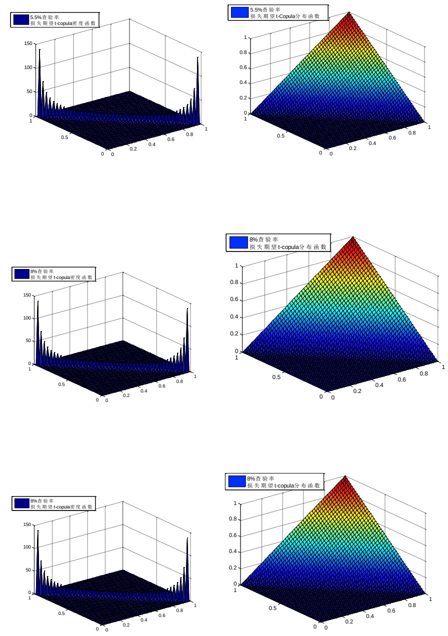

Figure 4 t-Copula density function and distribution function

Use copula-stat function solving the Kendall rank correlation coefficient corresponds to the t-Copula (see Table 3). Seen from table 3, with the increase in the proportion of (xs), the value of ξis also increased, but the increase rate in reducing. Further found that diminishing marginal utility theory, the minimum expected loss estimated by t-copula function and ML t-copula function close to the utility. 2 models are given with satisfactory results, the calculation of ML t-copula function is better.

	tcopula		ML-tcopula	
	rho_t	nuhat	MLRho	nu
program 2	-0.9967	3.8795	-0.9953	3.6128
program 3	-0.9961	3.8792	-0.9945	3.6099
program 4	-0.9981	3.8873	-0.9962	3.6277

Table 2 Ratio of decision making and expected loss

	dt2	dt2ML
program 2	0.0069	0.0065
program 3	0.0063	0.0061
program 4	0.0076	0.0068

Table 3 squared Euclidean distance

Simulation decision scheme 3, the ratio reached 8% for the expected loss of utility is -0.9945. It is the best simulation decision scheme.

4.3 Model evaluation

According to the evaluation results of squared Euclidean distance, the decision scheme 3 is the

minimum distance(see Table 4).
According to the model evaluation, select 8% of the inspection rate to achieve optimal allocation in the case of human resources permitting.

5 Conclusions

In this paper, using computer simulation technology build simulation environment for tariff source risk model. At the same time, the Copula function is introduced for the analysis of correlation between risk decision cost and loss rate. By empirical research, simulation test the loss decision and its conclusion of the tariff source risk. It has important significance and application prospect that combined with the use of complex systems and Copula function.

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