Unemployment Insurance Model for Migrant Workers under Financial Crisis

BIAN Kuan-jiang[1], ZHANG Zhen-li[1]*, JIANG Hong-jing[2]

1，School of Science，Northwest A&F University，Yangling 712100，China；2. School of Mathematical Science and Computing Technology，Central South University，Changsha 410075，China

Abstract　Based on the assumption that the interest rate is constant，the unemployment insurance risk model for migrant workers is established. The premium income and the expense of this risk model are compound Poisson process. Among them，the premium of an insurance policy and the claim amount of unemployment insurance belong to random sequence. The proof procedure of model deduction and relevant ruin probability are put forward，and then the estimation formula for exact value of ruin probability of insurance company is obtained without considering the interest rate. Taking a certain city in China as an example，willingness investigation on unemployment insurance purchase is carried out among some migrant workers in six industries. According to the investigation data，the unemployment insurance risk model of migrant workers is used to estimate the ruin probability of insurance company. Results show that the more initial capital leads to lower ruin probability of insurance company and stronger survival capability. It is proved that under the background of financial crisis，implementation of unemployment insurance of migrant workers is an effective way to solve the unemployment problem of migrant workers.

Key words　Unemployment insurance，Income of farmers，Ruin probability，China

　　In recent years，affected by the financial crisis，the problem of unemployment and reemployment of migrant workers becomes more and more severe which has caused bad influence on the agricultural production and stability. The income level of migrant workers directly influences the progress of Chinese urbanization and industrialization，social stability of rural areas and the long-term stability of China[1]. In order to raise the income of migrant workers，governments from all levels have made numerous efforts. For instance，through providing small sum of loan to encourage self-employment，creating more jobs and establishing the unemployment insurance system for migrant workers. Based on the actual situations，the risk model whose premium income is compound Poisson progress under constant interest rate is applied to the unemployment insurance research of migrant workers. Based on the existing rate，the ruin probability of insurance company can be estimated so as to supply reference to our government for establishing the unemployment insurance category.

1　The establishment of unemployment insurance model for migrant workers

　　When implementing the unemployment insurance for migrant workers，the state takes the interest rate into account as the important factor of affecting insurance company's financial situation. If the state ignores the interest rate completely in calculating the ruin capability，lager deviation from the actual value would be caused. Besides，sometimes migrant workers work in a particular area permanently，while their work age in a certain position will not last long and the interest rate is relatively sta-

ble，so the interest rate is assumed to be constant. In addition，according to the stochastic process theory，the process of waiting for the applicant of the insurance company is similar to the process of waiting for services，while in accordance with the migrant workers in different industries，the premium and the amount of claim charged by the insurance company is different，so the premium income is assumed to be compound Poisson process[2−3].

　　The X_k and Y_k are used to present the number k of the amount of claim and the insurance premium charged after receiving the policy respectively. $X = \{ X_k \geqslant 0, k = 0,1,\cdots \}$、$Y = \{ Y_k \geqslant 0, k = 0,1,\cdots \}$ are independent non-negative random variable sequence，their distribution functions are $F(x)$，$G(y)$ respectively. Besides，$P_k = E(X_k)$ and $P_k = E(Y_k)$ are the number k origin moments of X and Y；$M(t)$，$N(t)$ present the total amount of policies and the claim times during the period of（o，t］. Among them，$\{ M(t), t \geqslant 0 \}$ and $\{ N(t), t \geqslant 0 \}$ are independent Poisson progresses. Their intensity are λ and μ，$M(0) = 0$，$N(0) = 0$；$\{ Y_k, k \geqslant 1 \}$ are independent；i represents constant interest rate. Then：

$$S(t) = (1 + i) \sum_{k=1}^{M(t)} Y_k - \sum_{k=1}^{N(t)} X_k \qquad (1)$$

　　The formula（1）is the earning of insurance company at time t. suppose that u is the initial capital of insurance company，then：

$$U(t) = (u + \sum_{k=1}^{M(t)} Y_k)(1 + i) - \sum_{k=1}^{N(t)} X_k \qquad (2)$$

　　The formula（2）is the unemployment insurance risk model for migrant workers under the constant interest rate and the premium income is the compound Poisson progress.

　　The bankruptcy happens，when the capital earning of insurance company is less than zero. After the bankruptcy，the insurance company can maintain its operation by additional

capital. Under the conditions that the initial capital equals u, $T = \inf\{t, t \geqslant 0 \text{ and } U(t) < 0\}$ is called the bankrupt time; as for $T = \infty$, it can be regarded that for any $t \geqslant 0$, $\{U(t) \geqslant 0\}$, the bankruptcy will not happen; the probability $\psi(u) = P\{T < \infty \mid U(0) = U\}$ is called bankruptcy probability; $Q = \dfrac{\lambda P'(1+i)}{\mu P_1} - 1$ is relative safe loan, when $\theta \leqslant 0, \psi(u) = 1$, the bankruptcy will happen definitely. It is supposed that $\theta > 0$ in the following study.

Suppose $h_1(r) = \int_0^\infty e^{-ry} \mathrm{d}G(y) - 1$ and $\int_0^\infty e^{-ry} \mathrm{d}G(y) = L_Y(r)$ is the Laplace transformation of the random variable Y; suppose $h_2(r) = \int_0^\infty e^{rx} \mathrm{d}F(x) - 1$ and $\int_0^\infty e^{rx} \mathrm{d}F(x) = M_x(r)$ is the moment generating function of the random variable X, the earning process of insurance company at the t moment [formula(1)] has the following nature.

Nature 1: as for the earning process $\{S(t), t \geqslant 0\}$, there is the function of $g(r)$, which makes $E[e^{-rs(t)}] = e^{tg(r)}$.

Proof:

Because $E[e^{-rs(t)}] = E[e^{-r(1+i)\sum\limits_{k=1}^{M(t)} Y_k + \sum\limits_{k=1}^{N(t)} X_k}] = E[e^{-r(1+i)\sum\limits_{k=1}^{M(t)} Y_k}] E(e^{r\sum\limits_{k=1}^{N} X_k})$

But $E[e^{-r(1+i)\sum\limits_{k=1}^{M(t)} Y_k}] = E[\prod\limits_{K=1}^{M(t)} e^{-r(1+i)Y_k}]$

$= E\{L_Y[(1+i)r]^{M(t)}\}$

$= \sum\limits_{k=1}^\infty [\int_0^\infty e^{-(1+i)ry} \mathrm{d}G(y)]^k \dfrac{\lambda^K}{K!} e^{-\lambda t}$

$= e^{-\lambda t} e^{\lambda t \int_0^\infty e^{-r(1+i)ry} \mathrm{d}G(y)} = e^{\lambda t h_1[(1+i)r]}$

$E(e^{r \cdot \sum\limits_{k=1}^{NK} X_k}) = E(\prod\limits_{K=1}^{N(t)} e^{rX_k})$

$= E[M_x(r)^{N(t)}]$

$= \sum\limits_{k=1}^\infty [\int_0^\infty e^{rx} \mathrm{d}F(x)]^k \dfrac{u^k}{k!} e^{-ut}$

$= e^{-ut} e^{ut \int_0^\infty e^{rx} \mathrm{d}F(x)}$

$= e^{uth_2(r)}$

So $E[e^{-rs(t)}] = e^{\lambda t h_1[(1+i)r]} e^{uth_2(r)} = e^{\{\lambda h_1[(1+i)r] + uh_2(r)\}t}$

Suppose $g(r) = \lambda h_1[(1+i)r] + uh_2(r)$, then $E[e^{-rs(t)}] = e^{tg(r)}$

Nature 2: the formula $g(r) = \lambda h_1[(1+i)r] + uh_2(r) = 0$ have the unique positive solution R, R is called adjustment coefficient.

Proof:

Because $g(r) = \lambda h_1[(1+i)r] + uh_2(r) = \lambda[L_Y(1+i)r] + u[M_x(r) - 1]$, so $g'(r) = \lambda(1+i)L'_Y[(1+i)r] + uM'_x(r)$; $g''(r) = \lambda(1+i)^2 L''_Y[(1+i)r] + uM''_x(r)$

Because $L_Y(0) = M_x(0) = 1, L'_Y(0) = E(-Y) = -p'_1$, $L''_Y(0) = E(Y^2) = p'_2$, $M'_x(0) = E(X) = p_1, M''_x(0) = E(X^2) = p_2$, so $g(0) = 0, g'(0) = -\lambda(1+i)p'_1 + up_1 < 0, g''(0) = \lambda(1+i)^2 p'_2 + up_2 > 0$, then the curve $g(r)$ starts from the origin point and is lower convex function in $(0, \infty)$, the slope passing through the origin point is negative, so there is $R \in (0, \infty)$ makes $g(R) = 0$ and R is unique.

As for the risk model $\{U(t)\ t \geqslant 0\}$, the bankruptcy probability is

$$\psi(u) = \dfrac{e^{-R(1+i)u}}{E[e^{-RU(T)} \mid T < \infty]} \qquad (3)$$

The formula (3) can be used to calculate accurate bankruptcy probability, when $T < \infty$, $U(t) < 0$, $E[e^{-RU(t)} \mid T < \infty] \geqslant$

1, so there is the inequality:

$$\psi(u) \leqslant e^{-R(1+i)u} \qquad (4)$$

The formula (4) is the Lundberg inequality of the model (2) under the constant interest rate. It can calculate the bankruptcy probability well. $T = 0$, then formulas (3) and (4) correspondingly change into:

$$\psi(u) = \dfrac{e^{-Ru}}{E[e^{-RU(T)} \mid T < \infty]} \qquad (5)$$

$$\psi(u) \leqslant e^{-Ru} \qquad (6)$$

Formulas (5) and (6) are the expression formula and estimation formula of bankruptcy probability regardless of the interest rate.

2　The survey and analysis of the willingness of buying unemployment insurance of migrant workers

In model (1), certain migrant workers in city A are surveyed on their willingness of buying unemployment insurance so as to get the value of the intensity λ of $M(t)$ during the Poisson process, the survey data of willingness of buying unemployment insurance of migrant workers was obtained. Thus the results can be worked out according to the 4 830 valid questionnaires (Table 1).

Table 1　The survey data summary of wiliness of buying unemployment insurance of migrant workers

Industry classification	The effective numbers of copies	Numbers of willingness to buy	The proportion of buyers //%
Industry 1	904	316	34.96
Industry 2	1 036	256	24.71
Industry 3	815	267	32.76
Industry 4	670	187	27.91
Industry 5	783	312	39.84
Industry 6	622	201	32.32

It can be seen from Table 1 that workers in industry 1and 5 have relatively stronger willingness of buying unemployment insurance. While in industry 2 and 4, a small proportion of migrant workers is willing to buy unemployment insurance, because they know well about their work. The proportion of buyers is used to estimate the number of buyers in the industry. In city A, each industry of the six industries mentioned above have about 2000 people, then the number of workers who is willing to buy unemployment insurance is 699, 494, 655, 558, 797, 646 respectively.

After unbiased estimation, the result can be obtained:

$$\lambda = \dfrac{699 + 494 + 655 + 558 + 797 + 646}{6} = 641$$

It can be known from the policy and the statistical analysis of the claim data, each policy Y_k subjects to exponential distributions, the parameters $\beta = 1$; each claim X_k also subjects to exponential distributions, the parameters $\alpha = 1/1\,500$.

Suppose the annual interest rate i equals 2.25%, the unemployment rate of migrant workers equals 0.20, then $\mu = 0.20$.

According to the calculation, $h_1(r) = \dfrac{\beta}{\beta + r} - 1, h_2(r) = \dfrac{\alpha}{\alpha - r} - $

1 then $g(r) = 641[\frac{1}{1+(1+2.25\%)r} - 1] + 0.2(\frac{1}{1-1\,500r} - 1)$.

Suppose $g(r) = 0$, the unique positive solution $R = 3.60 \times 10^{-4}$.

By substituting $R = 3.60 \times 10^{-4}$, $i = 2.25\%$ into the formula (4), then when $\mu = 1 \times 10^4$, $\psi(u) \leq 2.520\,0\%$ when $\mu = 2 \times 10^4$, $\psi(u) \leq 0.063\,5\%$ when $\mu = 3 \times 10^4$, $\psi(u) \leq 0.001\,6\%$ when $\mu = 5 \times 10^4$, $\psi(u) \leq 0.000\,001\,02\%$.

The results show that the more initial capital leads to lower bankruptcy probability of insurance company and stronger survival capability. Certainly there are some errors in the results. The reasons are as follows：① The samples are relatively small, so it can not cover all the situations. The research mainly takes certain migrant workers in city A as samples to estimate the bankruptcy probability. According to the Probability Theory, the greater the insurance group is, the smaller the bankruptcy probability. ② The results has something to do with the initial capital and working ability of insurance company. ③ The relatively small value of α and β also have certain impact on the results. In conclusion, under the current situation of financial crisis, the implement of new unemployment insurance category is an effective solution for the unemployment of migrant workers.

3　Discussions

In considering whether the unemployment insurance system can cover the urban migrant workers and rural surplus labor forces, the " expansion of scope" should not be pursued blindly while it should be taken into consideration combining with the country's industrial policy, economic development and many other comprehensive factors. With the appearance of multiple-employment, irregular unemployment will be caused and the traditional employment insurance system which aimed at traditional employment style can not solve it. What's more, the short-term temporary jobs can not achieve the minimum payment limit of unemployment insurance, so the number of people who are not entitled to the social security rights will increase. That's the challenge faced by the unemployment insurance system[4].

References

[1] LIU XL, JIANG ZQ. Challenge and approach of the employment of farmer losing the land[J]. Journal of Anhui Agricultural Sciences, 2007, 35(33):9738 –9739. （in Chinese）.
[2] GERBER HU. An introduction to mathematical risk theory[M]. Translated by CHENG SX, YAN Y. Beijing：World Book Publishing Company, 1997. （in Chinese）.
[3] XU N, ZHAO MQ. Risk model of random interest and premium income[J]. Statistics and Decision, 2008(12):33 –34. （in Chinese）.
[4] CHEN HP, HE Q. Research review of unemployment insurance system of peasant worker[J]. Contemporary Management, 2008(21): 1292 –1293. （in Chinese）.

金融危机下的农民工失业保险模型探讨

边宽江¹,张振力¹*,蒋红敬²   (1. 西北农林科技大学理学院,陕西杨凌 712100;2. 中南大学数学科学与计算技术学院,湖南长沙 410075)

摘要　基于利率为常数的假设,建立了保费收入、保费支出均为复合 Poisson 过程的农民工失业保险风险模型,其中保单的保费和失业保险的理赔额均为随机序列,给出了模型推导和相关破产概率的性质证明过程,得出了不考虑利率的情况下保险公司破产概率精确值的估计式。以中国某市为例,对 6 个行业的部分农民工进行了失业保险购买意愿调查。根据调查所得数据,利用农民工失业保险风险模型估算了保险公司的破产概率。结果表明,初始资本越多,保险公司破产概率越低,生存能力越强,进而证明了金融危机背景下推行农民工失业保险是国家解决农民工失业问题的有效途径。

关键词　失业保险;农民收入;破产概率

四川现代农业进程研究

郭　强,陈东梅*   (西南交通大学经济管理学院,四川成都 610031)

摘要　首先,参考相关文献,指出现代农业是农业发展到一定阶段的产物,其评价标准会随着经济的发展而逐步提高,并且不同的国家、不同的地区根据自己资源禀赋会采取不同的实现形式。其次,参照以往指标体系,根据指标体系建立的科学性、充分性、可控制性、可操作性、可比性原则,建立四川现代农业评价指标体系,采用层次分析法,运用多人多准则对建立的指标体系进行权重计算。最后,依据 1997 ~ 2007 年四川现代农业的综合水平相关数据,采用综合指数法,计算出现阶段四川农业的发展水平,并用灰色预测法中的 GM(1,1)模型对 2008 ~ 2012 年四川农业的发展趋势做出预测。结果表明,农业发展水平不断增加,但有些年份增长不均衡;在 2012 年,四川的现代农业发展水平可达到 0.764 2,虽还是处于初步实现阶段,但已经离基本实现阶段非常接近。

关键词　进程;现代农业;指标体系;发展趋势